MEASUREMENT

CK-12 Foundation

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TABLE OF CONTENTS

Licensing

1: Money

- 1.1: Recognize Monetary Units
  - 1.1.1: Convert Prices from Numbers to Words
  - 1.1.2: Convert Prices from Words to Numbers
- 1.2: Convert and Count Monetary Units
  - 1.2.1: Convert Between Coin Values
  - 1.2.2: Convert Between Cents and Dollars
  - 1.2.3: Convert Between Cents and Dollars Applications
- 1.3: Compare and Arrange Monetary Units
  - 1.3.1: Compare Monetary Values
  - 1.3.2: Identify Equal and Unequal Monetary Values
  - 1.3.3: Order Monetary Values
  - 1.3.4: Identify Greater and Lesser Monetary Amounts
- 1.4: Operations with Money
  - 1.4.1: Add and Subtract Money
  - 1.4.2: Add and Subtract Money Applications
  - 1.4.3: Higher Order Addition and Subtraction of Money Applications
  - 1.4.4: Find Total Value of Coins and Bills
  - 1.4.5: Convert Dollars and Coins into Dollars Applications
  - 1.4.6: Use Two or More Operations in Money Problems
  - 1.4.7: Use Four Operations in Money Problems

2: Time

- 2.1: Days, Weeks, Months and Years
  - 2.1.1: Overview of Simple Time Conversions
  - 2.1.2: AM and PM
  - 2.1.3: Convert Years into Days
  - 2.1.4: Convert Years into Weeks
  - 2.1.5: Convert Years into Months
  - 2.1.6: Convert Weeks into Days
  - 2.1.7: Add Compound Units in Years, Months, Weeks and Days
  - 2.1.8: Subtract Compound Units in Years, Months, Weeks and Days
  - 2.1.9: Convert Days and Hours
  - 2.1.10: Add and Subtract Compound Units of Time
  - 2.1.11: Convert Compound Units of Time
- 2.2: Tell Time to Minutes, Quarters, and Hours
  - 2.2.1: Time to Quarter, Half-Past and Hour
  - 2.2.2: Identify Time in 5-Minute Intervals
  - 2.2.3: Identify Time in 1-Minute Intervals
  - 2.2.4: Time Conversion between Words and Numbers
- 2.3: Analog and Digital Clocks

- 2.3.1: Convert between Analog and Digital
- 2.3.2: Match the Time
- 2.3.3: 24 hour Clocks
- 2.4: Operations with Clock Time
  - 2.4.1: Time Patterns
  - 2.4.2: Tell Time Before and After
  - 2.4.3: Determine Elapsed Time
  - 2.4.4: Elapsed Time Applications
  - 2.4.5: Elapsed Time in a Sequence of Events Applications
  - 2.4.6: Difference between Two Time Intervals
  - 2.4.7: Elapsed Time with a 24-Hour Clock
  - 2.4.8: Applications of Four Operations with Time
  - 2.4.9: Four Operations and Fractions in Time Applications
- 2.5: Schedules
  - 2.5.1: Read a Schedule
  - 2.5.2: Use a Timeline

3: Measurement Systems and Unit Conversion

- 3.1: Introduction to Measurement Systems
  - 3.1.1: Introduction to Customary Units of Length
  - 3.1.2: Introduction to Customary Units of Mass and Capacity
  - 3.1.3: Introduction to Metric Units of Length
  - 3.1.4: Introduction to Metric Units of Mass and Capacity
- 3.2: Tools of Measurement
  - 3.2.1: Tools for Measurement of Customary and Metric Lengths
  - 3.2.2: Tools of Metric Measurement of Length
  - 3.2.3: Tools for Measurement of Customary Units of Length, Weight and Capacity
- 3.3: Convert Units of Length, Weight, and Capacity
  - 3.3.1: Conversion between Customary Units of Length, Weight, and Capacity
  - 3.3.2: Multiply or Divide to Convert between Customary Units of Length, Weight, and Capacity
  - 3.3.3: Conversion of Customary Length, Weight, and Capacity Applications
  - 3.3.4: Convert between Metric Units of Length, Weight, and Capacity
  - 3.3.5: Customary and Metric Measurement Conversion
  - 3.3.6: Convert Using Unit Analysis

4: Length

- 4.1: Determine Customary Lengths
  - 4.1.1: Length in Inches
  - 4.1.2: Compare Length in Inches
  - 4.1.3: Estimate by Inches and Feet
  - 4.1.4: Measure and Estimate in Feet and Yards
  - 4.1.5: Differences in Inches, Feet, and Yards
  - 4.1.6: Estimate the Measure in Inches, Feet, and Yards
  - 4.1.7: Distances Greater Than or Less Than a Foot or a Yard
  - 4.1.8: Measurement of Length to a Fraction of an Inch
- 4.2: Convert Customary Lengths
  - 4.2.1: Convert Inches to Feet
  - 4.2.2: Convert Feet to Inches

- 4.2.3: Convert Inches to Yards
- 4.2.4: Convert Feet to Yards
- 4.2.5: Convert Yards to Feet
- 4.2.6: Convert between Yards and Miles
- 4.2.7: Convert Miles to Feet
- 4.2.8: Convert between Inches, Feet and Yards
- 4.2.9: Mixed Unit Comparison
- 4.2.10: Conversion Applications

- 4.3: Customary Length Operations
  - 4.3.1: Determine Distance Using Addition
  - 4.3.2: Add Unit Length Applications.
  - 4.3.3: Subtract Unit Lengths
  - 4.3.4: Add and Subtract Unit Lengths
  - 4.3.5: Length Comparison Applications
  - 4.3.6: Multiply Unit Lengths
  - 4.3.7: Divide Unit Lengths
- 4.4: Compound Customary Units of Length
  - 4.4.1: Add and Subtract to Solve Compound Unit Problems
  - 4.4.2: Add and Subtract to Solve Compound Unit Applications
  - 4.4.3: Compare Compound Units
  - 4.4.4: Order Compound Units - Ascending
  - 4.4.5: Order Compound Units- Descending
- 4.5: Metric Units of Length
  - 4.5.1: Meters
  - 4.5.2: Centimeters
  - 4.5.3: Estimate and Compare Meters and Centimeters
  - 4.5.4: Metric Length Comparison in Meters, Centimeters and Millimeters
- 4.6: Convert and Compare Metric Units of Length
  - 4.6.1: Meter, Centimeter Conversions
  - 4.6.2: Meter, Kilometer Conversions
  - 4.6.3: Centimeter, Millimeter Conversions
  - 4.6.4: Meter Millimeter Conversions
  - 4.6.5: Multiple Metric Conversions
  - 4.6.6: Higher Order Metric Conversions
  - 4.6.7: Appropriate Decimal Units for Metric Measurement
- 4.7: Metric Length Operations
  - 4.7.1: Metric Addition
  - 4.7.2: Add Metric Lengths and Distances
  - 4.7.3: Metric Subtraction
  - 4.7.4: Applications of Metric Addition and Subtraction
  - 4.7.5: Metric Multiplication
  - 4.7.6: Metric Division
  - 4.7.7: Metric Multiplication and Division
  - 4.7.8: Multi-Operation and Multi-Step Metric Problems
  - 4.7.9: Multi-Operation and Multi-Step Metric Applications
  - 4.7.10: Compound Metric Units of Length
- 4.8: Scale
  - 4.8.1: Find Scale Dimensions

- 4.8.2: Find Scale or Actual Dimensions
- 4.8.3: Find Actual Dimensions
- 4.8.4: Find the Scale Factor

5: Capacity and Volume

- 5.1: Visually Identify and Compare Measures of Capacity
- 5.2: Compare Customary Units of Capacity
  - 5.2.1: Compare Cups and Pints
  - 5.2.2: Compare Pints and Quarts
  - 5.2.3: Compare Cups and Quarts
  - 5.2.4: Compare Gallons and Quarts
  - 5.2.5: Compare Cups Pints and Quarts
  - 5.2.6: Compare Pints Quarts and Gallons
  - 5.2.7: Customary Units of Volume Comparisons
- 5.3: Convert Customary Units of Capacity
  - 5.3.1: Convert between Cups and Pints
  - 5.3.2: Convert between Pints and Quarts
  - 5.3.3: Convert between Quarts and Gallons
  - 5.3.4: Convert between Cups and Quarts
  - 5.3.5: Convert between Pints and Gallons
  - 5.3.6: Convert between Cups and Gallons
  - 5.3.7: Convert between Cups, Pints and Quarts
  - 5.3.8: Convert between Gallons, Pints and Quarts
  - 5.3.9: Convert between Cups, Pints, Quarts and Gallons
- 5.4: Compound Customary Units of Capacity
  - 5.4.1: Overview of Customary Unit Compound Conversion
  - 5.4.2: Convert Pints into Compound Units
  - 5.4.3: Convert Quarts into Compound Units
  - 5.4.4: Convert Gallons into Compound Units
  - 5.4.5: Select Correct Conversion Units for Capacity Operations
  - 5.4.6: Compare Compound Customary Units of Capacity
  - 5.4.7: Order Compound Customary Units of Capacity
- 5.5: Customary Capacity Operations
  - 5.5.1: Add Customary Units of Capacity
  - 5.5.2: Add Customary Units of Capacity Applications
  - 5.5.3: Subtract Customary Units of Capacity
  - 5.5.4: Add and Subtract Customary Units of Capacity
  - 5.5.5: Customary Units of Capacity Applications
- 5.6: Metric Capacity in Liters
  - 5.6.1: Compare Capacity in Liters
  - 5.6.2: Higher Order Capacity Conversion of Liters
- 5.7: Metric Capacity Operations using Liters
  - 5.7.1: Find Capacity in Metric Units Using Pictures
  - 5.7.2: Addition and Subtraction of Liters Applications
  - 5.7.3: Multiplication and Division of Liters Applications
  - 5.7.4: Multi-step Metric Capacity Applications
- 5.8: Metric Capacity Operations Using Milliliters

- 5.8.1: Add Mililiters
- 5.8.2: The Four Basic Operations Using Milliliters
- 5.8.3: Higher Order Metric Capacity in Milliliters Applications
- 5.9: Convert Metric Units of Capacity
  - 5.9.1: Best Unit of Measure Liters and Milliliters
  - 5.9.2: Metric Conversion of Liters and Milliliters to find Equivalent Units
  - 5.9.3: Mixed Operations Addition and Subtraction Metric Capacities
  - 5.9.4: Multiply and Divide Then Convert - Mixed Metric Capacities Applications
  - 5.9.5: Multi-Step - Four-Operations Applications
  - 5.9.6: Convert between Kiloliters, Milliliters, and Liters
- 5.10: Compound Metric Units of Capacity
  - 5.10.1: Convert between Liters and Milliliters
  - 5.10.2: Add and Convert to find Liters and Milliliters
  - 5.10.3: Add Subtract and Convert to find Liters and Milliliters
  - 5.10.4: Addition and Subtraction Multi-Step Compound Unit Applications
  - 5.10.5: Multiply and Convert to find Liters and Milliliters Applications
  - 5.10.6: Divide and Convert to find Liters and Milliliters Applications
  - 5.10.7: Multiply, Divide and Convert to find Liters and Milliliters Applications
  - 5.10.8: Mixed-Operation Multi-Step Compound-Conversion Applications

6: Weight and Mass

- 6.1: Measuring Weight and Mass
  - 6.1.1: Visually Identify Equal Weight
  - 6.1.2: Visually Compare Weight
  - 6.1.3: Identify and Order Lightest and Heaviest
- 6.2: Convert Customary Units of Weight
  - 6.2.1: Read the Compound Units in Pounds and Ounces
  - 6.2.2: Convert Pounds and Ounces into Ounces
  - 6.2.3: Convert Ounces into Pounds and Ounces
  - 6.2.4: Convert Between Ounces Pounds and Tons
  - 6.2.5: Convert then Compare Values of Compound Units
- 6.3: Customary Weight Operations
  - 6.3.1: Add Customary Units of Weight Including Applications
  - 6.3.2: Subtract Customary Units of Weight Including Applications
  - 6.3.3: Add and Subtract Compound Customary Units of Weight Applications
  - 6.3.4: Multiply and Divide Compound Customary Units of Weight Applications
  - 6.3.5: Four-Operation Compound Customary Units of Weight Applications
- 6.4: Metric Weight Operations
  - 6.4.1: Add Metric Weight
    - 6.4.1.1: Add Weights in Grams
    - 6.4.1.2: Add Weights in Kilograms
    - 6.4.1.3: Add Weights in Grams or Kilograms Applications
    - 6.4.1.4: Add Compound Units
  - 6.4.2: Subtract Metric Weight
    - 6.4.2.1: Subtract Weights in Grams
    - 6.4.2.2: Subtract Weights in Grams Applications
    - 6.4.2.3: Subtract Weights in Kilograms

- 6.4.2.4: Subtract Compound Units
- 6.4.2.5: Subtract and Convert Using Compound Units Applications
- 6.4.3: Add and Subtract Metric Weight
  - 6.4.3.1: Add, Subtract and Compare Mass in Grams Multi-Step Applications
  - 6.4.3.2: Add and Subtract and Convert Compound Units
  - 6.4.3.3: Add, Subtract and Compare Grams and Kilograms Multi-Step Applications
- 6.4.4: Multiply and Divide Metric Weight
  - 6.4.4.1: Multiply to Find the Weight in Grams or Kilograms
  - 6.4.4.2: Divide to Find the Weight in Grams or Kilograms
  - 6.4.4.3: Multiply and Divide to Find the Weight in Grams or Kilograms Applications
- 6.4.5: Mixed Operations to find Metric Weight
  - 6.4.5.1: Use the Four Operations to Find Weight in Grams and/or Kilograms Applications
  - 6.4.5.2: Higher Order Four-Operations to Find Weight in Grams or Kilograms Applications
- 6.5: Convert Metric Units of Weight
  - 6.5.1: Identify Weight in Kilograms and Grams
  - 6.5.2: Convert Between Kilograms and Grams
  - 6.5.3: Convert Between Kilograms and Grams and Milligrams

Index

Glossary

Detailed Licensing

Licensing

*A detailed breakdown of this resource's licensing can be found in **Back Matter/Detailed Licensing**.*

CHAPTER OVERVIEW

1: Money

1.1: Recognize Monetary Units

1.1.1: Convert Prices from Numbers to Words

1.1.2: Convert Prices from Words to Numbers

1.2: Convert and Count Monetary Units

1.2.1: Convert Between Coin Values

1.2.2: Convert Between Cents and Dollars

1.2.3: Convert Between Cents and Dollars Applications

1.3: Compare and Arrange Monetary Units

1.3.1: Compare Monetary Values

1.3.2: Identify Equal and Unequal Monetary Values

1.3.3: Order Monetary Values

1.3.4: Identify Greater and Lesser Monetary Amounts

1.4: Operations with Money

1.4.1: Add and Subtract Money

1.4.2: Add and Subtract Money Applications

1.4.3: Higher Order Addition and Subtraction of Money Applications

1.4.4: Find Total Value of Coins and Bills

1.4.5: Convert Dollars and Coins into Dollars Applications

1.4.6: Use Two or More Operations in Money Problems

1.4.7: Use Four Operations in Money Problems

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1.1.1: Convert Prices from Numbers to Words

1.1.2: Convert Prices from Words to Numbers

Writing Prices of Items

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Converting Item Costs from Words to Numerals

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1.2.1: Convert Between Coin Values

1.2.2: Convert Between Cents and Dollars

1.2.3: Convert Between Cents and Dollars Applications

Converting Coins - Two Units

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Converting Dollars into Cents

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The Fewest Number of Coins and Bills to Equal a Given Amount

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1.3.1: Compare Monetary Values

1.3.2: Identify Equal and Unequal Monetary Values

1.3.3: Order Monetary Values

1.3.4: Identify Greater and Lesser Monetary Amounts

1.3.1: Compare Monetary Values

Resources

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Which Amount is not Equal to a Given Amount of Money?

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1.3.3: Order Monetary Values

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Practice: **Order Monetary Values**

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1.3.4: Identify Greater and Lesser Monetary Amounts

Resources

Practice: **Identify Greater and Lesser Monetary Amounts**

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1.4.1: Add and Subtract Money

1.4.2: Add and Subtract Money Applications

1.4.3: Higher Order Addition and Subtraction of Money Applications

1.4.4: Find Total Value of Coins and Bills

1.4.5: Convert Dollars and Coins into Dollars Applications

1.4.6: Use Two or More Operations in Money Problems

1.4.7: Use Four Operations in Money Problems

Adding and Subtracting Money with Pictures in Columns

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Adding and Subtracting Money Using Words

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Challenging Multi-step Money Problems

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Practice: **Higher Order Addition and Subtraction of Money Applications**

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Request ID: TsyPSwoV6XGLskAfB6uFDHxSzpScsHV4Vd8atFfOVoexxdCAm99ekA==
```

Additional Resources

Practice: **Find Total Value of Coins and Bills**

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Converting Dollars and Coins into Dollars in Words

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Request ID: GL_wqx_wljeOTmdkXlQYHfaSC7oHobBvvZn-Hh9DAISpId1y5YNjuQ==
```

Additional Resources

Practice: **Convert Dollars and Coins into Dollars Applications**

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Place Value Problems Involving Money

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Request ID: ok0dVlzgV5WRuLpR9k9ghabHdSkugKTGJfJpE0yKmeygGhKf2zGjzg==
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Additional Resources

Practice: **Use Two or More Operations in Money Problems**

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Request ID: KgiU5hOF-TI8LFN82NxYXBije4je2jB2imPvCvJGE252ho9qz0pBwQ==
```

Additional Resources

Practice: **Use Four Operations in Money Problems**

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CHAPTER OVERVIEW

2: Time

2.1: Days, Weeks, Months and Years

2.1.1: Overview of Simple Time Conversions

2.1.2: AM and PM

2.1.3: Convert Years into Days

2.1.4: Convert Years into Weeks

2.1.5: Convert Years into Months

2.1.6: Convert Weeks into Days

2.1.7: Add Compound Units in Years, Months, Weeks and Days

2.1.8: Subtract Compound Units in Years, Months, Weeks and Days

2.1.9: Convert Days and Hours

2.1.10: Add and Subtract Compound Units of Time

2.1.11: Convert Compound Units of Time

2.2: Tell Time to Minutes, Quarters, and Hours

2.2.1: Time to Quarter, Half-Past and Hour

2.2.2: Identify Time in 5-Minute Intervals

2.2.3: Identify Time in 1-Minute Intervals

2.2.4: Time Conversion between Words and Numbers

2.3: Analog and Digital Clocks

2.3.1: Convert between Analog and Digital

2.3.2: Match the Time

2.3.3: 24 hour Clocks

2.4: Operations with Clock Time

2.4.1: Time Patterns

2.4.2: Tell Time Before and After

2.4.3: Determine Elapsed Time

2.4.4: Elapsed Time Applications

2.4.5: Elapsed Time in a Sequence of Events Applications

2.4.6: Difference between Two Time Intervals

2.4.7: Elapsed Time with a 24-Hour Clock

2.4.8: Applications of Four Operations with Time

2.4.9: Four Operations and Fractions in Time Applications

2.5: Schedules

2.5.1: Read a Schedule

2.5.2: Use a Timeline

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2.1.1: Overview of Simple Time Conversions

2.1.2: AM and PM

2.1.3: Convert Years into Days

2.1.4: Convert Years into Weeks

2.1.5: Convert Years into Months

2.1.6: Convert Weeks into Days

2.1.7: Add Compound Units in Years, Months, Weeks and Days

2.1.8: Subtract Compound Units in Years, Months, Weeks and Days

2.1.9: Convert Days and Hours

2.1.10: Add and Subtract Compound Units of Time

2.1.11: Convert Compound Units of Time

Overview of Simple Time Conversions

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Overview of AM and PM

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Additional Resources

Practice: **AM and PM**

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Converting Years to Days

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Additional Resources

Practice: **Convert Years into Days**

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Converting Years into Weeks

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Additional Resources

Practice: **Convert Years into Weeks**

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Converting Years to Months

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Additional Resources

Practice: **Convert Years into Months**

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Converting Weeks to Days

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Additional Resources

Practice: **Convert Weeks into Days**

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Adding Compound Units in Years and Months

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Additional Resources

Practice: **Add Compound Units in Years, Months, Weeks and Days**

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Subtracting Compound Units in Years and Months

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Request ID: sB079RP-C5Y8mp62Hd_i9U-g2XcHb4TDlLO0VvqZhvqbbG9hKNaqqw==
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Additional Resources

Practice: **Subtract Compound Units in Years, Months, Weeks and Days**

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Converting Days to Hours

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Additional Resources

Practice: **Convert Days and Hours**

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Overview of Addition and Subtraction of Time

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```

Additional Resources

Practice: **Add and Subtract Compound Units of Time**

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2.1.11: Convert Compound Units of Time



Figure 2.1.11.1

Maria needs to run a couple errands before meeting with her friend. She thinks she will spend 15 minutes at the post office, 1 hour and 25 minutes at the mall, and 20 minutes to drive to her friend's house. If Maria leaves her house at 1:00 pm, around what time will she reach her friend's house?

In this concept, you will learn how to add and subtract measures of time.

Adding and Subtracting with Time

Time is most commonly measured using the units: second, minute, and hour. Of the three, the second is the smallest unit and the hour is the largest unit.

60 seconds = 1 minute

60 minutes = 1 hour

Just as with other conversions such as length, weight, or speed, you multiply when converting a larger unit to a smaller unit, and divide when converting a smaller unit to a larger unit.

Let's look at some examples.

Convert 120 seconds to minutes.

120 seconds = _____ minutes

This involves converting a smaller unit to a larger unit. 60 seconds equals 1 minute. Divide the number of seconds by 60.

$120 \div 60 = 2$

120 seconds = 2 minutes

Now, convert 4 hours to minutes.

4 hours = _____ minutes

This involves converting a larger unit to a smaller unit. 1 hour equals 60 minutes. Multiply the number of hours by 60.

$4 \times 60 = 240$

4 hours = 240 minutes

To add measures of time, add the like units first. Start with the smallest unit. Add seconds to seconds, minutes to minutes, and hours to hours. Then, simplify the answer when necessary by converting the units.

Find the sum of 1 hour 55 minutes and 45 minutes.

1 hr 55 min + 45 min=1 hr 100 min

You know that 60 minutes equal 1 hour. Simplify 100 minutes by converting it in terms of hours and minutes.

100 minutes = ____ hours ___ minutes

Divide the number of minutes by 60.

100 ÷ 60 = 1 with a remainder of 40

100 minutes = 1 hour 40 minutes

Rewrite 100 minutes as 1 hour 40 minutes. This will add 1 hour to the total number of hours.

1 hr 100 min=1 hr + 1 hr 40 min=2 hr 40 min

The sum of 1 hour 55 minutes and 45 minutes is 2 hours 40 minutes.

To subtract measure of time, start by subtracting the smallest unit first. You may need to borrow from the larger unit. Then, simplify the answer when necessary by converting the units.

Find the difference between 2 minutes 30 seconds and 1 minute 40 seconds.

2 min 30 sec − 1 min 40 sec

You cannot subtract 40 from 30. Borrow from the minute unit. 1 minute equals 60 seconds. Add 60 seconds to 30 seconds.

2 min 30 sec=1 min 90 sec

1 min 90 sec - 1 min 50 sec=0 min 40 sec

The difference between 2 minutes 30 seconds and 1 minute 40 seconds is 50 seconds.

Time can also be described as fractional **units of time**, for example: "a quarter of an hour" or "half an hour." You know that 1 hour equals 60 minutes. To find a fraction of an hour, multiply the fraction by 60 minutes.

(1/4)(60)=60/4=15

A quarter hour is 15 minutes.

Examples

Example 2.1.11.1

Earlier, you were given a problem about Maria on her way to a friend's house.

Maria leaves her house at 1:00 pm and thinks she will spend 15 minutes at the post office, 1 hour and 25 minutes at the mall, and 20 minutes driving to her friend's house. Find the total time of her errands and the drive time to determine what time Maria will arrive at her friend's house.

Solution

First, add the time for each activity.

1 hr 25 min + 20 min + 15 min=1 hr 60 min

Then, simplify 60 minutes. 60 minutes equals 1 hour. This will add 1 hour to the total number of hours.

1 hr 60 min=1 hr + 1 hr=2 hr

2 hours after 1:00 pm is 3:00 pm. Maria should arrive at her friend's house at 3:00 pm.

Example 2.1.11.2

What is 1/8 of an hour in minutes?

Solution

To figure this out, multiply 1/8 times 60 minutes.

1/8(60)=60/8=15/2=7(1/2)

1/8 of an hour is 7(1/2) minutes.

Example 2.1.11.3

Convert the following units: 180 minutes = _____ hours.

Solution

Convert minutes to hours. There are 60 minutes in 1 hour. Divide the number of minutes by 60.

180 ÷ 60 = 3

180 minutes = 3 hours

180 minutes is equal to 3 hours.

Example 2.1.11.4

Convert the following units: 1 hour 5 minutes + 45 minutes = _____

Solution

First, add the like units.

1 hr 5 min + 45 min=1 hr 50 min

The sum is 1 hour 50 minutes.

Example 2.1.11.5

Convert the following units: 5 hours 10 minutes – 30 minutes = _____

Solution

First, subtract the like units starting from the smallest unit.
5 hr 10 min − 30 min

You cannot subtract 30 from 10 so you must borrow from the hour unit. 1 hour equals 60 minutes. Add 60 minutes to the 10 minutes and subtract.

5 hr 10 min=4 hr 70 min

4 hr 70 min - 30 min=4 hr 40 min

The difference is 4 hours 40 minutes.

Review

Add the following units of time.

1. 15 minutes + 60 minutes = _____
2. 10 minutes + 20 minutes = _____
3. 15 seconds + 45 seconds = _____
4. 1 hour 50 minutes + 20 minutes = _____
5. 75 minutes + 15 minutes 10 seconds = _____

Subtract the following units of time.

6. 35 minutes - 10 minutes = _____
7. 60 minutes - 10 minutes = _____
8. 1 hour 75 minutes - 20 minutes = _____
9. 2 hour 10 minutes - 20 minutes = _____
10. 1 hour 5 seconds - 5 minutes = _____

Convert the following units and fractional units of time.

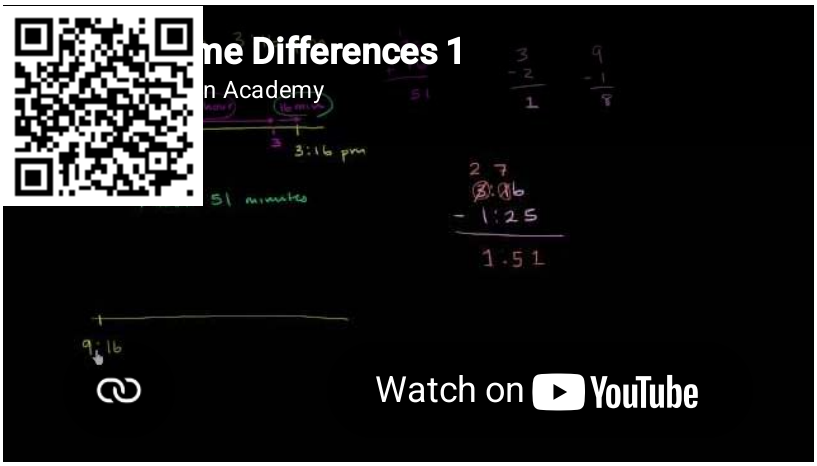
11. 3000 seconds = _____ minutes
12. 6000 seconds = _____ hours _____ minutes
13. 360 minutes = _____ hours
14. 300 minutes = _____ hours
15. 12,000 seconds = _____ minutes
16. (1/4) hour = _____ minutes
17. (1/8) hour = _____ minutes
18. (1/2) hour = _____ minutes

Review (Answers)

To see the Review answers, open this PDF file and look for section 6.14.

Additional Resources

Video:



Practice: **Convert Compound Units of Time**

Real World Application: **Timing a Countdown**

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2.2.1: Time to Quarter, Half-Past and Hour

2.2.2: Identify Time in 5-Minute Intervals

2.2.3: Identify Time in 1-Minute Intervals

2.2.4: Time Conversion between Words and Numbers

Looking at the Clock and Telling the Time

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Request ID: aewHdQJf7PxYHEvqBg8F7UrZZqrOJFIEbvK-8oiAqSrehJ4Uneq6Cw==
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Additional Resources

PLIX: **World Clocks**

Practice: **Time to Quarter, Half-Past and Hour**

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Additional Resources

Practice: **Identify Time in 5-Minute Intervals**

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Overview of Telling Time to 1-minute Intervals

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Request ID: xal4YZqHz04z8XR9bw2jpryPER-isRha2g-_Ccr8Xt6EtSVDDIaOJA==
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Additional Resources

Practice: **Identify Time in 1-Minute Intervals**

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Writing Times in Numbers

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Request ID: rxH6kVmFapoyby4dvpAF_TD2hmQRrornmOruVl_haCZ0ea0ji80c6g==
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Additional Resources

Practice: **Time Conversion between Words and Numbers**

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2.3.1: Convert between Analog and Digital

2.3.2: Match the Time

2.3.3: 24 hour Clocks

Matching the Analog and Digital Clocks

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Additional Resources

Practice: **Time Conversion between Words and Numbers**

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Matching the Time to the Clock

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Additional Resources

Practice: **Match the Time**

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Overview of 24-hour Clocks

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Additional Resources

Practice: **24 hour Clocks**

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2.4.1: Time Patterns

2.4.2: Tell Time Before and After

2.4.3: Determine Elapsed Time

2.4.4: Elapsed Time Applications

2.4.5: Elapsed Time in a Sequence of Events Applications

2.4.6: Difference between Two Time Intervals

2.4.7: Elapsed Time with a 24-Hour Clock

2.4.8: Applications of Four Operations with Time

2.4.9: Four Operations and Fractions in Time Applications

Time Patterns with Clocks

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Additional Resources

Practice: **Time Patterns**

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Overview of Before and After (Time)

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Additional Resources

Practice: **Tell Time Before and After**

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Overview of Elapsed Time

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Practice: **Determine Elapsed Time**

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Additional Resources

Practice: **Elapsed Time Applications**

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Additional Resources

Practice: **Elapsed Time in a Sequence of Events Applications**

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Additional Resources

Practice: **Difference between Two Time Intervals**

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Elapsed Time - Finding the Starting Time (Single Step)

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Additional Resources

Practice: **Elapsed Time with a 24-Hour Clock**

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Solving Multi-step Problems Involving Time

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Additional Resources

Practice: **Applications of Four Operations with Time**

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Determining Elapsed Time with Fractions

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Additional Resources

Practice: **Four Operations and Fractions in Time Applications**

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2.5.1: Read a Schedule

2.5.2: Use a Timeline

Reading Schedules

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Practice: **Read a Schedule**

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Using Timelines to 1-minute Increments

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Additional Resources

Practice: **Use a Timeline**

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CHAPTER OVERVIEW

3: Measurement Systems and Unit Conversion

3.1: Introduction to Measurement Systems

3.1.1: Introduction to Customary Units of Length

3.1.2: Introduction to Customary Units of Mass and Capacity

3.1.3: Introduction to Metric Units of Length

3.1.4: Introduction to Metric Units of Mass and Capacity

3.2: Tools of Measurement

3.2.1: Tools for Measurement of Customary and Metric Lengths

3.2.2: Tools of Metric Measurement of Length

3.2.3: Tools for Measurement of Customary Units of Length, Weight and Capacity

3.3: Convert Units of Length, Weight, and Capacity

3.3.1: Conversion between Customary Units of Length, Weight, and Capacity

3.3.2: Multiply or Divide to Convert between Customary Units of Length, Weight, and Capacity

3.3.3: Conversion of Customary Length, Weight, and Capacity Applications

3.3.4: Convert between Metric Units of Length, Weight, and Capacity

3.3.5: Customary and Metric Measurement Conversion

3.3.6: Convert Using Unit Analysis

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3.1.1: Introduction to Customary Units of Length

3.1.2: Introduction to Customary Units of Mass and Capacity

3.1.3: Introduction to Metric Units of Length

3.1.4: Introduction to Metric Units of Mass and Capacity

3.1.1: Introduction to Customary Units of Length

Customary Units of Length



Figure 3.1.1.1

Megan is planning a birthday party for her friend. She wants to hang a large "Happy Birthday" banner on the wall but needs to make sure she gets the right size banner to fit the space she has. The wall she wants to hang the banner on needs to be measured correctly so she can determine the banner **length**. The only problem is, Megan doesn't know which unit she should use to measure. She has three options: **inches**, feet or miles.

In this concept, you will learn about **customary units of length measurement** and their appropriate uses.

Units of Length

Measurement is a concept that appears all the time in everyday life. To measure something is to determine a size, amount, or degree of an object using tools or comparison of objects.

Length is the measurement of the distance between two points, two things or two places. To measure length, a unit of measurement is used. There are two different systems for measuring: customary and metric. This concept is about Customary Units of measurement.

The most common customary units of measurement are the inch, the **foot**, the **yard** and the **mile**.These units can be converted between one another; for example, there are 12 inches in 1 foot, 3 feet in 1 yard, 5,280 feet in 1 mile etc. An important skill in measuring is to know when to use each of these units of measurement so less conversions need to occur.

One **inch** is roughly the length of your thumb from the tip to the knuckle. The abbreviation for the inch is in.(for example, 5 in.) The ruler below shows what inches look like when marked on a ruler.



Figure 3.1.1.2

Small things are measured in inches. Here is a picture of a crayon. The length of the crayon can be determined in inches using this ruler.

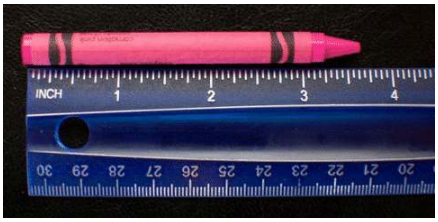


Figure 3.1.1.3

The inch can also be divided into smaller segments or smaller units. This helps when objects do not measure to a perfect whole inch (which happens more often than not). On a ruler you can see the smaller inch segments of 14″,12″,34″.

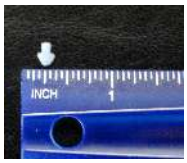


Figure 3.1.1.4

The next largest customary unit is the **foot**. The abbreviation for measuring a foot is ft (for example, 3 ft). One foot is roughly the length from your elbow to the end of your fingers. A ruler is used to measure feet because a ruler is exactly one foot long.



Figure 3.1.1.5

On a ruler, there are 12 inches marked, which makes one whole foot. Larger objects are measured using feet instead of inches because it is a larger unit of measurement. Feet are commonly used in measurement for objects such as the length of a car, height of a door, or the distance between two objects.

Another customary unit of measurement is **yards.** The abbreviation for yards is yd (for example, 7 yd). There are three feet in one yard. Yards can be used to measure larger objects than would be measured with inches or feet.

It makes sense to use inches, feet and yards when measuring short distances or the length of objects or people. We use these customary units of measurement all the time in our everyday life.

To measure longer distances, the customary unit of **miles** is used. A mile is the longest customary unit of measurement. There are 5,280 feet in one mile.

Examples

Example 3.1.1.1

Earlier, you were given a problem about Megan and her banner decoration for her friend's birthday party.

Megan needs to use the appropriate unit of measurement to figure out the right length banner to hang on the wall. She needs to measure the wall length to determine the correct banner length. Her choices for measuring are inches, feet or miles.

Solution

First, Megan needs to think about the object she is measuring or actually stand in front of the wall she is planning to hang the banner on.

Next, Megan needs to consider the choices she has for measuring and rule out any units that do not make sense for this object. Miles are used to measure very far distances, not banners, so she can rule that choice out.

Then, Megan will match up the appropriate unit with the wall. Both inches and feet could be used, but inches are so small that it would take much longer to measure the wall than it should. Feet are the appropriate unit to measure a wall.

The answer is feet.

Megan will measure the wall in feet to determine the correct length of banner to fit that wall.

Example 3.1.1.2

Determine which unit of measurement to use to measure the length of a pencil.

Solution

First, try to find a real-life example of the object. If you do not have one, try to picture in your head what that object looks like.

Next, think about the customary units of measurement and how small or big they are. Our choices are inches, feet, yards or miles (in order from smallest to biggest).

Then, try to match an appropriate unit with the size of the object you are measuring. In this question, a pencil is rather small and does not even span the entire length of a ruler, which is 1 foot. The next smallest unit should be used then, which is the inch.

The answer is inches.

Example 3.1.1.3

What unit of measurement would be used to measure the height of a door?

Solution

First, find the object to be measured or picture it in your mind.

Next, think about your unit of measurement options and rule out ones that don't make sense. Miles would definitely not be needed to measure a door height, so we are left with inches, feet or yards.

Then, determine which unit is most appropriate. Yards are the largest and would require us to measure in much smaller segments than a whole yard. Inches are the smallest and would take a really long time to measure the height. Feet are just the right unit of measurement to use.

The answer is feet.

Example 3.1.1.4

What unit of measurement would be used to measure your sneaker?

Solution

First, find the object or think about what the object looks like.

Next, think about your measuring options. Miles and yards are both much longer than a sneaker those are ruled out.

Then, match the appropriate unit with the object. Some feet are longer than the length of a ruler (which is one foot, or 12 inches), but most feet are less than 12 inches, so a ruler would also be too large. Inches would be our only reasonable choice.

The answer is inches.

Example 3.1.1.5

What unit of measurement would be used to measure the distance between two cities?

Solution

First, think about the items to be measured (Cities are places, not objects, so picture how far apart they would be in your mind).

Next, think about your unit of measurement choices. None are ruled out since the length being measured is so large, but there are more appropriate choices than others.

Then, match the appropriate unit of measurement with the items to be measured. Long distances are never measured in inches or even feet. Yards can sometimes be used to measure distances, but usually distance between objects closer together like houses or sidewalks. Miles is the only reasonable choice to measure such a long distance between two locations.

The answer is miles.

Review

Write the appropriate customary unit of measurement for each item.

1. The height of a sunflower
2. The depth to plant a seed in the soil
3. The height of a tree
4. The area of a garden plot

5. The distance from a garden to the local farm store
6. The length of a carrot
7. A stretch of fencing
8. The length of a hoe
9. The distance between two seedlings planted in the ground
10. The height of a corn stalk
11. A piece of pipe for a water line
12. The depth of a pool
13. The distance across a lake
14. The distance from your home to school
15. The size of a paperclip
16. The measure of a length of thread

Review (Answers)

To see the Review answers, open this PDF file and look for section 2.1.

Vocabulary

Term	Definition
Customary System	The customary system is the measurement system commonly used in the United States, including: feet, inches, pounds, cups, gallons, etc.
Customary units of length	Customary units of length include: inches, feet, yards and miles.
Foot	A foot is a customary unit of measurement. There are 12 inches in 1 foot.
Inches	An inch is a customary unit of measurement, measured best by a ruler.
Length	Length is a measurement of how long something is. Examples of customary units of length are inches, feet, yards and miles.
Measurement	A measurement is the weight, height, length or size of something.
Mile	A mile is a customary unit for measuring distance. There are 5280 feet in 1 mile.
Yard	A yard is a customary unit of measurement. There are 3 feet in 1 yard.

Additional Resources

PLIX Interactive: **Customary Units of Length: Giraffe Measurement**

Practice: **Introduction to Customary Units of Length**

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3.1.2: Introduction to Customary Units of Mass and Capacity

Introduction to Customary Units of Length



Figure 3.1.2.1

Jeffrey works part-time at the butcher shop. Today he is labeling single portions of steak and bottling the store's special barbeque sauce. Each item must be measured accurately in order to be priced correctly. Which unit of measurement should Jeffery use to label the steaks and the bottles of barbecue sauce?

In this concept, you will learn how to choose the best unit of **weight** or measure.

Selecting the Appropriate Weight or Capacity Units

Choosing the correct units can make all the difference for a measurement. You would not measure how tall you are in miles. Neither would you measure length of a football field in inches. The same idea applies for weight and volume. If you were making a pot of soup, it could be pretty complicated to measure the amount of liquid in **ounces**. Think of how challenging that would be as you are measuring. To get an idea of the size of the units of weight and volume, take a look at the table below.

unit	type	examples	
1 ounce	weight	5 quarters, candy bar, cheese slice	
1 pound	weight	2 apples, box of cereal, pair of sneakers	
1 ton	weight	small car, 5 large bears	
1 fluid ounce	volume	bottle of perfume, tube of sunscreen	
1 cup	volume	coffee cup, juice glass, jar of honey	
1 pint	volume	bottle of water, small ice cream container	
1 quart	volume	quart of milk, can of motor oil, medium ice cream container	
1 gallon	volume	gasoline, large milk jug, two large ice cream containers	

Figure 3.1.2.2

This table is useful as a reference for many of the different ways to measure weight and capacity. Think about what you are measuring before you choose a unit. Use units of weight to find how heavy an object is. Use units of volume to find how much space that object takes up. Generally, the size of the object you are measuring can give you a clue as to which unit to use.

Which unit of measurement would you use to weigh a large dog?

There are three units of weight in the table-- ounce, pound, and **ton**. Think about which unit would work best for this example.

The ounce is too small of a unit. A large dog would weigh several hundred ounces. The ton is too large of a unit. The pound would be the best unit to measure the weight of a large dog.

Examples

Example 3.1.2.1

Earlier, you were given a problem about Jeffrey at the butcher shop.

Jeffrey has to label the steak packages and bottles of barbeque sauce. He has to decide which unit would work best to accurately label each item.

Solution

First, consider the packages of steak. Most of the steaks are less than a pound. Therefore, Jeffrey should use ounces to label the packages of steak.

Then, consider the bottles of barbecue sauce. The bottles are about the size of a water bottle. He has several options he can use — **fluid ounce**, **cup**, or **pint**. The most accurate unit would be the smallest unit. Therefore, Jeffrey should use fluid ounces to label the bottles of barbecue sauce.

Example 3.1.2.2

Choose the best unit of measure: if Darcy is filling up her swimming pool, which unit of capacity would she use to measure the amount of water needed?

Solution

Think about what is being measured. A swimming pool requires a large amount of water. Darcy would use gallons, the largest unit for capacity.

Example 3.1.2.3

Choose the best unit of measure: the milk in a baby bottle.

Solution

Measure the capacity of a baby bottle using fluid ounces.

Example 3.1.2.4

Choose the best unit of measure: a bundle of wood.

Solution

Measure the weight of a bundle of wood using **pounds**.

Example 3.1.2.5

Choose the best unit of measure: flour for a cake.

Solution

Measure the capacity of flour for a cake using cups.

Review

Choose the best unit of measure for each item below.

1. The weight of a dog
2. The weight of a camper
3. Soda in a can
4. Two Elephants
5. A television set
6. A baby bottle
7. A jug of milk
8. An automobile
9. The water in a pool
10. A pile of pennies
11. A pallet of wood pellets
12. A rhinocerous
13. A boat
14. An apple
15. Water in an eye dropper

Review (Answers)

To see the Review answers, open this PDF file and look for section 7.15.

Vocabulary

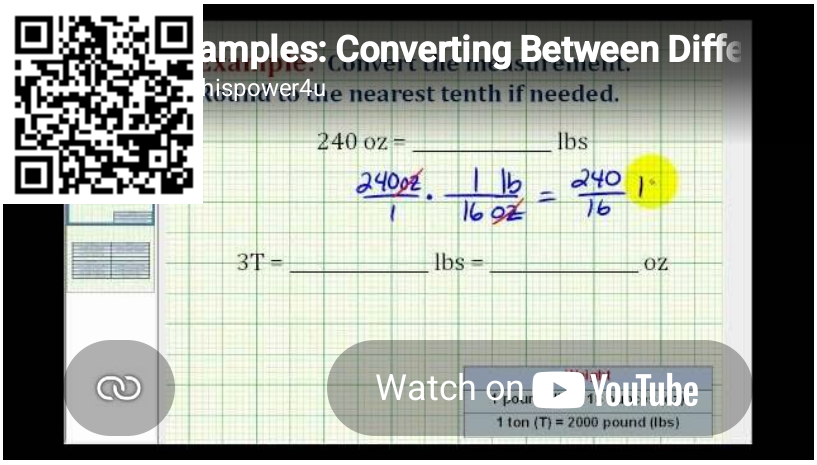
Term	Definition
Cup	A cup is a small customary unit for measuring liquid capacity. One cup is equal to eight ounces or about 0.25 liters.
Customary System	The customary system is the measurement system commonly used in the United States, including: feet, inches, pounds, cups, gallons, etc.
Fluid Ounce	A fluid ounce is a customary unit for measuring liquid capacity. Soft drinks are measured in fluid ounces.
Gallon	A gallon is a unit of liquid capacity. One gallon is equivalent to four quarts.
Ounces	Ounces are the smallest common unit of weight in the customary system, used to measure very light items.
Pint	A pint is a unit of liquid capacity. One pint is equivalent to two cups.
Pounds	Pounds are one of the most common units for measuring weight.
Quart	A quart is a unit of capacity that is equivalent to two pints.
Ton	A ton is the largest common unit for measuring weight. Very large items like cars and trucks are measured in tons.
Weight	Weight is a measurement of the heaviness or mass of someone or something. The customary units of weight included ounces, pounds, and tons.

Additional Resources

PLIX Interactive: **Using the Right Units**

Practice: **Introduction to Customary Units of Mass and Capacity**

Video:



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3.1.3: Introduction to Metric Units of Length

Metric System



Figure 3.1.3.1

David is measuring the length of a textbook so he can cover his book with paper for a project. He normally uses a customary ruler to measure, but he does not have one with him, and the only tool he has measures in metric units. David needs help figuring out which metric unit of measurement he should use to measure his text book so he can finish his project.

In this concept, you will learn how to determine the best use of each metric unit of length.

Metric System

In science classes, and anywhere outside of the United States, length is measured with the **Metric System.** The most common units that we use to measure length in the metric system are the **millimeter**, **centimeter**, **meter**, and **kilometer**.

The **millimeter** is the smallest commonly used unit in the metric system. The abbreviation for millimeters is mm (for example, 3 mm). A millimeter would be used to measure something that is very small, like a seed.

The **centimeter** is the next smallest unit of measurement. The abbreviation for centimeters is cm (for example, 3 cm). Centimeters are smaller than inches. One centimeter is roughly the width of a staple. There are 10 millimeters in one centimeter.

On most rulers, both the customary units of measurement and the metric units of measurement are shown, so you can see millimeters marks, centimeter marks and inch marks.

The next common metric unit is the **meter**. The abbreviation for the meter is m (for example, 8 m). A meter is longer than a foot; in fact, a meter is roughly about the same length as a yard. One way to get an idea of the length of a meter is to stretch your arms out to your sides and your fingertip to fingertip shows about a meter. One meter is much longer than one centimeter. There are actually 100 centimeters in one meter. Meters are used to measure bigger objects or longer distances, such as the depth of a pool or length of a hallway.

Kilometers are the longest unit of metric measurement. The abbreviation for kilometers is km (for example, 12 km). Like miles, kilometers are used to measure long distances, such as the distance from your house to the store or from one town to another. Kilometers are a little more than 1/2 a mile, and they are much longer than meters. There are 1,000 meters in a kilometer.

Examples

Example 3.1.3.1

Earlier, you were given a problem about David and his text book he was covering for a project.

Solution

He needs to measure the length of the book so he can get the right amount of paper to cover it. He needs to use metric units and his options are millimeters, centimeters, meters or kilometers. Which unit of measurement should David use to measure his textbook?

First, consider the object David is measuring. David needs to get his textbook out in front of him as a reference.

Next, David needs to think about the metric units and decide which ones make sense as possibilities. He now knows kilometers are used to measure long distances, so that is ruled out. He also knows a meter is much longer than a text book, so he can rule out meters as well. He needs to decide between using millimeters or centimeters.

Then, David will match the appropriate choice with the object he is measuring. He knows millimeters measure very small objects like seeds or staples. His textbook is much larger than those types of objects, so centimeters are the right choice for measuring his book.

The answer is centimeters.

David will use centimeters to measure his textbook to complete his project.

Example 3.1.3.2

Which unit of metric measurement would you use to measure the length of a piece of paper?

Solution

First, take out a sample of the object you are measuring, or picture it in your mind.

Next, think about your metric units and consider which units make sense with this object. There are millimeters, centimeters, meters and kilometers as the most commonly used units of metric measurement. If possible, rule out units that are definitely not appropriate to measure the object. Kilometers are about a half of a mile and are used to measure long distances, so that unit is not appropriate. Meters are about the size of a yard, or your wingspan, so that is also not appropriate. That leaves us with millimeters and centimeters.

Then, match the appropriate unit with the object you are measuring. Millimeters are tiny units used to measure very small objects that are even sometimes hard to see. You can see a piece of paper quite well, so you would not use millimeters for this size of an object. Centimeters are the most appropriate unit to measure the length of a piece of paper.

The answer is centimeters.

Example 3.1.3.3

What unit of measurement would you use to measure the distance around a track?

Solution

First, consider the object you are measuring and look at it or picture it in your mind.

Next, consider your unit of measurement choices. A track is a large object to measure so you would definitely rule out millimeters and centimeters. That leaves meters and kilometers.

Then, match the object with the best appropriate unit of measurement. Long distances like a track or distance around a block etc. are often measured by kilometers. Meters are used to measure things that are closer together, like lengths of houses or pools. The appropriate unit in this example is kilometers.

The answer is kilometers.

Example 3.1.3.4

What unit of measurement would you use to measure the length of an apple seed?

Solution

First, get the object out to measure or picture it in your mind.

Next, think about the reasonable measurement choices. Kilometers are much to large to measure such a small object, as well as meters. That leaves centimeters and millimeters are the two possibilities.

Then, match the object with the best unit of measurement. Centimeters are 10 times bigger than millimeters, and could be difficult to get a close measurement with the larger unit; therefore, millimeters would give the most accurate measurement.

The answer is millimeters.

Example 3.1.3.5

What unit of measurement would you use to measure the length of a paper clip?

Solution

First, get out a paper clip or picture one in your mind.

Next, consider the unit choices that make sense with the object. A paper clip is very small, so kilometers and meters do not make sense. That leaves two choices: millimeters and centimeters.

Then, match the object with the appropriate unit. A paper clip could be measured with either unit (millimeter or centimeter) but a millimeter is the more appropriate size to get an accurate measurement.

The answer is millimeters.

Review

Choose the appropriate unit of length using metric units for each item listed below.

1. The depth to plant a seed in the soil
2. The height of a tree
3. The area of a garden plot
4. The distance from a garden to the local farm store
5. The length of a carrot
6. A stretch of fencing
7. The length of a hoe
8. The distance between two seedlings planted in the ground
9. The height of a corn stalk
10. A road race
11. A grub collected from the garden
12. The width of a garden row
13. The length of a garden row
14. The size of a small seed
15. The distance that a tractor can travel on a large farm per day

Review (Answers)

To see the Review answers, open this PDF file and look for section 2.2.

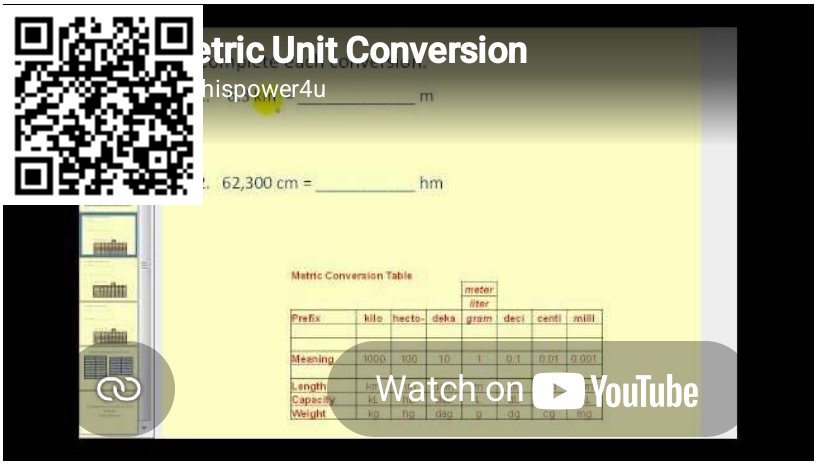
Vocabulary

Term	Definition
Centimeter	A centimeter is a very small unit of metric measure. A centimeter is one hundredth of one meter.
Kilometer	A kilometer is a common metric unit of length that is equal to 1,000 meters.
Meter	A meter is a common metric unit of length that is slightly larger than a yard.
Metric System	The metric system is a system of measurement commonly used outside of the United States. It contains units such as meters, liters, and grams, all in multiples of ten.
Metric units of length	The metric units of length are units of measurement such as millimeter, centimeter, meter and kilometer.
Millimeter	A millimeter is the smallest common metric unit of length.

Additional Resources

PLIX Interactive: **Metric System: Stretchy Worm**

Video:



Practice: **Introduction to Metric Units of Length**

Real World Application: **Running the Race**

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3.1.4: Introduction to Metric Units of Mass and Capacity

Appropriate Metric Units of Mass or Capacity



Figure 3.1.4.1

Jesse works in the mailroom of a large company. Part of his responsibility is to make sure all mail is sent out with the correct postage. The postage depends on the size and weight of the mail. He is given a box that contains 10 books and some documents. Which metric unit of measurement should Jesse use to weigh the package?

In this concept, you will learn to choose the appropriate metric unit of **mass** or **capacity** for the situation.

Metric Units for Mass or Capacity

Grams, milligrams, and kilograms are metric units for measuring mass. To really understand each unit, you have to understand the size of each unit. Here are some examples of things that might weigh 1 of each metric unit of mass.

Unit	Examples
1 kilogram	1 liter of water, dictionary
1 gram	paperclip, one dollar bill
1 milligram	a grain of sand, ant

It would be best to measure heavier objects like people or textbooks in kilograms. Grams are often used to measure ingredients in baking recipes. Milligrams are very tiny units that are not used very often in everyday situation. Scientists are one group of people that might use milligrams to measure objects with very little mass.

Liters and milliliters are metric units for measuring capacity. Here are some examples of things that might weigh 1 of each metric unit of capacity.

Unit	Examples
1 liter	1 liter of water, quart of milk
1 milliliter	20 drops, one-fifth of 1 teaspoon

A liter would be used to measure much larger volumes of liquid, like the capacity of a car's fuel tank. Millimeters are much smaller and would be used to measure very small amounts of liquid, like the amount of cough syrup you should take.

Think carefully about what is being measured before you decide on which unit to use.

Examples

Example 3.1.4.1

Earlier, you were given a problem about Jesse in the mailroom.

Jesse needs to decide which metric unit he should use to weigh a box of books and documents.

Solution

First, think about the size and weight of the objects in the box.

Milligrams would be far too small of a unit. The books alone would probably weigh a few million milligrams. Even grams is really not ideal, since the total weight would be thousands of grams.

Jesse should use kilograms to weigh the package for postage.

Example 3.1.4.2

Choose the best unit of measurement.

Which unit of mass would you use to measure a handful of peanuts?

Solution

First, think about the size and weight of a handful of peanuts and then choose the best unit for measuring mass.

Peanuts are small, so the kilogram would be too much for a handful of peanuts. Peanuts may be small, but they are much larger than grains of sand. Milligrams would be too small to measure peanuts.

Grams would be the best unit to weigh a handful of peanuts.

Example 3.1.4.3

Choose the best unit of measurement: the weight of 5 pennies.

Solution

First, think about the size and weight of 5 pennies and then choose the best unit for measuring mass.

5 pennies would definitely weigh less than a kilogram and be too heavy for milligrams.

Grams would be the best unit to weigh 5 pennies, since each penny is about 2.5 grams.

Example 3.1.4.4

Choose the best unit of measurement: the amount of water in a bathtub.

Solution

First, think about the size of a bathtub and choose the best unit for measuring capacity.

Milliliters would be far too small to measure the amount of water a bathtub can hold.

Liters would be the better unit of capacity for the amount of water in a bathtub.

Example 3.1.4.5

Choose the best unit of measurement: the weight of a car.

Solution

First, think about the size and weight of a car and then choose the best unit for measuring mass.

A car is large and very heavy, so you will need the largest unit of the three choices.

Kilograms would be the best unit to weigh a car of the three.

Review

Choose the best unit of either mass or capacity to measure each item.

1. A dictionary
2. A flea under a microscope
3. A jug of apple cider
4. An almond
5. Drops of water from an eyedropper

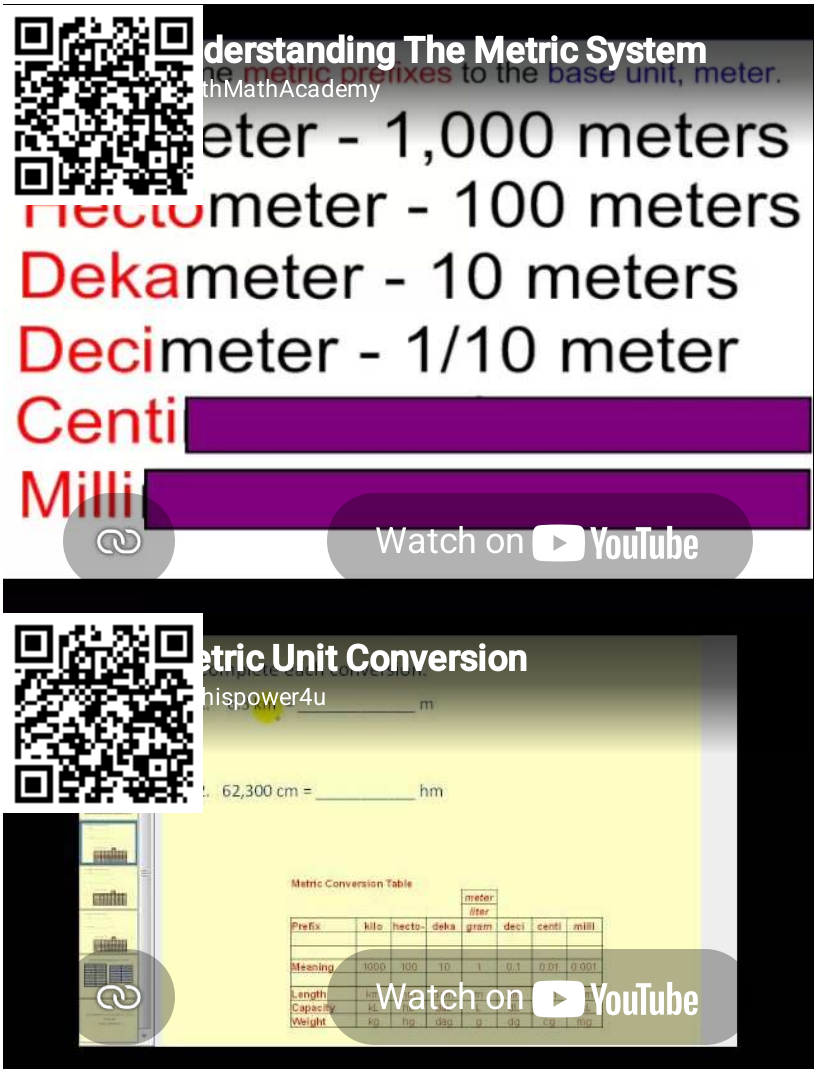
6. Ten dimes
7. A bucket of water
8. A baby bottle
9. A handful of rice
10. A large jug of water
11. A water tower
12. The water in a swimming pool
13. The weight of a boat
14. A handful of sand
15. The weight of a backpack

Review (Answers)

To see the Review answers, open this PDF file and look for section 4.19.

Additional Resources

Videos:



PLIX Interactive: **Using the Right Units**

Practice: **Introduction to Metric Units of Mass and Capacity**

Real World Application: **Weighing In**

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3.2.1: Tools for Measurement of Customary and Metric Lengths

3.2.2: Tools of Metric Measurement of Length

3.2.3: Tools for Measurement of Customary Units of Length, Weight and Capacity

3.2.1: Tools for Measurement of Customary and Metric Lengths

Appropriate Measurement Tools



Figure 3.2.1.1

Erin is redecorating her living room and has some things she wants to measure in the room. She needs to go to the hardware store to purchase some tools, one of which is the best tool to measure the objects in her living room. She needs help deciding which tool is the most useful measuring tool for her to buy.

In this concept, you will learn about different tools that are used to measure both customary and metric units of measurements.

Tools for Measuring

Whether you are measuring the **length** of items using the customary system of **measurement** or the metric system of measurement, you will still have to decide which measurement tool is the best one to use.

These are the most commonly used tools for measurement:

- Rulers
- Tape measures
- **Yard** sticks
- **Meter** sticks

Rulers are used all the time in mathematics. Rulers are used to measure things that are small. Most rulers show both customary units of measurement like **inches** and metric units of measurement, such as the **millimeter** and the **centimeter**.

You can measure a small item in customary units or metric units.



Figure 3.2.1.2



Figure 3.2.1.3

In customary units, the barrette is about 2 inches long. In metric units, it is a little over 5 centimeters long. If an item that is being measured fits on a piece of paper, a ruler is probably the best tool to use.

Another tool to measure length is a **tape measure.** They are used to measure many of the distances that are too long for a ruler to measure easily and they are flexible, not rigid. Examples of things you would use a tape measure for could be the distance across a room or an object that is very long like a large picture frame. Tape measures most commonly show length in inches and feet, but sometimes a tape measure has both customary units and metric units marked.

A **yard stick** measures things by the yard and only shows customary units of inches and feet. Since there are three feet in a yard, a yard stick could be used for things that are longer than a piece of paper, but not too long. Some of the things that you could measure with a tape measure we could also measure with a yard stick, but it depends on if a rigid measurer like a yard stick is appropriate versus the flexible tape measure.

A **meter stick** measures one meter and shows only metric units of measurement of millimeters and centimeters. Meter sticks are used to measure objects that are larger than a piece of paper. Remember that you can use centimeters and millimeters if the object is smaller than a piece of paper. Those items are easily measured with a ruler. A meter stick is a little over 3 feet long, because a meter is approximately 3.2 feet. A meter stick closely compares to a yard stick.

For instances where a yard stick would be used for customary units, a meter stick would be used to measure metric units. For example, when measuring a table length, a yard stick would measure customary length well and a meter stick would alternately measure metric length well.

Examples

Example 3.2.1.1

Earlier, you were given a problem about Erin and her redecorating project in her living room.

She wants to buy the most useful measuring tool she can for measuring different objects in her living room.

Solution

First, Erin needs to think about the different objects she may measure such as furniture, tables, etc.

Next, Erin needs to consider what units most of the objects would be measured in. For objects of these sizes, she will most likely be measuring in feet or maybe yards or meters.

Then, Erin needs to choose a tool at the hardware store that can measure feet and perhaps even yards to meters. She decides on a tape measure for its flexibility and versatility with different units of measurement.

The answer is tape measure.

Erin buys a tape measure to help get her redecorating started.

Example 3.2.1.2

Which tool would you use to measure the length of a bug that needs to be seen with a magnifying glass?

Solution

First, think about the bug and its size compared to units of measurement and different tools.

Next, consider what unit would be most appropriate so you can determine the best tool. If the bug is so tiny that it needs to be seen with a magnifying glass, then it is probably smaller than inches and centimeters. The smallest unit to measure would be millimeters.

Then, match a tool with the unit you are using to measure the object. The best tool that contains millimeters is the ruler.

The answer is a ruler.

Example 3.2.1.3

What tool would you use to measure a toothpick?

Solution

First, consider the object by looking at it or picturing it in your mind.

Next, think about what unit would be best to measure the object. A toothpick is a small object that would be too small for a **foot**. The smaller units of inches, centimeters or millimeters would be more appropriate.

Then, match a tool with the unit you would use to measure the object. Whether inches, centimeters, or millimeters are used as the unit of measurement, the ruler is the tool that will work best.

The answer is ruler.

Example 3.2.1.4

What tool would you use to measure the length of a room?

Solution

First, picture the object in your mind or look at the space.

Next, think about what unit of measurement makes the most sense for measuring a wall. You can rule out very small units like inches, centimeters and millimeters. We can also rule out really large units like miles and kilometers. The most appropriate units are either feet, yards or meters.

Then, determine which tool can be used to measure those units. Most tape measures contain both customary and metric units, but it's also important to think that yards and meters are quite similar so picking one or the other is appropriate.

The answer is tape measure.

Example 3.2.1.5

What tool would you use to measure the height of a floor lamp?

Solution

First, look at the object or picture it in your mind.

Next, think about what unit of measurement you would use to measure the object. A floor lamp is usually around the height of an average person, so we could consider feet, yards or meters for measuring.

Then, choose a tool that would measure these units. This particular object can be measured with either a rigid or flexible measuring tool. Feet and yards are measured on both a yard stick and a tape measure, and meters are measured on meter sticks and most tape measures. Any of these three tools would be appropriate to measure the lamp.

The answer is tape measure, yard stick or meter stick.

Review

Choose the appropriate measurement tool for each item listed below.

1. A grub collected from the garden
2. The width of a street
3. The length of a street
4. The size of a small worm
5. The distance from one town to the next

Choose the appropriate tool to measure each item in metrics and customary units.

6. The height of a light switch
7. The width of a refrigerator
8. The measurements of a placemat
9. The length of a pencil
10. The width of a chapter book
11. The length of a table cloth
12. An eyelash
13. The length of an ant
14. The width of a piece of paper
15. A television screen

Review (Answers)

To see the Review answers, open this PDF file and look for section 2.3.

Vocabulary

Term	Definition
Centimeter	A centimeter is a very small unit of metric measure. A centimeter is one hundredth of one meter.
Customary units of length	Customary units of length include: inches, feet, yards and miles.
Foot	A foot is a customary unit of measurement. There are 12 inches in 1 foot.
Inches	An inch is a customary unit of measurement, measured best by a ruler.
Kilometer	A kilometer is a common metric unit of length that is equal to 1,000 meters.
Length	Length is a measurement of how long something is. Examples of customary units of length are inches, feet, yards and miles.
Measurement	A measurement is the weight, height, length or size of something.
Meter	A meter is a common metric unit of length that is slightly larger than a yard.
Metric units of length	The metric units of length are units of measurement such as millimeter, centimeter, meter and kilometer.
Mile	A mile is a customary unit for measuring distance. There are 5280 feet in 1 mile.
Millimeter	A millimeter is the smallest common metric unit of length.
Yard	A yard is a customary unit of measurement. There are 3 feet in 1 yard.

Additional Resources

Video:



PLIX Interactive: **Measurement Sticks**

Practice: **Tools for Measurement of Customary and Metric Lengths**

Real World Application: **Bridging the Gap**

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3.2.2: Tools of Metric Measurement of Length

Appropriate Tools for Metric Measurement



Figure 3.2.2.1

Maya and her family live in Australia. At school Maya is learning about water conservation. She takes a survey online about how her family uses water at home. It asks her questions about how long their showers are, how often they do laundry or run the dishwasher, and whether they water their lawn. Then, the program estimates how much water her family uses in a year. How can Maya determine what metric unit would be most appropriate for this estimate?

In this concept, you will learn how to choose appropriate tools and units for given metric **measurement** situations.

Choosing Appropriate Tools and Units for Metric Measurement

The **metric system** is the system of measurement primarily used in science and in countries outside of the United States. The metric system includes units of length (meters), mass (grams), and capacity (liters).

When you want to measure something, the first thing you need to decide is what unit of measurement you want to use. You want to use the unit that most closely matches the object you are measuring. You wouldn't want to measure the volume of a swimming pool in milliliters - the number would be too big!

Here are some real world measurement benchmarks to help you to decide the best unit of measurement.

Length:

- A grain of sand is about 1 millimeter long
- A paperclip is about 1 centimeter wide
- A table could be about 1 meter tall
- A road could be about 1 kilometer long

Mass:

- A speck of dust could weigh about 1 milligram
- A paperclip weighs about 1 gram
- A kitten could weigh about 1 kilogram

Volume:

- An eyedropper holds about 1 milliliter
- A juice box holds about 25 centiliters

- A soda bottle holds about 1 liter
- A kid's pool could hold about 1 kiloliter

Here is an example.

Choose the appropriate metric unit to measure the weight of a pencil.

First, notice that you are looking for a weight. A pencil weighs more than a paperclip but less than a kitten. This means it would be best measured in grams.

The answer is the weight of a pencil would be best measured in grams.

Once you have determined the appropriate unit of measurement, you can select an appropriate tool for measuring.

When measuring the length a small item, it is best to use a **metric ruler**. You can use metric rulers to measure in millimeters, centimeters, and meters.



Figure 3.2.2.2

When measuring the weight or mass of a small object, you can use a scale or a balance. You can use a scale to measure milligrams, centigrams, grams, and small numbers of kilograms.



Figure 3.2.2.3

When measuring small amounts of capacity, you can use a graduated cylinder. Graduated cylinders can measure milliliters and centiliters.



Figure 3.2.2.4

Here is an example.

Choose the appropriate tool for measuring the weight of a golf ball.

First, notice that you are looking for the weight of a small object. This means you should use a balance or a scale to do the measurement.

The answer is the weight of a golf ball could be measured with a scale.

Here is another example.

Choose the appropriate tool for measuring the volume of water in a chemical solution.

First, notice that you are looking for a volume which is the same as capacity. There is likely a small amount of water in a chemical solution so you can use a graduated cylinder to do the measurement.

The answer is the amount of water in a chemical solution could be measured with a graduated cylinder.

Examples

Example 3.2.2.1

Earlier, you were given a problem about Maya and her family in Australia.

Maya took a survey about her family's water usage in order to estimate how much water her family uses in a year. Maya wonders what metric unit would be most appropriate for this estimate.

Solution

First Maya should notice that she will be using a metric unit of capacity. The amount of water a family uses in a year is a large amount of water - more than the amount of water in a pool! This means kiloliters would be the best unit of measurement.

The answer is that the family's water usage for the year would be best measured in kiloliters.

Example 3.2.2.2

Choose the appropriate metric unit for the following measurements.

1. The volume of a jug of milk.
2. The distance between your house and your school.

Solution

For part a, first notice that you are looking for a volume which is a capacity. A jug of milk holds about the same amount of liquid as a bottle of soda. This means its volume would be best measured in liters.

The answer to part a is the volume of a jug of milk would be best measured in liters.

For part b, first notice that you are looking for a distance which is a length. The distance between your house and your school likely contains at least one road and is definitely longer than a table. This means it would be best measured in kilometers.

The answer to part b is the distance between your house and your school would be best measured in kilometers.

Example 3.2.2.3

What is the best tool to measure a bag of flour?

Solution

First, notice that you are looking for a weight. A typical bag of flour is something that you can carry, so it is not too big. This means you should use a balance or a scale to do the measurement.

The answer is the weight of a bag of flour could be measured with a scale.

Example 3.2.2.4

What is the best tool to measure the length of a table?

Solution

First, notice that you are looking for a length. A typical table is no more than a few meters long. This means you should use a meter stick to do the measurement.

The answer is the length of a table could be measured with a meter stick.

Example 3.2.2.5

What is the best tool to measure the amount of water in a glass?

Solution

First, notice that you are looking for a volume which is the same as capacity. You can use a graduated cylinder to do the measurement.

The answer is the amount of water in a glass could be measured with a graduated cylinder.

Review

Choose the appropriate tool for the following measurements.

1. The volume of a water balloon
2. The length of a basketball court
3. The weight of an apple
4. The volume of a milk carton

Choose the appropriate unit for the following measurements.

5. The distance between two towns
6. The weight of a peanut
7. The length of a hand
8. The volume of a raindrop
9. The weight of a person
10. The weight of a bag of sand
11. The height of a table

Solve each problem.

12. The town square has a length of 39.2 meters and a width of 17.5 meters. What is the perimeter of the square? [Remember: P=2l+2w]
13. A pharmacist mixing cough syrup mixes 1,550 milliliters of syrup, 725 milliliters of cherry flavor and 1.25 liters of water. Once mixed, what is the total volume of the cough syrup in liters?
14. A stable houses horses with the following weights. Arnaud: 331.6 kg; Josie: 331,061 g; Max: 331,612 g; Taboo: 331.61 kg. Order the horses from greatest to least weight.
15. At the farmer's market, Josh bought 1.5 kilograms of oranges, 150 grams of grapes, and 15,000 centigrams of apples. How many grams of fruit did he buy in all?

Review (Answers)

To see the Review answers, open this PDF file and look for section 2.20.

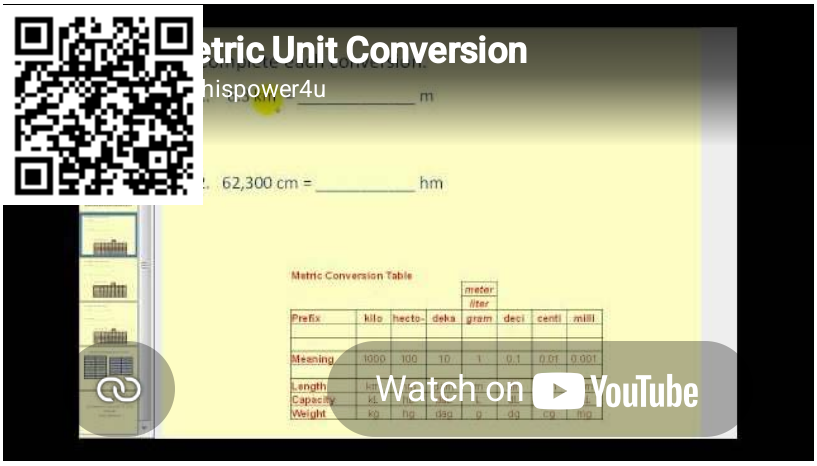
Vocabulary

Term	Definition
Centi	Centi is a prefix used in the metric system meaning 100.
Equivalence	Equivalence is the condition of being equal in value or meaning.
Kilo	Kilo is a prefix meaning 1,000. It is used in the metric system.
Measurement	A measurement is the weight, height, length or size of something.
Metric Ruler	A metric ruler is a tool for measuring metric lengths such as millimeters and centimeters.
Milli	Milli is a prefix used in the metric system meaning 11000 or 0.001.

Additional Resources

PLIX Interactive: **Appropriate Tools for Metric Measurement**

Video:



Practice: **Tools of Metric Measurement of Length**

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3.2.3: Tools for Measurement of Customary Units of Length, Weight and Capacity

Tools of Metric Measurement of Length



Figure 3.2.3.1

Megan runs a small dairy farm with her family. Right now they have 85 cows and they milk each cow twice a day. They sell some of the milk in their own store at their farm, and the rest they turn into yogurt or cheese or sell to local grocery stores. Megan likes to keep track of how much milk she gets each day from her cows. What unit of **measurement** would be most appropriate for recording the amount of milk her cows are producing each day?

In this concept, you will learn how to choose appropriate tools and units for given customary measurement situations.

Choosing Appropriate Tools for Customary Measurement

The **customary system of measurement** is the system of measurement primarily used in the United States. The customary system includes units of length, mass, and capacity.

When you want to measure something, the first thing you need to do is select an appropriate tool for measuring.

When measuring the length of an item or a distance, first consider how small or large it is. For a small item, it is best to use a **ruler**. A ruler is 1 foot (12 inches) in length and can be used to measure in inches. To measure items or distances that are slightly longer than a foot, you can use a **yardstick**. Yardsticks are 1 yard (3 feet) in length. To measure the length of an even longer item or distance, you can use a **measuring tape**. Measuring tapes can be uncurled to measure longer lengths. Measuring tapes usually show inches and feet.



Figure 3.2.3.2

When measuring the weight or mass of a small object, you can use a scale or a balance. You can use a scale to measure ounces and pounds.



Figure 3.2.3.3

When measuring units of capacity in cooking, you can use measuring cups and measuring spoons. Standard measuring cups come in 1 cup, 12 cup, 13 cup, and 14 cup sizes. There are also 2-cup and 4-cup measuring cups to measure pints and quarts. You can use measuring spoons to measure teaspoons and tablespoons.



Figure 3.2.3.4

Here is an example.

Choose the appropriate tool for measuring the weight of an apple.

First, notice that you are looking for the weight of a small object. This means you should use a balance or a scale to do the measurement.

The answer is the weight of an apple could be measured with a scale.

Here is another example.

Choose the appropriate tool for measuring the length of a caterpillar.

First, notice that you are looking for the length of a small item. This means you should use a ruler to do the measurement.

The answer is the length of a caterpillar could be measured with a ruler.

When you need to measure something, always consider the most reasonable unit to use before measuring. If you choose a unit that is too small, you will get a large number that is hard to keep track of. If you choose a unit that is too large, it will be difficult to be precise in your measurement.

Let's look at an example.

Choose the appropriate customary unit to measure the weight of a jar of jam.

First, notice that you are looking for a weight. A jar of jam is relatively small and likely weighs less than a pound. This means it would be best measured in ounces.

The answer is the weight of a jar of jam would be best measured in ounces.

Examples

Example 3.2.3.1

Earlier, you were given a problem about Megan and her family's dairy farm.

Megan wants to keep track of the amount of milk her 85 cows are producing each day and needs to know what unit of measurement would be most appropriate to use.

Solution

First, Megan should keep in mind that she is looking for a capacity. The amount of milk that 85 cows produce each day is a large amount. This means it would be best measured in gallons.

The answer is Megan should record the amount of milk produced by her cows each day in gallons.

Example 3.2.3.2

What tool and unit would you use to measure the height of a tree?

Solution

First, notice that you are looking for a height. A typical tree is more than a few feet tall. This means you should use a measuring tape to do the measurement.

Next, think about the unit. A tree is more than a few feet tall, but much less than a mile tall. It would make sense to measure the height of a tree in feet or yards.

The answer is the height of a could be measured with a measuring tape in feet or yards.

Example 3.2.3.3

What is the best tool to measure milk needed for a recipe?

Solution

First, notice that you are looking for a volume or capacity for cooking. This means you should use a measuring cup to do the measurement.

The answer is the volume of milk needed for a recipe could be measured with a measuring cup.

Example 3.2.3.4

What is the best tool to measure the dimensions of a garden plot?

Solution

First, notice that you are looking for lengths. A typical garden plot is more than a few feet long. This means you should use a measuring tape to do the measurement.

The answer is the dimensions of a garden plot could be measured with a measuring tape.

Example 3.2.3.5

What is the best tool to measure the weight of a bunch of bananas?

Solution

First, notice that you are looking for a weight. A typical bunch of bananas is something that you can carry, so it is not too big. This means you should use a balance or a scale to do the measurement.

The answer is the weight of a bunch of bananas could be measured with a scale.

Review

Choose the appropriate tool for the following measurements.

1. The weight of a violin
2. The volume of a small amount of oregano
3. The volume of a glass of milk
4. The length of one side of your desk
5. Sugar for a cup of coffee
6. The amount of sugar needed for a cake
7. The weight of a person

Choose the appropriate unit for the following measurements.

8. The length of a football field
9. The volume of a car's gas tank
10. The length of an insect
11. The weight of a tennis shoe
12. The distance a person runs in 1 hour
13. The amount of water in a large drum
14. The amount of water in a pool
15. The size of a child's foot

Review (Answers)

To see the Review answers, open this PDF file and look for section 3.20.

Vocabulary

Term	Definition
Customary System	The customary system is the measurement system commonly used in the United States, including: feet, inches, pounds, cups, gallons, etc.
Equivalence	Equivalence is the condition of being equal in value or meaning.
Measurement	A measurement is the weight, height, length or size of something.

Additional Resources

PLIX Interactive: **Appropriate Tools for Customary Measurement: Matching**

Video:

403 ERROR

The request could not be satisfied.

Request blocked. We can't connect to the server for this app or website at this time. There might be too much traffic or a configuration error. Try again later, or contact the app or website owner.
If you provide content to customers through CloudFront, you can find steps to troubleshoot and help prevent this error by reviewing the CloudFront documentation.

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Generated by cloudfront (CloudFront)
Request ID: dQxA6z5udO2ikEGl3n-vDrCp02zmchYPaAYcyLWf-r4aHCcqB5gLmQ==
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Practice: **Tools for Measurement of Customary Units of Length, Weight**

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3.3.1: Conversion between Customary Units of Length, Weight, and Capacity

3.3.2: Multiply or Divide to Convert between Customary Units of Length, Weight, and Capacity

3.3.3: Conversion of Customary Length, Weight, and Capacity Applications

3.3.4: Convert between Metric Units of Length, Weight, and Capacity

3.3.5: Customary and Metric Measurement Conversion

3.3.6: Convert Using Unit Analysis

3.3.1: Conversion between Customary Units of Length, Weight, and Capacity

Conversion of Customary Units of Measurement



Figure 3.3.1.1

Leslie is trying to decide which yogurt to buy at the grocery store. There are two yogurts she is considering. The first kind of yogurt is in a 2 pound container and costs $6. The second kind of yogurt is in a 6 ounce container and is being sold in packs of 5 for $6. She sees that both options cost $6 so she figures she should choose whichever option will give her more yogurt. How can Leslie figure out which option will give her more yogurt?

In this concept, you will learn how to convert and compare customary units of measure.

Converting Customary Units of Measure

The **customary system of measurement** is the system of measurement primarily used in the United States. The tables below show some of the most common U.S. customary units and how they are related.

U.S. Customary Units of Length

inch (in)
foot (ft) = 12 inches
yard (yd) = 3 feet
mile (mi) = 5,280 feet

U.S. Customary Units of Mass

ounce (oz)
pound (lb) = 16 ounces

U.S Customary Units of Capacity

fluid ounce (oz)
cup (c) = 8 ounces
pint (pt) = 2 cups = 16 ounces
quart (qt) = 4 cups = 2 pints = 32 ounces
gallon (gal) = 4 quarts

U.S Customary Units of Capacity Used in Cooking

teaspoon (tsp)
tablespoon (tbsp) = 3 teaspoons
cup (c) = 16 tablespoons

To move between different U.S. customary units of length, mass, and capacity, you will multiply or divide by a conversion factor.

- Any time you are going from a smaller unit of measure to a larger unit of measure you will need to divide by the conversion factor.
- Any time you are going from a larger unit of measure to a smaller unit of measure you will need to multiply by the conversion factor.

Here is an example.

Convert 374 inches to feet.

First, notice that inches are smaller than feet. You are moving from a smaller unit of measure to a larger unit of measure. This means you will need to divide. There are 12 inches in a foot, so your conversion factor is 12.

Now, divide. Take the given number of inches and divide by 12.

$374 \div 12 = 374/12 = 187/6 = 31(1/6)$

The answer is 374 inches=31(1/6) feet.

Once you know how to convert between different units of measurements, you can compare measurements. The best way to compare two measurements is to first make sure they are in the same unit. Then, you can more easily see which measurement is larger and which is smaller.

Let's look at an example.

Compare 4(1/2) pounds and 74 ounces.

First, notice that you have two different units of mass. In order to compare these measurements, convert one of them so that both units are the same. Let's convert 4(1/2) pounds to ounces.

Now, when converting pounds to ounces you are moving from a larger unit of measure to a smaller unit of measure. This means you will need to multiply. There are 16 ounces in a pound, so your conversion factor is 16.

Next, multiply. Take the given number of pounds and multiply by 16.

$4(1/2) \times 16 = (9/2) \times (16/1) = 144/2 = 72$

4(1/2) pounds=72 ounces

Now you are looking to compare 72 ounces and 74 ounces. 72 ounces is less than 74 ounces, so 4(1/2) pounds is less than 74 ounces.

The answer is 4(1/2) pounds<74 ounces.

Examples

Example 3.3.1.1

Earlier, you were given a problem about Leslie, who is trying to buy yogurt.

She has two options. Her first option is a 2 pound container. Her second option is five 6-ounce containers. Both options will cost her $6. She wants to choose the option that will give her more yogurt.

Solution

First Leslie should realize that five 6-ounce containers is 30 ounces of yogurt. Leslie needs to compare 2 pounds and 30 ounces. Since Leslie has two different units of mass, in order to compare these measurements she should convert one of them

so that both units are the same. She can convert pounds to ounces.

Now, when converting pounds to ounces she is moving from a larger unit of measure to a smaller unit of measure. This means she will need to multiply. There are 16 ounces in a pound, so her conversion factor is 16.

Next, she should multiply. Take the given number of pounds and multiply by 16.

$2 \times 16 = 32$

2 pounds=32 ounces

Now Leslie is looking to compare 32 ounces and 30 ounces. 32 ounces is more than 30 ounces, so 2 pounds is greater than 30 ounces.

The answer is Leslie should buy the 2 pound container of yogurt.

Example 3.3.1.2

Henrietta is having her 7 best friends over for a luncheon. She wants to prepare salads in which she uses exactly 7 tablespoons of Romano cheese. If she is preparing 8 salads, how many cups of Romano cheese does Henrietta require?

Solution

First, figure out how many tablespoons of Romano cheese Henrietta will need. She is making 8 salads and each salad requires 7 tablespoons of cheese.

$8 \times 7 = 56$

Henrietta will need 56 tablespoons of Romano cheese.

Now, convert 56 tablespoons to cups. You are moving from a smaller unit of measure to a larger unit of measure. This means you will need to divide. There are 16 tablespoons in a cup, so your conversion factor is 16.

Now, divide.

$56 \div 16 = 3(1/2)$

The answer is Henrietta will need 3(1/2) cups of Romano cheese.

Example 3.3.1.3

Convert 82 pints to quarts.

Solution

First, notice that pints are smaller than quarts. You are moving from a smaller unit of measure to a larger unit of measure. This means you will need to divide. There are 2 pints in a quart, so your conversion factor is 2.

Now, divide. Take the given number of pints and divide by 2.

$82 \div 2 = 41$

The answer is 82 pints=41 quarts.

Example 3.3.1.4

Compare 80 ounces and 3 quarts.

Solution

First, notice that you have two different units of capacity. In order to compare these measurements, convert one of them so that both units are the same. Let's convert 3 quarts to ounces.

Now, when converting quarts to ounces you are moving from a larger unit of measure to a smaller unit of measure. This means you will need to multiply. There are 32 ounces in a quart, so your conversion factor is 32.

Next, multiply. Take the given number of quarts and multiply by 32.

$3 \times 32 = 96$

3 quarts=96 ounces

Now you are looking to compare 80 ounces and 96 ounces. 80 ounces is less than 96 ounces, so 80 ounces is less than 3 quarts.

The answer is 80 ounces<3 quarts.

Example 3.3.1.5

Convert 8(1/2) gallons to quarts.

Solution

Convert 8(1/2) gallons to quarts.

First, notice that gallons are larger than quarts. You are moving from a larger unit of measure to a smaller unit of measure. This means you will need to multiply. There are 4 quarts in a gallon, so your conversion factor is 4.

Now, multiply. Take the given number of gallons and multiply by 4.

$8(1/2) \times 4 = (17/2) \times (4/1) = 68/2 = 34$

The answer is 8(1/2) gallons=34 quarts.

Review

Convert the following measurements into yards. Round to the nearest tenth when necessary.

1. 195 inches
2. 0.2 miles
3. 88 feet
4. 90 feet
5. 900 feet

Convert the following measurements into pounds.

6. 2,104 ounces
7. 96 ounces
8. 3 tons
9. 15 tons

Convert the following measurements into pints.

10. 102 quarts
11. 57 ounces
12. 9.5 gallons
13. 4 quarts
14. 18 quarts
15. 67 gallons

Review (Answers)

To see the Review answers, open this PDF file and look for section 3.21.

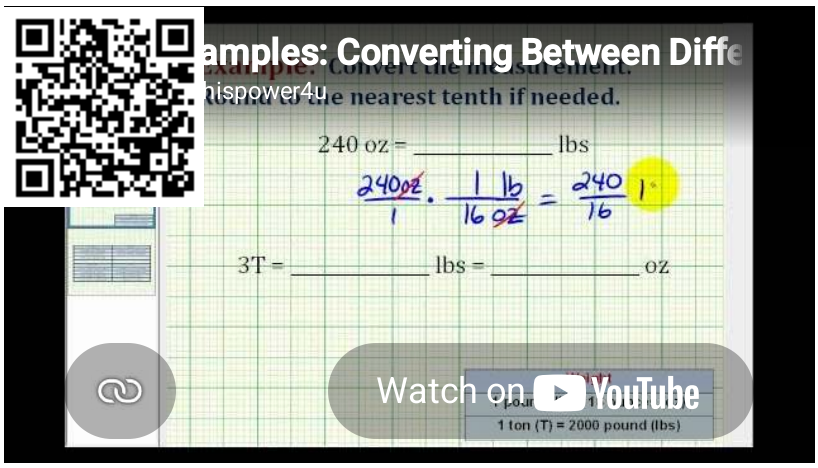
Vocabulary

Term	Definition
Customary System	The customary system is the measurement system commonly used in the United States, including: feet, inches, pounds, cups, gallons, etc.
Metric System	The metric system is a system of measurement commonly used outside of the United States. It contains units such as meters, liters, and grams, all in multiples of ten.
Proportion	A proportion is an equation that shows two equivalent ratios.
Ratio	A ratio is a comparison of two quantities that can be written in fraction form, with a colon or with the word “to”.

Additional Resources

PLIX Interactive: **United States Customary Units: Gelato Pint**

Video:



Practice: **Conversion between Customary Units of Length, Weight, and** (...)

Real World Application: **You Can Cook**

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3.3.2: Multiply or Divide to Convert between Customary Units of Length, Weight, and Capacity

Conversion of Customary Units by Multiplying



Figure 3.3.2.1

Michaela is planning a party. She buys 5 pounds of shrimp for 10 people. She guesses that each person will eat about 7 ounces of shrimp. Will Michaela have enough shrimp for everyone?

In this concept, you will convert customary units of measure using multiplication.

Converting Customary Units by Multiplying

When converting customary units of measure from a larger unit to a smaller unit, multiply the the larger unit by its smaller **equivalent** unit. You may already be wondering why you need to multiply as opposed to some other operation. Here is an example to demonstrate this.

1 dollar = 100 pennies

There are 100 pennies in one dollar. The dollar is a larger unit than the penny. You need many pennies to equal one dollar. The same is true when working with units of **length**, **weight** and **capacity**. You need more of a smaller unit to equal a larger unit.

Think back to all of the units of length, weight and capacity that you have previously learned about.

Here are some equivalence tables.

Customary Units of Length

inch (in.)	**foot (ft)**	**yard (yd)**	**mile (mi)**
12	1		
	3	1	
		1,760	1

Customary Units of Weight

ounces (oz)	**pounds (lb)**	**tons (T)**
16	1	
	2,000	1

Customary Units of Capacity

fluid ounces (fl oz)	cups (c)	pints (pt)	quarts (qt)	gallon (gal)
8	1			
16	2	1		
32	4	2	1	
128	16	8	4	1

Let's look at a conversion problem.

John has a rope that is 10 feet long. How long is his rope in inches?

Notice, you are converting from feet to inches. A foot is a larger unit than an inch.

10 feet = _____ inches

To solve this problem, multiply the number of feet by the unit equivalence. This will give you the measurement in inches.

1 foot = 12 inches

10 × 12 = 120

The answer is 10 feet is equivalent to 120 inches.

Examples

Example 3.3.2.1

Earlier, you were given a problem about Michaela and her party.

Michaela has 5 pounds of shrimp and is wondering if she will have enough for 10 people if each person eats 7 ounces of shrimp. Convert the 5 pounds to ounces to see if Michaela will have enough for everyone.

Solution

5 pounds = _____ ounces

First, check if she will multiply or divide. A pound is larger than an ounce. Multiply when converting a larger unit to a smaller unit.

Then, find the unit equivalence.

1 pound = 16 ounces

Next, multiply the number of pounds by the unit equivalence.

5 × 16 = 80

5 pounds = 80 ounces

If 10 people eat 7 ounces of shrimp each, then Michaela will need at least 70 ounces of shrimp. Michaela will have enough shrimp for the party.

Example 3.3.2.2

Convert the unit of measure: Jason's baby brother drank 3 cups of milk. How many fluid ounces did he drink?

Solution

Once again, you are going from a larger unit to a smaller unit.

3 cups = _____ fl oz

Multiply the number of cups by the unit equivalence.

1 cup = 8 fl oz.

3 × 8 = 24

The answer is 3 cups is equivalent to 24 fluid ounces.

Convert the following units of measure.

Example 3.3.2.3

Convert the following unit of measure: 4 tons = ____ pounds.

Solution

Multiply the number of tons by the unit equivalence.

1 ton = 2,000 pounds.

4 × 2,000 = 8,000

The answer is 4 tons is equivalent to 8,000 pounds

Example 3.3.2.4

Convert the following unit of measure: 5 feet = ____ inches.

Solution

Multiply the number of feet by the unit equivalence.

1 foot = 12 inches

5 × 12 = 60

The answer is 5 feet is equivalent to 60 inches

Example 3.3.2.5

Convert the following unit of measure: 8 pints = ____ cups.

Solution

Multiply the number of tons by the unit equivalence.

1 pint = 2 cups

8 × 2 = 16

The answer is 8 pints is equivalent to 16 cups.

Review

Convert the following units of measure.

1. 5 tons = ____ pounds
2. 6 feet = ____ inches
3. 9 tons = ____ pounds
4. 8 pounds = ____ ounces
5. 2.5 feet = ____ inches
6. 3.5 tons = ____ pounds
7. 2.25 pounds = ____ ounces
8. 9 cups = ____ fl oz
9. 5 pints = ____ cups
10. 7 pints = ____ cups

11. 8 quarts = ____ pints
12. 1 quart = ____ pints
13. 6 gallons = ____ quarts
14. 7.75 gallons = ____ quarts
15. 8 miles = _____ feet
16. 3 feet = _____ inches
17. 12 miles = _____ feet

Review (Answers)

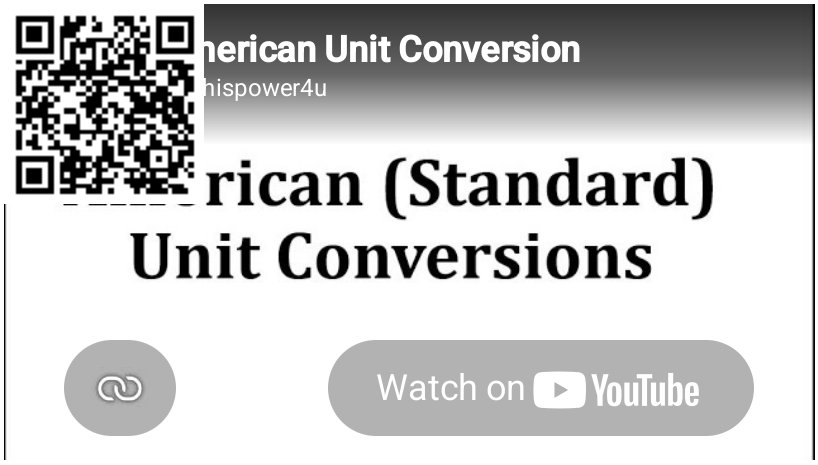
To see the Review answers, open this PDF file and look for section 7.16.

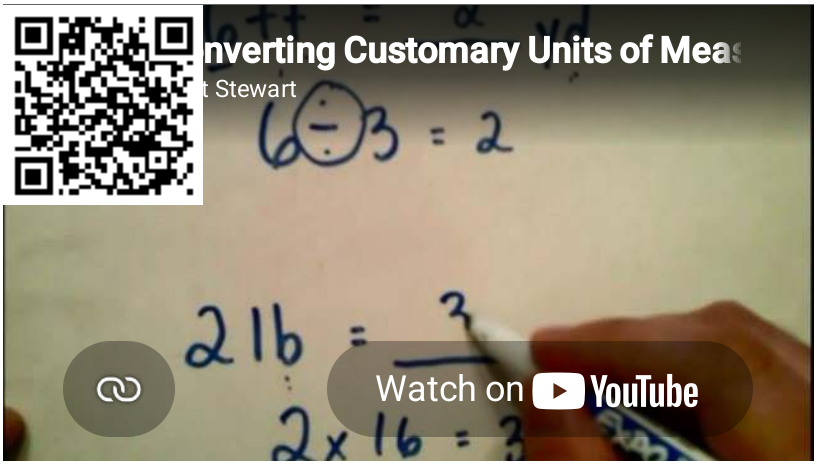
Vocabulary

Term	Definition
Capacity	The volume of liquid an object or item can hold. Customary units of capacity include fluid ounces, cups, pints, quarts and gallons.
Equivalent	Equivalent means equal in value or meaning.
Length	Length is a measurement of how long something is. Examples of customary units of length are inches, feet, yards and miles.
Weight	Weight is a measurement of the heaviness or mass of someone or something. The customary units of weight included ounces, pounds, and tons.

Additional Resources

Video:





PLIX Interactive: **The Price of a Unit**

Practice: **Multiply or Divide to Convert between Customary Units of** (...)

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3.3.3: Conversion of Customary Length, Weight, and Capacity Applications

Convert Customary Units of Measurement in Real-World Situations



Figure 3.3.3.1

Evana is making a recipe for fruit punch that uses 3 cups of pineapple juice. If she makes 5 batches of the recipe, how many quarts of pineapple juice will she need?

In this concept, you will learn to convert customary units of **measurement** in real-world situations.

Customary System

The **customary system**, also known as the Imperial System, is made up of units such as inches, feet, cups, gallons and pounds. Let's look at conversions within the customary system of measurement.

Customary Units of Measurement



Figure 3.3.3.2

Let's look at an example.

The distance from John's house to Mike's house on a map is 4.5 inches. The scale of the map is 1.5 inches=2 miles. What is the actual distance from John's house to Mike's house in feet?

First, set up a **proportion**.

(1.5 inches)/(2 miles)=(4.5 inches)/(x miles)

Next, cross multiply.

1.5/2=4.5/x

1.5x=2×4.5

1.5x=9

Then, divide both sides by 1.5 to solve for x.

1.5x=9

1.5x/1.5=9/1.5

x=6

Then, if the actual distance is 6 miles, what is this distance in feet.

1 mile/5280 feet=6 miles/x feet

Then, cross multiply to solve for x .

1/5280=6/x

1x=6×5280

x=31,680

The answer is 31,680.

The distance between the two houses is 31,680 feet.

Examples

Example 3.3.3.1

Earlier, you were given a problem about Evana and her thirsty conversion.

Evana needs to make 5 batches with each batch needing 3 cups of juice. She needs to find the total amount of juice in quarts.

Solution

First, find the total number of cups she needs. If there are 3 cups in one batch, and she is making 5 batches, then she will need:

3×5=15 cups

Next, set up a proportion.

4 cups/1 quart=15 cups/x quarts

Then, cross multiply.

4/1=15/x

4x=1×15

4x=15

Then, divide both sides by 4 to solve for x.

4x=15

4x/4=15/4

x=3.75

The answer is 3.75.

Evana needs to make 3.75 quarts of punch.

Example 3.3.3.2

A scale model of a building has a height of 3.5 feet. The scale of the model is 112 inch=10 feet. What is the actual height of the building?

Solution

First, set up a proportion to find the height in inches.

12 inches/1 foot=x inches/3.5 feet

Next, cross multiply to solve for x.

12/1=x/3.5

1x=12×3.5

x=42

The answer is 42.

The scale model is 42 inches high.

Then, set up a proportion to solve for the actual height of the building.

1.5 inches/10 feet=42 inches/x feet

Then, cross multiply.

1.5/10=42/x

1.5x=10×42

1.5x=420

Then, divide both sides by 1.5 in order to solve for x.

1.5x=420

1.5x/1.5=420/1.5

x=280

The answer is 280.

The building is 280 feet tall.

Example 3.3.3.3

Karin has a recipe that calls for 3 gallons of cider. How many quarts will she need?

Solution

First, set up a proportion.

1 gallon/4 quarts=3 gallons/x quarts

Next, cross multiply to solve for x.

1/4=3/x

1x=3×4

x=12

The answer is 12.

Karin will need 12 quarts of cider.

Example 3.3.3.4

Jack threw the ball 12 feet. How many inches did he throw the ball?

Solution

First, set up a proportion.

1 foot/12 inches=12 feet/x inches

Next, cross multiply to solve for x.

1/12=12/x

1x=12×12

x=144
The answer is 144.

Jack threw the ball 144 inches.

Example 3.3.3.5

Carl drank 3 pints of lemonade. How many ounces did he drink?

Solution

First, set up a proportion.

1 pint/16 ounces=3 pints/x ounces

Next, cross multiply to solve for x.

1/16=3/x

1x=16×3

x=48
The answer is 48.

Carl drank 48 ounces of lemonade.

Review

Solve each problem.

1. Justin ran 3 miles. How many feet did he run?
2. If the flour weighed four pounds, how many ounces did it weigh?
3. How many pounds is equal to 4 tons?
4. Mary needs 3 cups of juice for a recipe. How many ounces does she need?
5. Jess bought 3 quarts of pineapple juice. How many pints did she purchase?
6. If Karen bought 16 quarts of ice cream, how many gallons did she buy?
7. The length of the garden is four yards. How many feet is that?
8. If the width of the garden is 4 yards, how many inches is that?
9. Will eight cups of water fit in a two quart saucepan?
10. A recipe calls for 2 pints of milk. If Jorge cuts the recipe in half, how many cups of milk will he need?
11. Audrey is making brownies for a bake sale. The recipe calls for 8 ounces of flour for every 24 brownies. If she makes 96 brownies, how many pounds of flour will she need?
12. Two buildings are 5 inches apart on a map. The scale on the map is 14 inch=1 mile. What is the actual distance between the two buildings?
13. The length of a classroom on a floor plan is 2.5 inches. The scale of the map is 12 inches=5 feet What is the actual length of the classroom in inches?
14. A scale model of a mountain is 2.75 feet tall. The scale of the model is 14 inch=50 feet What is the actual height of the mountain in feet?
15. A scale drawing of a town includes a park that measures 0.5 inch by 1.5 inches. If the scale of the map is 0.5 inches=1 mile, what is the area of the park in square feet?

Review (Answers)

To see the Review answers, open this PDF file and look for section 4.13.

Vocabulary

Term	Definition
Customary System	The customary system is the measurement system commonly used in the United States, including: feet, inches, pounds, cups, gallons, etc.
Measurement	A measurement is the weight, height, length or size of something.
Proportion	A proportion is an equation that shows two equivalent ratios.
Ratio	A ratio is a comparison of two quantities that can be written in fraction form, with a colon or with the word “to”.

Additional Resources

PLIX Interactive: **The Price of a Unit**

Video:



Practice: **Conversion of Customary Length, Weight, and Capacity Applications**

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3.3.4: Convert between Metric Units of Length, Weight, and Capacity

Convert Metric Units of Measurement in Real-World Situations



Figure 3.3.4.1

Jessica works in a science lab. She needs to convert the liquid measure that she is working with from liters to milliliters. She has been given 3.5 liters to convert. If each container that Jessica has holds 100 milliliters, how many containers will she need?

In this concept, you will learn to convert metric units of **measurement** in real-world situations.

Converting Metric Units of Measurements

The **metric system** of measurement is the primary measurement system in many countries; it contains units such as meters, kilometers and liters. Let's review the metric units of measurement.

Metric Units of Measurement

Now, let's look at a real-world problem involving converting metric units.

A scale model of a building has a height of 1.5 meters. The scale of the model is 1 cm=0.5 m. What is the actual height of the building?

First, set up a proportion to change 1.5 m to cm.

100 cm/1 m=x cm/1.5 m

Next, cross multiply to solve for the number of centimeters for the height of the scale model.

100/1=x/1.5

1x=100×1.5

x=150

Next, set up a proportion to find the height of the actual model.

1 cm/0.5 m=150 cm/x m

Then, cross multiply to solve for x.

1/0.5=150/x

1x=0.5×150

x=75

The answer is 75.

The actual height of the building is 75 meters.

Examples

Example 3.3.4.1

Earlier, you were given a problem about Jessica's scientific measurements.

Jessica is given 3.5 L of liquid and needs to fill containers with 100 mL each. Jessica needs to know how many containers she will need.

Solution

First, set up a proportion to change 3.5 L to mL.

1000 mL/1 L=x mL/3.5 L

Next, cross multiply to solve for the number of milliliters Jessica has.

1000/1=x/3.5

1x=1000×3.5

x=3500

Next, divide by 100 to find the number of containers.

3500 mL/100 mL=35

The answer is 35.

Jessica will need 35 containers.

Example 3.3.4.2

Marcy is making beef stew. Her recipe calls for 900 grams of beef. She looks in the refrigerator and sees that she has 1.5 kilograms of beef wrapped in a package. Marcy isn't sure how much of the beef she should use. Does Marcy have enough beef for her recipe?

Solution

First, set up a proportion to change 1.5 kg to g.

1000 g/1 kg=x g/1.5 kg

Next, cross multiply to solve for the number of grams of beef Marcy has in her refrigerator.

1000/1=x/1.5

1x=1000×1.5

x=1500

The answer is 1500 g.

Marcy has 1500 grams of meat, but only needs 900 grams for her recipe. She will have 600 grams of meat left over.

Example 3.3.4.3

If the scale used for a model is 1 cm=0.5 m and the scale measurement is 3.2 meters, what is the actual measurement?

Solution

First, set up a proportion to change 3.2 m to cm.

100 cm/1 m=x cm/3.2 m

Next, cross multiply to solve for the number of centimeters for the height of the scale model.

100/1=x/3.2

1x=100×3.2

x=320

Next, set up a proportion to find the height of the actual model.

1 cm/0.5 m=320 cm/x m

Then, cross multiply to solve for x.

1/0.5=320/x

1x=0.5×320

x=160

The answer is 160.

The actual height of the building is 160 meters.

Example 3.3.4.4

If the scale used for a model is 1 cm=0.5 m and the scale measurement is 0.75 meters, what is the actual measurement?

Solution

First, set up a proportion to change 0.75 m to cm.

100 cm/1 m=x cm/0.75 m

Next, cross multiply to solve for the number of centimeters for the height of the scale model.

100/1=x/0.75

1x=100×0.75

x=75

Next, set up a proportion to find the height of the actual model.

1 cm/0.5 m=75 cm/x m

Then, cross multiply to solve for x.

1/0.5=75/x

1x=0.5×75

x=37.5

The answer is 37.5.

The actual height of the building is 37.5 meters.

Example 3.3.4.5

If the scale used for a model is 1 cm=0.5 m and the scale measurement is 0.25 m, what is the actual measurement?

Solution

First, set up a proportion to change 0.25 m to cm.

100 cm/1 m=x cm/0.25 m

Next, cross multiply to solve for the number of centimeters for the height of the scale model.

100/1=x/0.25

1x=100×0.25

x=25

Next, set up a proportion to find the height of the actual model.

1 cm/0.5 m=25 cm/x m

Then, cross multiply to solve for x.

1/0.5=25/x

1x=0.5×25

x=12.5

The answer is 12.5.

The actual height of the building is 12.5 meters.

Review

Figure out the measurements if the scale is 1 cm=0.5 m.

1. 3.5 m

2. 10 m

3. 6.5 m

4. 0.5 m

5. 2.5 m

6. 2.2 m

7. 4.5 m

8. 4 m

9. 3 m

10. 11 m

Solve each problem.

11. A recipe calls for 400 grams of flour. If Leena makes one quarter of the recipe, how many kilograms of flour will she need?

12. Two buildings are 9 centimeters apart on a map. The scale of the map is 0.5 centimeter=2 kilometers.. What is the actual distance between the two buildings in meters?

13. A scale model of a tower is 1.25 meters tall. The scale of the model is 0.5 cm=5 meters. What is the actual height of the tower in meters?

14. A scale drawing of a conference center includes a meeting room that measures 1.5 centimeters by 2.5 centimeters. If the scale of the drawing is 1 centimeter=2 meters, what is the area of the meeting room in square centimeters?

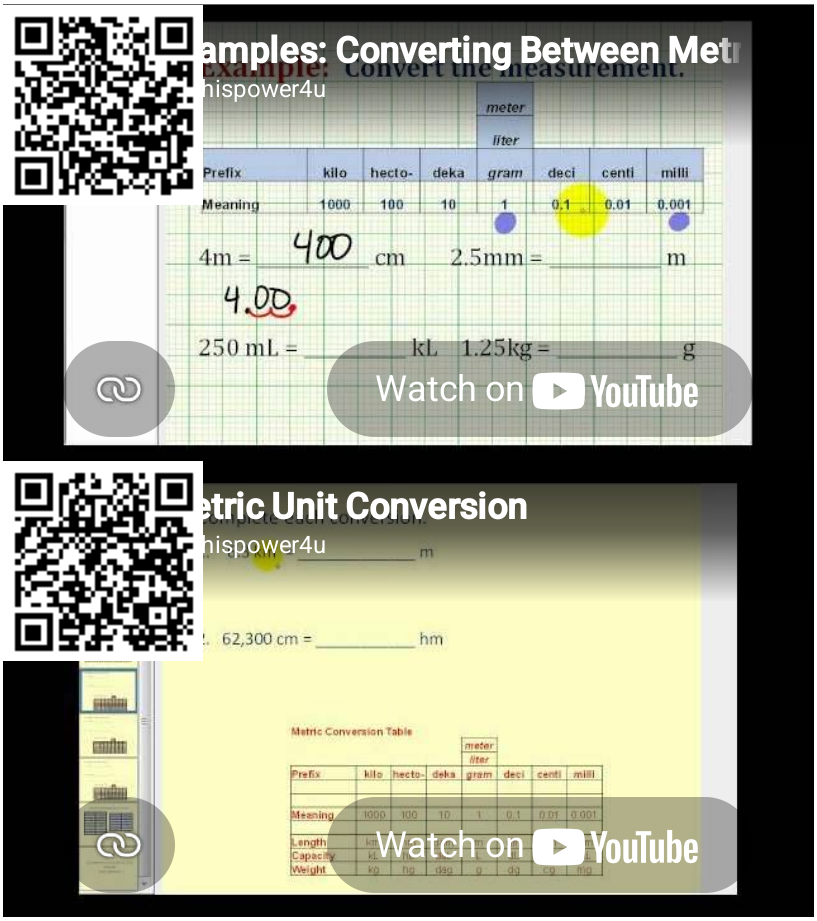
15. Samir ran a race that was 10 kilometers long. About how many meters did Samir run?

Review (Answers)

To see the Review answers, open this PDF file and look for section 4.15.

Additional Resources

Video:



PLIX Interactive: **Meter Menagerie**

Practice: **Convert between Metric Units of Length, Weight, and Capacity**

Real World Application: **Meter Wars**

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3.3.5: Customary and Metric Measurement Conversion

Estimation of Conversion to Metric Units



Figure 3.3.5.1

Billy is on a trip to Canada with his family. He is trying to get used to seeing all of the distances and speed limits on road signs given in terms of kilometers instead of miles! He sees a sign that says “maximum 50 km/h”. He knows that means 50 kilometers per hour, but he wonders if that is a fast speed or a slow speed. How can Billy **estimate** what 50 kilometers per hour would be in miles per hour?

In this concept, you will learn how to estimate **equivalence** between metric and customary units of measure.

Estimating Conversion to Metric Units

Recall that there are two primary systems of measurement that you can use.

1. The **customary system** is the system of measurement primarily used in the United States. Units in this system include the inch, foot, mile, pound, and cup.
2. The **metric system** is the system of measurement primarily used in science and in countries outside of the United States. Units in this system include the meter, liter, and gram.

You will encounter both metric units and customary units. Therefore, it’s important to develop a general idea of the equivalence between the two systems.

The table below shows the approximate metric equivalents for common customary units.

Approximate Metric Equivalents for Common Customary Units

Customary Unit	Metric Unit
1 inch	25.4 millimeters
1 foot	30.48 centimeters
1 yard	0.91 meter
1 mile	1.61 kilometers
1 teaspoon	4.93 milliliters
1 cup	0.24 liter
1 pint	0.47 liter
1 quart	0.95 liter
1 gallon	3.79 liters
1 ounce	28.35 grams
1 pound	0.45 kilogram

Notice how in this table all of the customary units are given in units of 1. So, for example, since 1 foot is about 30.48 centimeters, to convert 2 feet into centimeters just multiply 30.48 by 2 to get 60.96 centimeters. If you had a measurement in centimeters and wanted to estimate the number of inches, you could reverse the process and divide by 30.48.

Often you will just want to get a general idea of what a given measurement would be in the other system of measurement. If this is the case, you can use the table above and your estimation skills to determine an approximate equivalence.

Here is an example.

About how many cups are equal to 0.5 liter?

First, look at the table to see how cups and liters are related. You can see that 1 cup is approximately 0.24 liter.

Now, because you are going from a metric unit to a customary unit, you will need to divide the given value by the metric equivalent from the table. Keep in mind that 0.24 is approximately 0.25, and 0.5 divided by 0.25 is equal to 2.

$$0.5 \div 0.24 \approx 2$$

The answer is there are approximately 2 cups in 0.5 liter.

Remember that this answer is not exact! You're just looking to get a general sense for how the two systems of measurement are related.

Here is another example.

4 kilograms is equal to about how many pounds?

First, look at the table to see how pounds and kilograms are related. You can see that 1 pound is approximately 0.45 kilograms.

Now, because you are going from a metric unit to a customary unit, you will need to divide the given value by the metric equivalent from the table. Keep in mind that 0.45 is approximately 0.5, and 4 divided by 0.5 is equal to 8.

$$4 \div 0.45 \approx 8$$

The answer is there are approximately 8 pounds in 4 kilograms.

Examples

Example 3.3.5.1

Earlier, you were given a problem about Billy and his trip to Canada.

He noticed a sign that said “maximum 50 km/h” and he wonders what 50 kilometers per hour is in miles per hour.

Solution

First, Billy should look to see how miles and kilometers are related. He should notice that 1 mile is approximately 1.61 kilometers.

Now, because he is going from a metric unit to a customary unit, he will need to divide the given value by the metric equivalent. He should keep in mind that 1.61 is approximately 1.6, and 50 divided by 1.6 is equal to about 31.

$$50 \div 1.61 \approx 31$$

The answer is that 50 kilometers per hour is equal to approximately 31 miles per hour. This is a typical speed limit for a residential area.

Example 3.3.5.2

12 teaspoons is equal to about how many milliliters?

Solution

First, look at the table to see how teaspoons and milliliters are related. You can see that 1 teaspoon is approximately 4.93 milliliters.

Now, because you are going from a customary unit to a metric unit, you will need to multiply the given value by the metric equivalent from the table. Keep in mind that 4.93 is approximately 5, and 12 times 5 is equal to 60.

$$12 \times 4.93 \approx 60$$

The answer is there are approximately 60 milliliters in 12 teaspoons.

Example 3.3.5.3

4 gallons is equal to about how many liters?

Solution

First, look at the table to see how gallons and liters are related. You can see that 1 gallon is approximately 3.79 liters.

Now, because you are going from a customary unit to a metric unit, you will need to multiply the given value by the metric equivalent from the table. Keep in mind that 3.79 is approximately 3.75, and 4 times 3.75 is equal to 15.

$$4 \times 3.79 \approx 15$$

The answer is there are approximately 15 liters in 4 gallons.

Example 3.3.5.4

60 centimeters is equal to about how many feet?

Solution

First, look at the table to see how feet and centimeters are related. You can see that 1 foot is approximately 30.48 kilograms.

Now, because you are going from a metric unit to a customary unit, you will need to divide the given value by the metric equivalent from the table. Keep in mind that 30.48 is approximately 30, and 60 divided by 30 is equal to 2.

$$60 \div 30.48 \approx 2$$

The answer is there are approximately 2 feet in 60 centimeters.

Example 3.3.5.5

3 cups is equal to about how many liters?

Solution

First, look at the table to see how cups and liters are related. You can see that 1 cup is approximately 0.24 liter.

Now, because you are going from a customary unit to a metric unit, you will need to multiply the given value by the metric equivalent from the table. Keep in mind that 0.24 is approximately 0.25, and 3 times 0.25 is equal to 0.75.

$$3 \times 0.24 \approx 0.75$$

The answer is there is approximately 0.75 liter in 3 cups.

Review

Estimate a metric equivalent for the following customary measurements.

1. 5 cups to liters
2. 5 yards to meters
3. 6 inches to mm
4. 15 pounds to kg
5. 1 cup to liters
6. 4 miles to km
7. 5 feet to cm
8. 12 feet to cm
9. 8 inches to mm
10. 28.5 ounces to grams
11. 11.75 inches to millimeters
12. 8 quarts to liters
13. 15 pounds to kilograms

Solve the following problems.

14. To join the swim team, Jessica swam every day. The distances she swam for the first four days were as follows: 1.65 km, 1,750 m, 185,000 cm, 1,950,000 mm. If the pattern continues, how many kilometers will she swim on the fifth day?
15. Mrs. Roth is moving to a new apartment. She can lift exactly 22.5 kg. Which of the following objects can she lift: box of books (23,500 g), statue (2,450,000 cg), computer (2,550,000 mg), potted plant (22.55 kg)?

Review (Answers)

To see the Review answers, open this PDF file and look for section 2.23.

Vocabulary

Term	Definition
Customary System	The customary system is the measurement system commonly used in the United States, including: feet, inches, pounds, cups, gallons, etc.
Equivalence	Equivalence is the condition of being equal in value or meaning.
Estimate	To estimate is to find an approximate answer that is reasonable or makes sense given the problem.
Metric System	The metric system is a system of measurement commonly used outside of the United States. It contains units such as meters, liters, and grams, all in multiples of ten.

Additional Resources

Practice: **Customary and Metric Measurement Conversion**

Real World Application: **Crossing the Border**

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3.3.6: Convert Using Unit Analysis

Conversion Using Unit Analysis



Figure 3.3.6.1

Munni and Caras were excited about their upcoming whale-watching trip. They did their research and discovered that some whales can weigh up to 150 tons. Munni's home scale said that he weighed 120. Munni told everyone that he weighed only 30 pounds less than a whale. Was he correct?

In this concept, you will learn to use proportions and unit analysis.

Using Proportions and Unit Analysis

A **proportion** is created when two ratios are found to be equivalent or equal.

1/2=3/6 is a proportion.

A **unit rate** is a comparison of two measurements, one of which has a value of 1.

55 miles/1 hour is a unit rate.

A **unit scale** is a ratio that compares the dimensions of an actual object to the dimensions of a scale drawing or model that represents the actual object.

1 inch/11 feet is a unit scale.

A **standard unit** is one that is most commonly used.

Both the customary and metric systems of measurement include weight (or mass), length, and liquid volume standard units.

Some examples are:

Customary standard weight: 16 ounces = 1 pound

Metric standard length: 1 meter = 100 centimeters

Customary standard liquid: 4 quarts = 1 gallon

These are called **conversion factors** and can be defined as the ratio of a measurement in one unit to the equivalent numerical value in another unit.

The ratio for ounces to pounds is 16:1 or 16 ounces/1 pound.

Standard units of measurement and proportions can be used to convert one unit of measurement to another. The process of converting one unit to another is called **unit conversion**. Units can be converted by using proportions, setting ratios equal to one another, or by unit analysis, multiplying times a standard unit of measure.

Here is an example using proportions.

A pitcher holds 4 liters of water. Determine how many milliliters of water the pitcher holds. Use the unit conversion: 1 liter = 1000 milliliters

First, write the unit conversion as a fraction.

$$1 \text{ liter}/1000 \text{ millimeters}$$

Next, write a ratio that compares the unit as it is given to the unknown converted unit.

Remember that a ratio standing alone can be written with either value in the numerator or denominator, but once it is used in a calculation, it must be formatted accordingly.

Unit to be converted = from 4 liters to x milliliters

This could be written as 4 liters/x millimeters or x millimeters/4 liters.

Then, write a proportion using the correct format. When writing a proportion, the units must be consistent.

$$1 \text{ liter}/1000 \text{ milliliters} = 4 \text{ liters}/x \text{ milliliters is correct.}$$

Next, solve by cross multiplication.

$$x = 4000$$

The answer is x = 4,000 ml.

Another way to solve the same problem is to use unit analysis.

First, write the unit conversion as a fraction.

$$1 \text{ liter}/1000 \text{ milliliters or } 1000 \text{ milliliters}/1 \text{ liter}$$

Next, write a ratio for the unit to be converted.

$$4 \text{ liters}/1$$

When using unit analysis, the correct format will be such that after multiplication, the “from” units will cancel, and the answer will equal the “to” units.

$$4 \text{ liters}/1 \times 1000 \text{milliliters}/1 \text{ liters}$$

Then, cancel liters, and multiply.

$$4 \times 1000 \text{ ml}/1 \times 1 = 4000 \text{ ml}$$

The answer is 4,000 ml.

Examples

Example 3.3.6.1

Earlier, you were given a problem about Munni and Caras, who are going on a whale-watching trip.

Munni said a whale that weighed 150 tons was only 30 more than his weight of 120. Munni forgot the whale’s weight was in tons, and his was in pounds. Find the whale’s weight in pounds.

Solution

First, write the unit conversion as a fraction.

$$2000 \text{ pounds}/1 \text{ ton}$$

Next, write a ratio that compares the unit as it is given to the unknown converted unit.

$$x \text{ pounds}/150 \text{ tons}$$

Then, write a proportion making sure that the units are consistent.

$$2000 \text{ pounds}/1 \text{ ton} = x \text{ pounds}/150 \text{ tons}$$

Next, solve by cross multiplication.

$$x=300{,}000 \text{ pounds}$$

The answer is the whale weighs 300,000 pounds.

Example 3.3.6.2

How many milliliters are there in 2.5 liters? Write a proportion and solve.

Solution

First, write the unit conversion as a fraction.

$$1 \text{ liter}/1000 \text{ milliliters}$$

Next, write a ratio that compares the unit as it is given to the unknown converted unit.

$$2.5 \text{ liters}/x \text{ milliliters}$$

Then, write a proportion making sure that the units are consistent.

$$1 \text{ liter}/1000 \text{ milliliters}=2.5 \text{ liters}/x \text{ milliliters}$$

Next, solve by cross multiplication.

$$X=2500 \text{ ml}$$

The answer is x = 2,500 ml

Example 3.3.6.3

How many meters in 11 kilometers? Write a proportion and solve.

Solution

First, write the unit conversion as a fraction.

$$1000 \text{ m/km}$$

Next, write a ratio that compares the unit as it is given to the unknown converted unit.

$$x \text{ m}/11 \text{ km}$$

Then, write a proportion making sure that the units are consistent.

$$1000 \text{ m/km}=x \text{ m}/11 \text{ km}$$

Next, solve by cross multiplication.

$$X=11{,}000 \text{ m}$$

The answer is x = 11,000 m

Example 3.3.6.4

How many inches are there in 18 feet? Use unit analysis.

Solution

First, write the unit conversion as a fraction.

$$12 \text{ inches}/1 \text{ foot}$$

Next, write a ratio for the unit to be converted.

$$18 \text{ feet}/1$$

Then, cancel units, and multiply.

$$(12 \text{ inches}/1 \text{ foot}) \times (18 \text{ feet}/1) = 216 \text{ inches}$$

The answer is 18 feet = 216 inches.

Example 3.3.6.5

Convert 3 gallons to cups.

Solution

First, choose a method.

Since there is more than one standard unit between gallons and cups, setting up one proportion is not possible without intermediate steps. Use unit analysis.

First, write the unit conversions from gallons to cups as fractions.

$$1 \text{ gallon}/4\text{quarts } 1 \text{ quart}/2 \text{ pints } 1 \text{ pint}/4 \text{ cups}$$

Next, write a ratio for the unit to be converted.

$$3 \text{ gallons}/1$$

Then, set up a multiplication problem being sure to cancel unwanted units.

$$(3 \text{ gallons}/1) \times (4 \text{ quarts}/1 \text{ gallon}) \times (2 \text{ pints}/1 \text{ quart}) \times (4 \text{ cups}/1 \text{ pint})$$

Next, cancel units and multiply.

$$(3 \times 4 \times 2 \times 4 \text{ cups})/(1 \times 1 \times 1 \times 1) = 96 \text{ cups}$$

The answer is 3 gallons = 96 cups.

Review

Use unit analysis to solve each problem.

1. How many feet in 1 mile?
2. How many feet in 18.5 miles?
3. How many milliliters in 3.75 liters?
4. How many milliliters in 18.25 liters?
5. How many pounds in 3 tons?
6. How many pounds in 2.5 tons?
7. How many pounds in 4.75 tons?
8. How many feet in 18 yards?
9. How many inches in 4 feet?
10. How many inches in 8.75 feet?
11. How many milliliters in 29.5 liters?

Solve each problem.

12. Fred needs to buy vanilla extract to bake a cake. He could buy a 4-ounce bottle of vanilla extract for $8, or a 6-ounce bottle of vanilla extra for $15. Which bottle is the better buy?
13. A rope is 3 yards long. How many inches long is the rope? Use these unit conversions: 1 yard = 3 feet and 1 foot = 12 inches.
14. At the farmer's market, Maureen can buy 6 ears of corn for $3. At that price, how much would it cost to buy 9 ears of corn?
15. James bought a 128-ounce bottle of apple juice. How many pints of apple juice did James buy? Use these unit conversions: 1 cup = 8 fluid ounces and 1 pint = 2 cups.

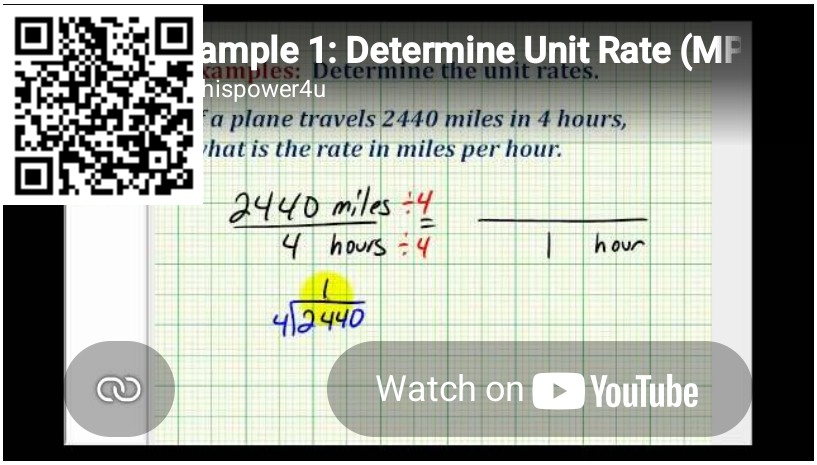
Review (Answers)

To see the Review answers, open this PDF file and look for section 5.15.

Additional Resources

PLIX Interactive: **The Price of a Unit**

Video:



Practice: **Convert Using Unit Analysis**

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CHAPTER OVERVIEW

4: Length

4.1: Determine Customary Lengths

4.1.1: Length in Inches

4.1.2: Compare Length in Inches

4.1.3: Estimate by Inches and Feet

4.1.4: Measure and Estimate in Feet and Yards

4.1.5: Differences in Inches, Feet, and Yards

4.1.6: Estimate the Measure in Inches, Feet, and Yards

4.1.7: Distances Greater Than or Less Than a Foot or a Yard

4.1.8: Measurement of Length to a Fraction of an Inch

4.2: Convert Customary Lengths

4.2.1: Convert Inches to Feet

4.2.2: Convert Feet to Inches

4.2.3: Convert Inches to Yards

4.2.4: Convert Feet to Yards

4.2.5: Convert Yards to Feet

4.2.6: Convert between Yards and Miles

4.2.7: Convert Miles to Feet

4.2.8: Convert between Inches, Feet and Yards

4.2.9: Mixed Unit Comparison

4.2.10: Conversion Applications

4.3: Customary Length Operations

4.3.1: Determine Distance Using Addition

4.3.2: Add Unit Length Applications.

4.3.3: Subtract Unit Lengths

4.3.4: Add and Subtract Unit Lengths

4.3.5: Length Comparison Applications

4.3.6: Multiply Unit Lengths

4.3.7: Divide Unit Lengths

4.4: Compound Customary Units of Length

4.4.1: Add and Subtract to Solve Compound Unit Problems

4.4.2: Add and Subtract to Solve Compound Unit Applications

4.4.3: Compare Compound Units

4.4.4: Order Compound Units - Ascending

4.4.5: Order Compound Units- Descending

4.5: Metric Units of Length

4.5.1: Meters

4.5.2: Centimeters

4.5.3: Estimate and Compare Meters and Centimeters

4.5.4: Metric Length Comparison in Meters, Centimeters and Millimeters

4.6: Convert and Compare Metric Units of Length
4.6.1: Meter, Centimeter Conversions
4.6.2: Meter, Kilometer Conversions
4.6.3: Centimeter, Millimeter Conversions
4.6.4: Meter Millimeter Conversions
4.6.5: Multiple Metric Conversions
4.6.6: Higher Order Metric Conversions
4.6.7: Appropriate Decimal Units for Metric Measurement
4.7: Metric Length Operations
4.7.1: Metric Addition
4.7.2: Add Metric Lengths and Distances
4.7.3: Metric Subtraction
4.7.4: Applications of Metric Addition and Subtraction
4.7.5: Metric Multiplication
4.7.6: Metric Division
4.7.7: Metric Multiplication and Division
4.7.8: Multi-Operation and Multi-Step Metric Problems
4.7.9: Multi-Operation and Multi-Step Metric Applications
4.7.10: Compound Metric Units of Length
4.8: Scale
4.8.1: Find Scale Dimensions
4.8.2: Find Scale or Actual Dimensions
4.8.3: Find Actual Dimensions
4.8.4: Find the Scale Factor

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4.1.1: Length in Inches

4.1.2: Compare Length in Inches

4.1.3: Estimate by Inches and Feet

4.1.4: Measure and Estimate in Feet and Yards

4.1.5: Differences in Inches, Feet, and Yards

4.1.6: Estimate the Measure in Inches, Feet, and Yards

4.1.7: Distances Greater Than or Less Than a Foot or a Yard

4.1.8: Measurement of Length to a Fraction of an Inch

4.1.1: Length in Inches

Resources

Video:

Single Object Length (English Units)

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Practice: **Length in Inches**

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4.1.2: Compare Length in Inches

Resources

Video:

Multiple Object Lengths (English Units)

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Practice: **Compare Length in Inches**

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4.1.3: Estimate by Inches and Feet

Resources

Video:

Estimating the Measure of Objects by Image: Feet or Inches?

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Practice: **Estimate by Inches and Feet**

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4.1.4: Measure and Estimate in Feet and Yards

Resources

Video:

Single Object Length II (English Units)

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Practice: **Measure and Estimate in Feet and Yards**

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4.1.5: Differences in Inches, Feet, and Yards

Resources

Video:

Visual Differences in Length (English Units)

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Practice: **Differences in Inches, Feet, and Yards**

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4.1.6: Estimate the Measure in Inches, Feet, and Yards

Resources

Video:

Estimating the Measure of Items by Description: Inches, Feet, or Yards?

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Practice: **Estimate the Measure in Inches, Feet, and Yards**

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4.1.7: Distances Greater Than or Less Than a Foot or a Yard

Resources

Video:

Measurement: Greater Than or Less Than a Yard?

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Request ID: FAJpm0PbNomgaOGXg08AqIwpq5fFqEjYSI15kDhu7IV4caUn1kRPiA==
```

Practice: **Distances Greater Than or Less Than a Foot or a Yard**

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4.1.8: Measurement of Length to a Fraction of an Inch

Measurement of Distance

Have you ever stood at one end of a road and wondered how far it was to the other end of it? If you have ever asked this question on a road or in a field or on a trail, then you are working with distance. You can measure a distance in a lot of different ways - you can use miles, kilometers, feet or yards. Think back in time. Can you imagine crossing the plains in a covered wagon when you didn't know how far a distance you were going to travel? Now think about it today. You can use a map or the computer to calculate distances and that information makes a road trip today easy to manage.

Here are some additional resources that provide a more in-depth exploration of this topic.

Additional Resources

PLIX Interactive: **What's in an Inch?**

Video:



Practice: **Measurement of Length to a Fraction of an Inch**

Real World Application: **Inching Along**

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4.2.1: Convert Inches to Feet

4.2.2: Convert Feet to Inches

4.2.3: Convert Inches to Yards

4.2.4: Convert Feet to Yards

4.2.5: Convert Yards to Feet

4.2.6: Convert between Yards and Miles

4.2.7: Convert Miles to Feet

4.2.8: Convert between Inches, Feet and Yards

4.2.9: Mixed Unit Comparison

4.2.10: Conversion Applications

4.2.1: Convert Inches to Feet

Resources

Video:

Converting Inches to Compound Units

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Request ID: mAN1TUsoCyMZs4jAaJXOxhlt_TwHy5SuKRD128HGX1P3z9SNTp0eRw==
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Practice: **Convert Inches to Feet**

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4.2.2: Convert Feet to Inches

Resources

Video:

Converting Compound Units to Inches

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Request ID: LG_dp4UcyDCXo0GlUWP9hKbbojFDYTmqcVZnyUwflD_I_7GgF3NS7A==
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Practice: **Convert Feet to Inches**

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4.2.3: Convert Inches to Yards

Resources

Video:

Converting Inches to Yards

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Request ID: kUeLYWDlGuazbCUW-YA5NOrUhW81gA1dYzOYWU0DSx3d8DxbDvNvfA==
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Practice: **Convert Inches to Yards**

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4.2.4: Convert Feet to Yards

Resources

Video:

Converting Feet to Yards

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Practice: **Convert Feet to Yards**

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4.2.5: Convert Yards to Feet

Resources

Video:

Using Symbol Maps with Compound Units (English Lengths and Distances)

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Request ID: 0gsdaZBSovcTO8ufu4RwvYZiZzfk98wDN0yruTH3Bj5mDtKmrgAWOw==
```

Practice: **Convert Yards to Feet**

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4.2.6: Convert between Yards and Miles

Resources

Video:

Converting Yards to Miles

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Request ID: N0Qx14gUm1Xbb8C0zg1KyqB_qucR1BYkGEtwyPjXkzJEfKoNz_uMcw==
```

Practice: **Convert between Yards and Miles**

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4.2.7: Convert Miles to Feet

Resources

Video:

Converting Miles to Feet

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Request ID: NXXtSkVz9G60NjzNCM2hEvr8Yzs9W0s49k2TbdQnEiPQZn9t-MljGg==
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Practice: **Convert Miles to Feet**

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4.2.8: Convert between Inches, Feet and Yards

Resources

Video:

Completing Conversion Tables

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Request ID: VSnSmHRA9Uh8X-mDCY-kL8Sw2w4f7u3-L16eGnPtHwmtkiR5MpywoA==
```

Practice: **Convert between Inches, Feet and Yards**

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Resources

Mixed Units: Which is Shortest?

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Request ID: AcdBZeJNbib0OjIMmYCqAPiSY-aVwFw6n9zneft2I1UIuN3IXAv5og==
```

Practice: **Mixed Unit Comparison**

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4.2.10: Conversion Applications

Resources

Video:

Conversion Word Problems (English Units)

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Request ID: MaB0f39_dhSPWmnF9BS_7p0ILB4yAw4yyQ1J5SEx99unU8jAy-eKFw==
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Practice: **Conversion Applications**

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4.3.1: Determine Distance Using Addition

4.3.2: Add Unit Length Applications.

4.3.3: Subtract Unit Lengths

4.3.4: Add and Subtract Unit Lengths

4.3.5: Length Comparison Applications

4.3.6: Multiply Unit Lengths

4.3.7: Divide Unit Lengths

4.3.1: Determine Distance Using Addition

Resources

Video:

Using Symbol Maps (English Lengths and Distances)

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Request ID: NwNiUFsvjWWs9blvMZZF_TlCSiWK10XDk6tnQU51vOLsnUh3Gceuvg==
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Practice: **Determine Distance Using Addition**

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4.3.2: Add Unit Length Applications.

Resources

Video:

Adding Unit Lengths in One Step (English Units)

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Request ID: gl7QxdRnrzas4SEzUlkgnB50vRcdvhMwX1wlTCv9WXlx3ZTHBxdqXg==
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Practice: **Add Unit Length Applications.**

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4.3.3: Subtract Unit Lengths

Resource

Video:

Differences in Label Lengths (English Units)

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Request ID: A1sy7A8sMgLy9d9pISGkJPB8-HTQIbQVxlR4tKP4wPflKM1MFKEvBA==
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4.3.4: Add and Subtract Unit Lengths

Resources

Video:

Adding and Subtracting Lengths in Two Steps (English Units)

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Request ID: BTTRCerqLxSXGh9hKUBxqz0Y8osqnm3vVHfUMOFhVic-njYK93DYBw==
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Practice: **Add and Subtract Unit Lengths**

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4.3.5: Length Comparison Applications

Resources

Video:

Length Comparisons Using Data Tables (English Units)

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Request ID: QbUPwXnCWsxvcfZNsVyETKS-Yf2qjnutwz2ztApaObVdF-jegah7VA==
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Practice: **Length Comparison Applications**

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4.3.6: Multiply Unit Lengths

Resources

Video:

Multiplying Lengths (English Units)

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Request ID: 7P7Bx5FpgtlLGRSh7BtCmakNEWXeVLlZg98Kg05NRfiEtrgXiLL_lQ==
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Practice: **Multiply Unit Lengths**

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4.3.7: Divide Unit Lengths

Resources

Video:

Dividing Lengths (English Units)

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Request ID: eqWBKdH5b5F6PWaKyPaBGl8n_i2hN7CeZFKf0EJcdB_smoGKA_GuIA==
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Practice: **Divide Unit Lengths**

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4.4.1: Add and Subtract to Solve Compound Unit Problems

4.4.2: Add and Subtract to Solve Compound Unit Applications

4.4.3: Compare Compound Units

4.4.4: Order Compound Units - Ascending

4.4.5: Order Compound Units- Descending

4.4.1: Add and Subtract to Solve Compound Unit Problems

Resources

Video:

Adding of Compound Units of Length (English Units)

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Request ID: qjoemF9noX60s0cCdMG4D3XZVMkcqt3KcAlFaao2OQfQ4y1dbDhKjQ==
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Practice: **Add and Subtract to Solve Compound Unit Problems**

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4.4.2: Add and Subtract to Solve Compound Unit Applications

Resources

Video:

Total Length in Compound Units (English Units)

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Request ID: zz1lDd5q1MZshtRGJ6KFYyYWK_s3v18IHhfaQj3eSAc_Owgr_QUGGg==
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Practice: **Add and Subtract to Solve Compound Unit Applications**

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4.4.3: Compare Compound Units

Resources

Video:

Greater or Less Than Comparisons of Length (English Units)

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Request ID: r2UMbZIUHAUBKyfHp4A8i84BTLX1q2xqRv1OTcKeign9hmz7LOGXgA==
```

Practice: **Compare Compound Units**

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4.4.4: Order Compound Units - Ascending

Resources

Video:

Which Compound Unit is Longest? (English Units)

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Request ID: dMZUS6lJuLWJC3uWGX3UE31iHPfe-diczkEqGR6Njhf5tlT4P9Qn9A==
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Practice: **Order Compound Units - Ascending**

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4.4.5: Order Compound Units- Descending

Resources

Video:

Which Compound Unit is Shortest? (English Units)

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Generated by cloudfront (CloudFront)
Request ID: oR68Gxae9N2adn0vs4S8R7HlpaHY8sZhz_Ql0uCuscdTxb-Nrnn7JQ==
```

Practice: **Order Compound Units- Descending**

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4.5.1: Meters

4.5.2: Centimeters

4.5.3: Estimate and Compare Meters and Centimeters

4.5.4: Metric Length Comparison in Meters, Centimeters and Millimeters

4.5.1: Meters

Resources

Video:

Introduction to Metric Measures: How Big is a Meter?

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Request ID: 0YDMmvaoabYweFoG7Y-0cXK12ezjbAc3hQBwSc_KCZm6pxHCe7viyA==
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Practice: **Meters**

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4.5.2: Centimeters

Resources

Video:

Comparing Lengths in Centimeters Using a Ruler

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Request ID: UEdT8PVXkE2smlzPBVaiOL5Fl5vgOYhNiAe2pTp-V-kG4GcuNhQQTA==
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Practice: **Centimeters**

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4.5.3: Estimate and Compare Meters and Centimeters

Resources

Video:

Estimating the Measure of Objects by Image: Centimeters or Meters?

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Request ID: VENBpTbqRpSyCfKJn7zXVpkTByrTTXB2lAoM9HWlH2o6abFMOj41mw==
```

Practice: **Estimate and Compare Meters and Centimeters**

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4.5.4: Metric Length Comparison in Meters, Centimeters and Millimeters

Metric Length Comparison



Figure 4.5.4.1

Juliana wants to build a doghouse. She has a few long pieces of wood. Her instructions say that she needs to cut one of the boards in to a piece that is 200 centimeters long, but she only has a meter stick. She wants to figure out if she can measure the entire length using only the meter stick. How can she compare the 200 cm to the meter stick?

In this concept, you will learn how to compare measurements that have different units.

Comparing Measurements of Different Units

The word **equivalent** means equal.

Here is a measurement chart of equivalent measurements.

$$1 \text{ cm} = 10 \text{ mm}$$

$$1 \text{ m} = 100 \text{ cm}$$

$$1 \text{ m} = 1000 \text{ mm}$$

$$1 \text{ km} = 1000 \text{ m}$$

Let’s say that you wanted to compare two different units to figure out which is greater and which is less. You can use the chart to help you.

5 cm _____ 70 mm

The first thing that you need to do is convert the measurements so that the unit of measurement is the same.

You need to have either all mm or all cm. It doesn’t matter which one you choose, as long as it is the same unit. Let’s use cm.

$$70 \text{ mm} = \_\_\_\_\_ \text{ cm}$$

$$70 \div 10 = 7$$

70 mm = 7 cm.

Let’s rewrite the problem.

5 cm _____ 7 cm

Use greater than >, less than < or equal to = to compare the measurements.

5 cm < 7 cm

The answer is 5 cm < 70 mm.

Let's try an example.

7000 m _____ 8 km

Here you have two different units of measurement. You have meters and kilometers.

First, convert both to the same unit. Let’s convert to meters this time.

8 km = 8 × 1000 = 8000 m

Then, compare.

7000 m < 8000 m

The answer is 7000 m is less than 8 km.

Examples

Example 4.5.4.1

Earlier, you were given a problem about Juliana's doghouse.

She needs to measure 200 cm, and she only has a meter stick. How does 200 cm compare to 1 m?

200 cm _____ 1 meter

Solution

First, decide which unit of measurement you would like to use.

m

Next, convert cm to m.

200 cm ÷ 100 = 2 m

Then, compare the two measurements.

2 m > 1 m

The answer is that 2 m is greater than 1 m. Juliana can measure 200 cm with the meter stick, but she would need to use the meter stick twice.

Example 4.5.4.2

Convert and compare the pair of measurements.

12 m _____ 1000 mm

Solution

First, decide which unit of measurement you would like to use.

mm

Next, convert the m to mm.

12 m × 1000 = 12,000mm

Then, compare the measurements.

12,000 mm > 1000 mm

The answer is 12 m is greater than 1000 mm.

Example 4.5.4.3

Convert and compare the pair of measurements.

7 m _____ 7000 mm

Solution

First, decide which unit of measurement you would like to use.

mm

Next, convert the m to mm.

7 m × 1000 = 7000mm

Then, compare the two measurements.

7000 m = 7000 m

The answer is that 7m is equal to 7000 mm.

Example 4.5.4.4

Convert and compare the pair of measurements.

3 km _____ 3300 m

Solution

First, decide which unit of measurement you would like to use.

m

Next, convert the km to m.

3 km × 1000 = 3000 m

Then, compare the two measurements.

3000 m < 3300 m

The answer is that 3 km is less than 3300 m.

Example 4.5.4.5

Convert and compare the pair of measurements.

1000 mm _____ 20 cm

Solution

First, decide which unit of measurement you would like to use.

cm

Next, convert mm to cm

1000 mm ÷ 10 = 100 cm

Then, compare the two measurements.

100 cm > 20 cm

The answer is 1000 mm is greater than 20 cm.

Review

Compare metric lengths using <, >, or =

1. 6 cm _____ 60 mm
2. 8 cm _____ 90 mm
3. 10 mm _____ 4 cm
4. 40 mm _____ 6 cm
5. 5 km _____ 4000 m
6. 7 km _____ 7500 m
7. 11 m _____ 1200 cm
8. 9 km _____ 9000 m
9. 100 mm _____ 750 cm

10. 18 km _____ 1500 m
11. 1000 m _____ 19 km
12. 10 m _____ 100 cm
13. .25 m _____ 1 km
14. 6 km _____ 6000 m
15. 7 km _____ 8000 m

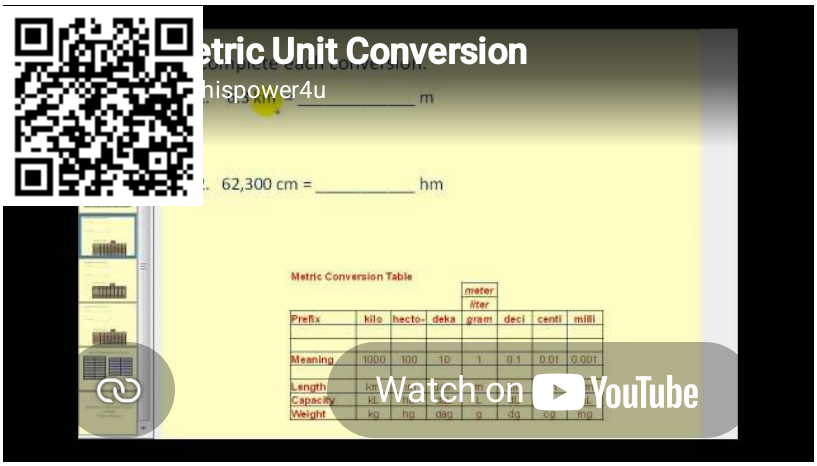
Review (Answers)

To see the Review answers, open this PDF file and look for section 3.9.

Additional Resources

PLIX Interactive: **Meter Menagerie**

Video:



Practice: **Metric Length Comparison in Meters, Centimeters and**

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4.6.1: Meter, Centimeter Conversions

4.6.2: Meter, Kilometer Conversions

4.6.3: Centimeter, Millimeter Conversions

4.6.4: Meter Millimeter Conversions

4.6.5: Multiple Metric Conversions

4.6.6: Higher Order Metric Conversions

4.6.7: Appropriate Decimal Units for Metric Measurement

4.6.1: Meter, Centimeter Conversions

Resources

Video:

Converting Meters to Centimeters

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Practice: **Meter, Centimeter Conversions**

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4.6.2: Meter, Kilometer Conversions

Resources

Video:

Converting Kilometers to Meters

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Practice: **Meter, Kilometer Conversions**

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4.6.3: Centimeter, Millimeter Conversions

Resources

Video:

Converting Centimeters to Millimeters

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```

Practice: **Centimeter, Millimeter Conversions**

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4.6.4: Meter Millimeter Conversions

Resources

Video:

Converting Meters to Millimeters

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Practice: **Meter Millimeter Conversions**

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4.6.5: Multiple Metric Conversions

Equivalent Metric Units of Length



Figure 4.6.5.1

Corey measures the distance between two trees in his backyard. He finds that the measurement is 8 meters, but he wants to express the measurement in centimeters. How many centimeters are in 8 meters?

In this concept, you will learn how to convert with metric units of measurements.

Converting Using Whole Number Values

Length measures how long something is from one end to the other end.

Here are the common metric units of **length** from smallest to largest.

A **millimeter** is the smallest unit. Millimeters are most useful when measuring really tiny things. You can find millimeters on some rulers.

A **centimeter** is the next smallest unit. Centimeters can also be found on a ruler.

A **meter** is a little more than 3 feet.

A **kilometer** is used to measure longer distances.

Here is a chart to help with the conversions.

$$1 \text{ km} = 1000 \text{ m}$$

$$1 \text{ m} = 100 \text{ cm}$$

$$1 \text{ cm} = 10 \text{ mm}$$

Now that you know the conversions, you can change one unit to another unit.

5 km = ____ m

You can convert larger units to smaller units by multiplying. There are 1000 meters in one kilometer.

$$5 \text{ km} = \_\_\_\_\_ \text{ m}$$

$$5 \times 1000 = 5000 \text{ m}$$

The answer is 5000 m.

Here's an example of converting smaller units to larger units.

600 cm = _____ m

You can convert smaller units to larger units by dividing. There are 100 cm in one meter.

$600 \div 100 = 6$

The answer is 6 m.

Examples

Example 4.6.5.1

Earlier, you were given a problem about Corey's measurement of his tree.

His measurement is 8 meters, but he wants to convert it to centimeters. How many centimeters are equal to 8 meters?

8 m = _____ cm

Solution

First, determine if the conversion is from smaller units to larger units or larger units to smaller units.

Larger to smaller

Next, perform the appropriate operation.

8 × 100

Then, write the value.

800

The answer is 800 cm. The distance between the two trees is 800 cm.

Example 4.6.5.2

Find the equivalent metric measurement.

6 m = _____ mm

Solution

First, determine if the conversion is from smaller units to larger units or larger units to smaller units.

Larger to smaller

Next, perform the appropriate operation.

6 × 1000

Then, write the value.

6000

The answer is 6000 mm.

Example 4.6.5.3

Find the equivalent metric measurement.

2000 mm = _____ cm

Solution

First, determine if the conversion is from smaller units to larger units or larger units to smaller units.

Smaller to larger

Next, perform the appropriate operation.

2000 ÷ 10

Then, write the value.

200

The answer is 200 cm.

Example 4.6.5.4

Find the equivalent metric measurement.

3 km = _____ m

Solution

First, determine if the conversion is from smaller units to larger units or larger units to smaller units.

Larger to smaller

Next, perform the appropriate operation.

3×1000

Then, write the value.

3000

The answer is 3000 m.

Example 4.6.5.5

Find the equivalent metric measurement.

4000 cm = _____ m

Solution

First, determine if the conversion is from smaller units to larger units or larger units to smaller units.

Smaller to larger

Next, perform the appropriate operation.

$4000 \div 100$

Then, write the value.

40

The answer is 40 m.

Review

Complete the following metric equivalents.

1. 6 km = _____ m
2. 5 m = _____ cm
3. 100 cm = _____ m
4. 400 cm = _____ m
5. 9 km = _____ m
6. 2000 m = _____ km
7. 20 mm = _____ cm
8. 8 cm = _____ mm
9. 900 cm = _____ m
10. 12 m = _____ cm
11. 10 cm = _____ mm
12. 100 cm = _____ mm
13. 6700 m = _____ km
14. 8200 m = _____ km
15. 12,500 m = _____ km

Review (Answers)

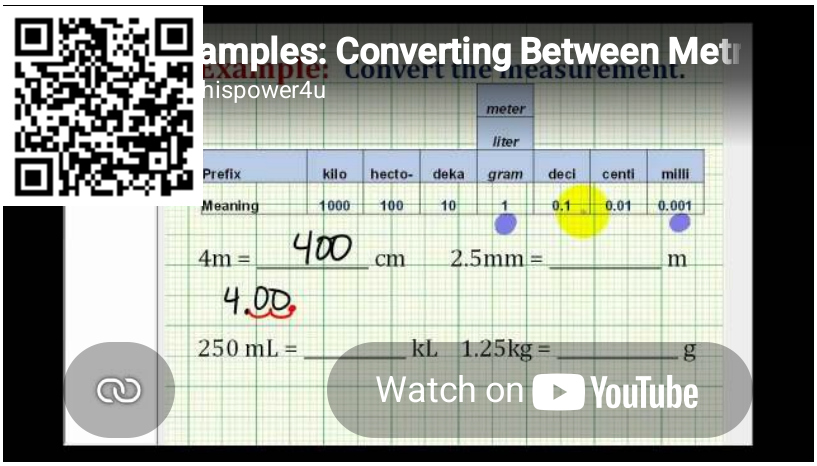
To see the Review answers, open this PDF file and look for section 3.5.

Vocabulary

Term	Definition
Centimeter	A centimeter is a very small unit of metric measure. A centimeter is one hundredth of one meter.
Kilometer	A kilometer is a common metric unit of length that is equal to 1,000 meters.
Length	Length is a measurement of how long something is. Examples of customary units of length are inches, feet, yards and miles.
Meter	A meter is a common metric unit of length that is slightly larger than a yard.
Metric System	The metric system is a system of measurement commonly used outside of the United States. It contains units such as meters, liters, and grams, all in multiples of ten.
Millimeter	A millimeter is the smallest common metric unit of length.

Additional Resources

Video:



PLIX Interactive: **Equivalent Metric Units of Length: City Blocks**

Practice: **Multiple Metric Conversions**

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4.6.6: Higher Order Metric Conversions

Comparison of Metric Measurements



Figure 4.6.6.1

Sarah and Laura both just joined the track team at school. So far they are really enjoying it! They are training for a meet next weekend where they will both be competing in long distance running events. Their coach told Sarah that she will be running in the 5000 m event. Laura will be running the 10k. At first, Sarah and Laura aren't sure what this means. How can they figure out who will be running the longer distance?

In this concept, you will learn how to compare given metric units of measure.

Comparing Metric Measurements

Sometimes you will want to compare different metric measurements. Knowing how to convert between metric units of measure and how to compare decimal numbers makes this possible.

You can compare two metric measurements in the same way that you compare decimal numbers. You just have to make sure that your measurements are in the same unit first.

Here are the steps for comparing metric measurements.

1. If necessary, convert one of the measurements so that both measurements are in the same unit.
2. Working from left to right, compare digits that have the same place value. Starting with the digit on the left and moving right, whichever number first has a larger digit is the larger number overall.

You can use an inequality symbol to show how two metric measurements are related.

Here is an example.

$$4.56 \text{ g} \_\_\_\_\_ 456 \text{ mg}$$

First, you want both measurements to be in the same unit. It doesn't matter which unit you convert. Let's convert 4.56 g to mg.

Now, notice that you are going from a larger unit to a smaller unit. This means you will need to multiply and move the decimal point to the right. Because there are 1000 milligrams in a gram, you will need to move the decimal point 3 to the right.

$$4.56 \times 1000 = 4560$$

$$4.56 \text{ g} = 4560 \text{ mg}$$

Next, rewrite your problem with both measurements in the same unit.

$$4560 \text{ mg} \_\_\_\_\_ 456 \text{ mg}$$

Now, compare the two numbers. 4560 has a digit in the thousands place while 456 does not. 4560 is the bigger number. This means 4560 milligrams is more than 456 milligrams, so 4.56 grams is more than 456 milligrams.

The answer is 4.56 g>456 mg.

Examples

Example 4.6.6.1

Earlier, you were given a problem about Sarah and Laura's upcoming track meet.

Sarah will be running the 5000 m while Laura will be running the 10K. They are wondering who will have to run the longer distance.

Solution

First, Sarah and Laura need to know that 10K means 10 kilometers. With running races, the letter “K” is often used to mean kilometer. So they are comparing 5000 meters with 10 kilometers.

$$5000 \text{ m} \_\_\_\_\_ 10 \text{ km}$$

Now, the girls will need both measurements to be in the same unit. They can convert 5000 meters to kilometers. Because there are 1000 meters in a kilometer, they will need to divide and move the decimal point 3 to the left.

$$5000/1000=5$$

$$5000 \text{ m}=5 \text{ km}$$

Next, they can rewrite the problem with both measurements in the same unit.

$$5 \text{ km} \_\_\_\_\_ 10 \text{ km}$$

Now, they can compare the two numbers. 5 is less than 10. This means 10 kilometers is more than 5 kilometers, so 10 kilometers is more than 5000 meters.

The answer is the 10K that Laura will be running is longer than the 5000 m that Sarah will be running.

Example 4.6.6.2

$$743 \text{ km} \_\_\_\_\_ 74{,}300{,}000 \text{ mm}$$

Solution

First, you want both measurements to be in the same unit. It doesn’t matter which unit you convert. Let’s convert 74,300,000 mm to km.

Now, notice that you are going from a smaller unit to a larger unit. This means you will need to divide and move the decimal point to the left. Because there are 1,000,000 millimeters in a kilometer (1,000 millimeters in a meter and 1,000 meters in a kilometer means $1{,}000 \times 1{,}000 = 1{,}000{,}000$ millimeters in a kilometer), you will need to move the decimal point 6 to the left.

$$74{,}300{,}000/1{,}000{,}000=74.3$$

$$74{,}300{,}000 \text{ mm}=74.3 \text{ km}$$

Next, rewrite your problem with both measurements in the same unit.

$$743 \text{ km} \_\_\_\_\_ 74.3 \text{ km}$$

Now, compare the two numbers. 743 km has a digit in the hundreds place while 74.3 does not. 743 is the bigger number. This means 743 kilometers is more than 74.3 kilometers, so 743 kilometers is more than 74,300,000 millimeters.

The answer is $743 \text{ km} > 74{,}300{,}000 \text{ mm}$.

Example 4.6.6.3

$$45 \text{ cm} \_\_\_\_\_ 500 \text{ mm}$$

Solution

First, you want both measurements to be in the same unit. It doesn’t matter which unit you convert. Let’s convert 500 mm to cm.

Now, notice that you are going from a smaller unit to a larger unit. This means you will need to divide and move the decimal point to the left. Because there are 10 millimeters in a centimeter, you will need to move the decimal point 1 to the left.

$$500/10=50$$

$$500 \text{ mm}=50 \text{ cm}$$

Next, rewrite your problem with both measurements in the same unit.

$$45 \text{ cm} \_\_\_\_\_ 50 \text{ cm}$$

Now, compare the two numbers. Both numbers start with a digit in the tens place. 5 is greater than 4. This means 45 centimeters is less than 50 centimeters, so 45 centimeters is less than 500 millimeters.

The answer is 45 cm<500 mm.

Example 4.6.6.4

2 km _____ 400 m

Solution

First, you want both measurements to be in the same unit. It doesn't matter which unit you convert. Let's convert 400 m to km.

Now, notice that you are going from a smaller unit to a larger unit. This means you will need to divide and move the decimal point to the left. Because there are 1000 meters in a kilometer, you will need to move the decimal point 3 to the left.

$$400/1000=0.4$$

$$400 \text{ m}=0.4 \text{ km}$$

Next, rewrite your problem with both measurements in the same unit.

$$2 \text{ km} \_\_\_\_\_ 0.4 \text{ km}$$

Now, compare the two numbers. 2 is greater than 0.4. This means 2 kilometers is greater than 0.4 kilometers, so 2 kilometers is greater than 400 meters.

The answer is 2 km>400 m.

Example 4.6.6.5

6 L _____ 60,000 mL

Solution

First, you want both measurements to be in the same unit. It doesn't matter which unit you convert. Let's convert 60,000 mL to L.

Now, notice that you are going from a smaller unit to a larger unit. This means you will need to divide and move the decimal point to the left. Because there are 1000 milliliters in a liter, you will need to move the decimal point 3 to the left.

$$60{,}000/1000=60$$

$$60{,}000 \text{ mL}=60 \text{ L}$$

Next, rewrite your problem with both measurements in the same unit.

$$6\text{L} \_\_\_\_\_ 60\text{L}$$

Now, compare the two numbers. 60 is greater than 6. This means 6 liters is less than 60 liters, so 6 liters is less than 60,000 milliliters.

The answer is 6 L<60,000 mL.

Review

Compare or order the following measurements. Write <, >, or = for each blank.

1. 14 km _____ 56 m
2. 1.23 m _____ 123 km
3. 3.4 km _____ 340 m
4. 18 g _____ 0.18 kg
5. 27 m _____ 2700 km
6. 14 l _____ 2100 ml
7. 5 g _____ 0.0005 kg
8. 18 mm _____ 0.18 cm
9. 2.3 km _____ 2700 m
10. 3.48 cl _____ 0.348 l
11. 57.21 kg _____ 572,100 cg
12. 91.17 mm _____ 0.09117 m
13. 4.4 cl _____ 0.44 ml
14. Order the following measurements from least to greatest: 79,282 kg, 7,838,200 cg, 7,938,200 mg, 79,382 g.
15. Order the following measurements from least to greatest: 2,261,000 cl, 21,061 l, 21.06 kl, 21,161,000 ml.

Review (Answers)

To see the Review answers, open this PDF file and look for section 2.22.

Vocabulary

Term	Definition
Customary System	The customary system is the measurement system commonly used in the United States, including: feet, inches, pounds, cups, gallons, etc.
Equivalence	Equivalence is the condition of being equal in value or meaning.
Estimate	To estimate is to find an approximate answer that is reasonable or makes sense given the problem.
Metric System	The metric system is a system of measurement commonly used outside of the United States. It contains units such as meters, liters, and grams, all in multiples of ten.

Additional Resources

PLIX Interactive: **Comparison of Metric Measurements: Millimeters and** (...)

Video:

Compare Compound Unit Weights in kg and g - Overview

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Practice: **Higher Order Metric Conversions**

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4.6.7: Appropriate Decimal Units for Metric Measurement

Metric Unit Length Conversions



Figure 4.6.7.1

Mustafa is planning to run a 5k race. In order to prepare for the race, he has been running each day. At the end of the first week, he runs 575 meters without stopping. He tries to figure out how that translates in kilometers so he converts 575 meters to kilometers. How many kilometers are equal to 575 meters?

In this concept, you will learn how to find equivalent metric measurements.

Converting Using Decimal Numbers

Sometimes when you convert metric units you don't have a whole number answer. When this happens, you end up with an answer that is a decimal.

Let's work through an example.

1 mm = _____ cm

Since you are converting a smaller unit to a larger unit, you are going to divide. There are 10 mm in one **centimeter**, so you are going to divide 1 by 10. You are dividing 1 whole into 10 parts.

1 ÷ 10 = 0.1 (one-tenth)

The answer is 0.1 cm.

Examples

Example 4.6.7.1

Earlier, you were given a problem about Mustafa and the race.

What is 575 meters in kilometers?

Solution

Convert 575 m to km

575 m = _____ km

First, determine if you are going from a smaller unit to a larger unit or a larger unit to a smaller unit.

Smaller to larger

Next, use the appropriate rule.

575 ÷ 1000

Then, write the value.

0.575

The answer is 0.575. Mustafa runs 0.575 kilometers.

Example 4.6.7.2

Convert 1 m to km.

1 m = _____ km

Solution

First, determine if you are going from a smaller unit to a larger unit or from a larger unit to a smaller unit.

Smaller to larger

Next, use the appropriate rule.

1 ÷ 1000 = 0.001

Then, write the value.

0.001

The answer is 0.001.

Example 4.6.7.3

Convert 2 m to km.

2 m = _____ km

Solution

First, determine if you are going from a smaller unit to a larger unit or from a larger unit to a smaller unit.

Smaller to larger

Next, use the appropriate rule.

2 ÷ 1000

Then, write the value.

0.002

The answer is 0.002 km.

Example 4.6.7.4

Convert 8 mm to cm.

8 mm = _____ cm

Solution

First, determine if you are going from a smaller unit to a larger unit or from a larger unit to a smaller unit.

Smaller to larger

Next, use the appropriate rule.

8 ÷ 10

Then, write the value.

0.8

The answer is 0.8 cm.

Example 4.6.7.5

Convert 4 cm to m.

4 cm = _____ m

Solution

First, determine if you are going from a smaller unit to a larger unit or from a larger unit to a smaller unit.

Smaller to larger

Next, use the appropriate rule.

4 ÷ 100

Then, write the value.

0.04

The answer is 0.04.

Review

Write each decimal conversion. Round to the nearest hundredth when necessary.

1. 1 mm = _____ cm
2. 5 mm = _____ cm
3. 10 mm = _____ cm
4. 15 mm = _____ cm
5. 8 cm = _____ m
6. 9 cm = _____ m
7. 11 cm = _____ m
8. 22 cm = _____ m
9. 12 m = _____ km
10. 8 m = _____ km
11. 22 mm = _____ cm
12. 225 mm = _____ cm
13. 543 mm = _____ cm
14. 987 mm = _____ cm
15. 1234 mm = _____ cm

Review (Answers)

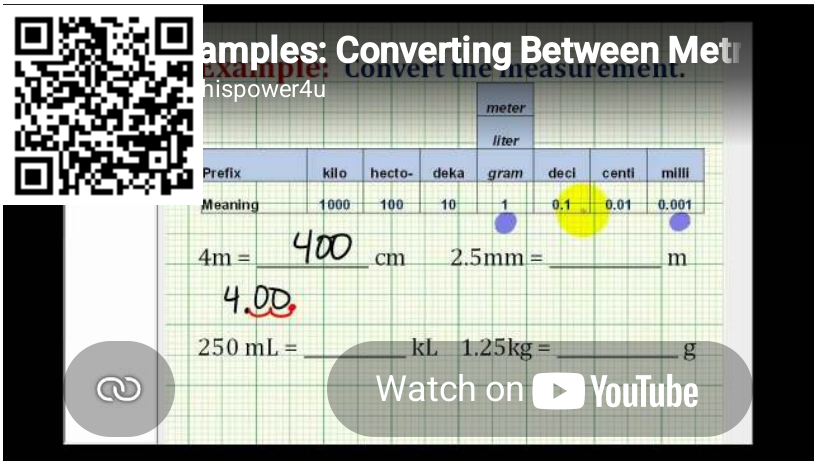
To see the Review answers, open this PDF file and look for section 3.6.

Vocabulary

Term	Definition
Centimeter	A centimeter is a very small unit of metric measure. A centimeter is one hundredth of one meter.
Kilometer	A kilometer is a common metric unit of length that is equal to 1,000 meters.
Length	Length is a measurement of how long something is. Examples of customary units of length are inches, feet, yards and miles.
Meter	A meter is a common metric unit of length that is slightly larger than a yard.
Metric System	The metric system is a system of measurement commonly used outside of the United States. It contains units such as meters, liters, and grams, all in multiples of ten.
Millimeter	A millimeter is the smallest common metric unit of length.

Additional Resources

Video:



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4.7: Metric Length Operations

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4.7.1: Metric Addition

Resources

Video:

Measuring Lengths in Centimeters

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Practice: **Metric Addition**

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4.7.2: Add Metric Lengths and Distances

Resources

Video:

Calculating Distance in Meters

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```

Practice: **Add Metric Lengths and Distances**

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4.7.3: Metric Subtraction

Resources

Video:

Subtracting Lengths in Meters

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Practice: **Metric Subtraction**

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4.7.4: Applications of Metric Addition and Subtraction

Resources

Video:

Adding and Subtracting Compound Unit Lengths (Metric Units)

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Practice: **Applications of Metric Addition and Subtraction**

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4.7.5: Metric Multiplication

Resources

Video:

Multiplying Compound Unit Lengths (Metric Units)

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Practice: **Metric Multiplication**

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4.7.6: Metric Division

Resources

Video:

Division of Lengths (Metric Units)

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Practice: **Metric Division**

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4.7.7: Metric Multiplication and Division

Resources

Video:

Multiplication and Division of Lengths

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Practice: **Metric Multiplication and Division**

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4.7.8: Multi-Operation and Multi-Step Metric Problems

Resources

Video:

Addition, Subtraction, Multiplication, and Division of Lengths

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Practice: **Multi-Operation and Multi-Step Metric Problems**

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4.7.9: Multi-Operation and Multi-Step Metric Applications

Resources

Practice: **Multi-Operation and Multi-Step Metric Applications**

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4.7.10: Compound Metric Units of Length

Resources

Video:

Distances Between Points on One Route (Metric Units)

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Practice: **Compound Metric Units of Length**

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4.8: Scale

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4.8.1: Find Scale Dimensions

Scale Distances or Dimensions

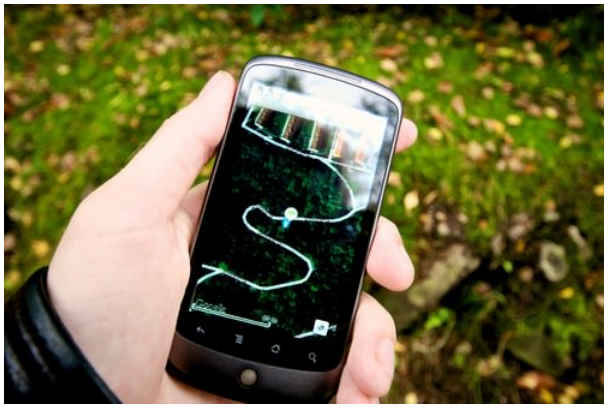


Figure 4.8.1.1

Sebastian, Abe, and Rajeesh have taken up geocaching. The boys have use of a GPS and can see the general location of the cache on a map. If the scale is 1" = 80 meters, and the map shows the cache as being 2 inches from the boys' current location, how far do they have to walk to reach it?

In this concept, you will learn about scale distances.

Scale Distances or Dimensions

A **ratio** compares two quantities. Ratios can be written as fractions, with a colon or with the word “to.”

2/3, 2:3, and "2 to 3" are ratios.

A **proportion** is created when two ratios are found to be equivalent or equal.

1/2=3/6 is a proportion.

A **unit rate** is a comparison of two measurements, one of which has a value of 1.

55 miles per hour, (55/1) miles/hour is a unit rate.

Somewhat like a unit rate, a **unit scale** is a ratio that compares two measurements.

A **unit scale** is a ratio that compares the dimensions of an actual object to the dimensions of a **scale drawing** or model that represents the actual object. Neither value in a unit scale has to equal 1.

The unit scale on a map may read 1 inch = 100 feet.

The ratio would be written 1 inch/100 ft.

To represent a line 500 feet long, the unit scale would be used to draw a line 5 inches long. A line 8 inches long would represent an actual line of 800 feet.

Unit scales and proportions can be used to calculate actual distances from maps, drawings, or models. Actual distances can be represented on maps, drawings, or models by using unit scales.

Examples

Example 4.8.1.1

Earlier, you were given a problem about the three boys who went geocaching.

The scale on their GPS unit is 2.5 cm = 80 meters, and the map shows the cache as being 5 cm from the boys' current location, how far do they have to walk to reach it?

Solution

First, write the unit scale as a ratio 2.5 cm/80 meters

$$cm/m=2.5/80$$

Next, keeping the units consistent, write a ratio that compares the scale distance to the actual distance from the cache.

$$scale/actual\ in\ cm/m=5/d$$

Next, set this ratio equal to the unit scale to form a proportion.

$$2.5/80=5/d$$

Then, cross multiply.

$$2.5d=400$$

$$d=160\ meters$$

The answer is d = 160 meters. The cache is 160 meters away.

Example 4.8.1.2

Rano has a rectangular backyard. Its actual dimensions are 50 feet by 30 feet. Rano wants to make a scale drawing of his backyard and has chose a scale of 1/2 in.=5 ft.

Find the dimensions of the backyard for the scale drawing.

Solution

First, write the unit scale as a ratio.

$$1/2\ in.=5\ ft$$

$$inches/feet=0.5/5$$

Next, keeping the units consistent, write ratios that compare the scale distance to the actual distance for both the length and width of the backyard.

$$Length=scale/actual\ in\ inches/feet=1/50$$

$$Width=scale/actual\ in\ inches/feet=w/30$$

Then, set each of these ratios equal to the unit scale to form two proportions, one for length and one for width.

$$Length=l/50=0.5/5$$

$$Length=w/30=0.5/5$$

Next, solve each proportion by cross multiplication.

Length

$$5l=0.5\times50$$

$$5l=25$$

$$l=5\ inches$$

Width

$$5w=0.5\times30$$

$$5w=15$$

$$w=3\ inches$$

The answer is l=5 inches and w=3 inches.

Rano's scale drawing of his backyard should be 5 inches long and 3 inches wide.

Example 4.8.1.3

A rectangular fish pond is 10 feet by 20 feet. Using the scale 1/2 in = 5 ft , determine the dimensions for a scale model to be used in a miniature display.

Solution

First, write the unit scale as a ratio. 1/2 in = 5 ft or 1/2 inches per 5 feet.

$$\text{inches/feet}=0.5/5$$

Next, keeping the units consistent, write ratios that compare the scale distance to the actual distance for both the length and width of the pond.

$$\text{Length=scale/actual in inches/feet}=1/20$$

$$\text{Width=scale/actual in inches/feet}=w/10$$

Then, set each of these ratios equal to the unit scale to form two proportions, one for length and one for width.

$$\text{Length}=l/20=0.5/5$$

$$\text{Width}=w/10=0.5/5$$

Next, solve each proportion by cross multiplication.

Length

$$5l=0.5\times 20$$

$$5l=10$$

$$l=2 \text{ inches}$$

Width

$$5w=0.5\times 10$$

$$5w=5$$

$$w=1 \text{ inches}$$

The answer is l = 2 inches, and w = 1 inch. The miniature fish pond should be 2 inches by 1 inch.

Example 4.8.1.4

A drawing has a scale of 1" = 10 ft, find the actual dimensions of a building that measures 10 inches by 14 inches on the drawing.

Solution

First, write the unit scale as a ratio 1 inch/10 feet

$$\text{inchesfeet}=110$$

Next, keeping the units consistent, write ratios that compare the scale distance to the actual distance for both the length and width of the building.

$$\text{Length=scale/actual in inches/feet}=14/l$$

$$\text{Width=scale/actual in inches/feet}=10/w$$

Then, set each of these ratios equal to the unit scale to form two proportions, one for length and one for width.

$$\text{Length}=14/l=1/10$$

$$\text{Width}=10/w=1/10$$

Next, solve each proportion by cross multiplication.

Length

$l=10\times14$

$l=140$ feet

Width

$w=10\times10$

$w=100$ feet

The answer is l = 140 feet, and w = 100 feet. The actual dimensions of the building are 140 ft by 100 feet.

Example 4.8.1.5

Below is a map of Camp Skyview.

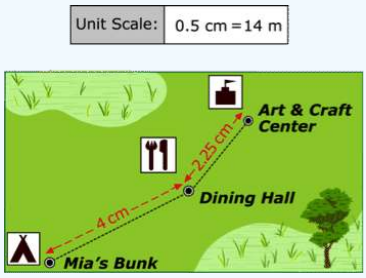


Figure 4.8.1.2

This morning, Mia walked directly from her bunk to the dining hall for breakfast. Then she walked directly to the Art & Craft Center. How many meters did she walk altogether?

Solution

First, add together the distances from the map that show how far Mia walked

4 cm + 2.25 cm = 6.25 cm

Next, write the unit scale as a ratio 0.5 cm/14 meters

Then, keeping the units consistent, write a ratio that compares the scale distance to the actual distance that Mia walked.

$$\text{scale/actual in cm/m}=6.25/d$$

Next, set this ratio equal to the unit scale to form a proportion.

$$0.5/14=6.25/d$$

Then, cross multiply.

$$0.5d=6.25\times14$$

$$d=175 \text{ meters}$$

The answer is d = 175 meters. Mia walked a total of 175 meters.

Review

Solve each problem using scale and measurement.

1. Haley made a scale model of her new school building. The scale she used for her model was 1 inch = 6 feet. The actual height of her school building is 30 feet. What was the height of the school building in her scale model?
2. If the width of Haley's school is 120 feet, what would be the width in the scale model?
3. If the length of Haley's school is 180 feet, what would be the length in the scale model?
4. Eddie drew a map of Main Street in his hometown. The scale he used for his map was 1 centimeter = 8 meters. The actual distance between the post office and City Hall, both of which are on Main Street, is 56 meters. What is the distance between

those two places on Eddie's map?

5. If the distance from the post office to the library is twice the distance from the post office to the City Hall, what is the distance on Eddie's map?
6. If the distance from the library to the school is three times the distance as from the post office to the City Hall, what is the distance on Eddie's map?
7. Asharah built a model of a car. The actual length of the car is 12 feet. The scale of her model is 1/4 inch=1 foot. What is the length of her model car?
8. Kenya built a model of the same car. His scale of the model is 1/2″=1 foot. What is the length of his model?
9. Jonah observed a spider that was too small to draw at its actual size. So he made a scale drawing, using the scale 0.5 centimeter = 4 millimeters. The actual length of the spider's body, not including its legs, was 16 millimeters. What is the length of the spider's body, not including its legs, in Jonah's drawing?
10. If Jonah made a drawing that is half the size of this one, what would length of the spider's body be in the new drawing?
11. Alyssa made a scale drawing of her rectangular classroom. She used the scale 1/2 inch=4 feet. Her actual classroom has dimensions of 32 feet by 28 feet. What are the dimensions of her classroom in the scale drawing?
12. Below is a scale drawing of a circular fountain. In the scale drawing, the diameter of the fountain measures 3 centimeters. What is the actual diameter of the fountain?

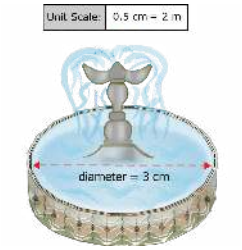


Figure 4.8.1.3

13. On a map, Brandon measured the straight-line distance between Los Angeles, California and San Francisco, California to be 2 inches. The scale on the map shows that 1/4 inch=43 miles. What is the actual straight-line distance between Los Angeles and San Francisco?
14. A butterfly that Adriana observed was too small to draw at its actual size. So, she made this scale drawing.

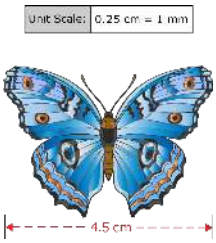


Figure 4.8.1.4

In the drawing, the wingspan of the butterfly measures 4.5 centimeters. What was the actual wingspan of the butterfly Adriana observed?

15. Jeremy made this scale model of Taipei 101, one of the tallest buildings in the world. The scale height of his model is 2(1/2) inches. Find the actual height of Taipei 101.

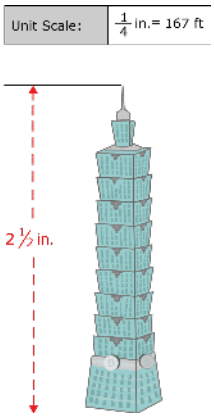


Figure 4.8.1.5

Review (Answers)

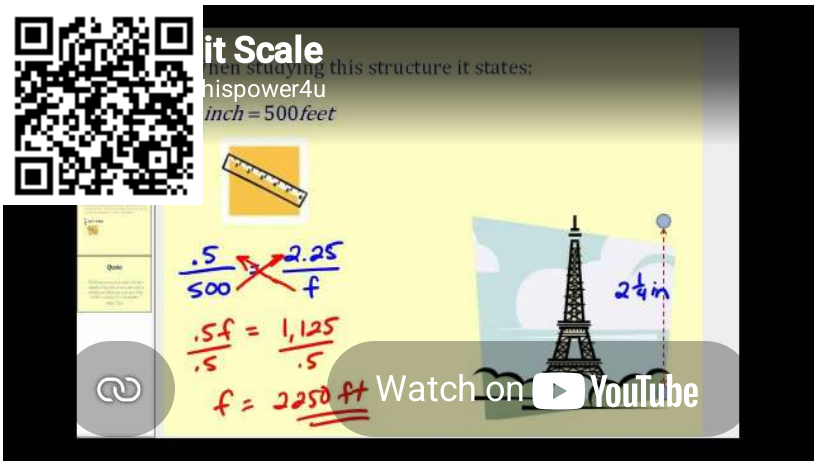
To see the Review answers, open this PDF file and look for section 5.11.

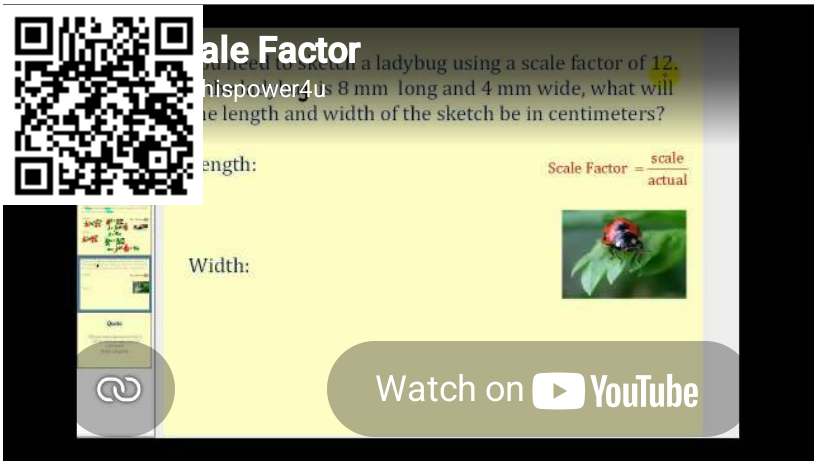
Vocabulary

Term	Definition
Scale Drawing	A scale drawing is a drawing that is done with a scale so that specific small units of measure represent larger units of measure.
Unit Scale	The unit scale is the scale of measurement used to represent actual dimensions in a model or drawing. The scale includes units of measurement such as inches, feet, meters.

Additional Resources

Video:





PLIX Interactive: **Scale Distances or Dimensions: Model Car**

Practice: **Find Scale Dimensions**

Real World Application: **Sizing Up Statues**

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4.8.2: Find Scale or Actual Dimensions

Read and Interpret Maps Involving Distance and Area

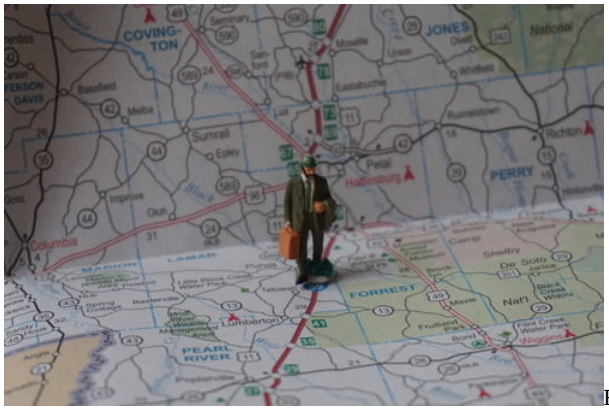


Figure 4.8.2.1

Kaitlyn is looking at a map and wants to find the area of the state of Nevada, United States. The map shows a scale of 1/2″ to 20 miles. If the distance on the map is 8″ wide and 12.25″ long, what is the area, in square miles of Nevada?

In this concept, you will learn to read and interpret maps involving distance and area by using scale measurement.

Distance and Area of Maps

A map is another type of **scale drawing** of a region. Maps can be very detailed or very simple, showing only points of interest and distances. You can read a map just like any other scale drawing—by using the scale.

Let's look at an example.

On the map below, the straight-line distance between San Francisco and San Diego is 3 inches. What is the actual straight-line distance between San Francisco and San Diego?



Figure 4.8.2.2

First, set up a **proportion**. The scale in the drawing says that 0.5 inches=75 miles, therefore the proportion is:

$$0.5 \text{ inches}/75 \text{ miles}$$

Next, write the second ratio. You know the scale length is 3 inches. The unknown length is x.

$$0.5 \text{ inches}/75 \text{ miles}=3 \text{ inches}/x \text{ miles}$$

Then, cross-multiply.

$$0.5/75=3/x$$

$$0.5x=75\times3$$

$$0.5x=225$$

Then, divide both sides by 0.5 to solve for x.

$$0.5x=225$$

$$0.5x/0.5=225/0.5$$

$$x=450$$

The answer is 450.

The straight-line distance from San Francisco to San Diego is 450 miles.

Note: The straight-line distance is also known as “as the crow flies.” If you were actually traveling from San Francisco to San Diego, it would be farther than 450 miles, since you would need to drive on highways that are not necessarily in a straight line.

You can also use a scale to find the area of a space or region. First, you need to figure out the length and width then we can complete any necessary calculations. Sometimes, you will have two different distances or areas that you are working to compare. When this happens, you can use proportions to compare the differences and similarities.

Let’s look at an example.

Marta has a square with a side length of 4 inches. She has a **similar** square with dimensions that are twice the first square. How does the area of the larger square compare to the area of the smaller square?

First, find the dimensions of the larger square. The problem states that the dimensions are twice the first square. You can use this information to figure out the scale factor, and this means they are scaled up by a factor of 2. The side length of the larger square is:

$4 \text{ inches}\times2=8 \text{ inches}$.

Next, find the area of both squares and compare.

Area of smaller square	Area of larger square
$A = lw$	$A = lw$
$A = (4 \text{ inches})(4 \text{ inches})$	$A = (8 \text{ inches})(8 \text{ inches})$
$A=16 \text{ in}^2$	$A=64 \text{ in}^2$

Then, compare the two areas. You want to know how the area of the larger square compares to the area of the smaller square. Write a ratio comparing the two areas.

$$64 \text{ in}^2/16 \text{ in}^2=4$$

The answer is 4.

The area of the larger square is 4 times larger than the area of the smaller square.

This leads to a rule when comparing areas of similar figures. The ratio of areas of similar figures is the square of the scale factor.

Examples

Example 4.8.2.1

Earlier, you were given a problem about Kaitlyn and her interest in Nevada.

Solution

First, set up a proportion. The scale in the drawing says that 1/2 inch=20 miles, therefore the proportion is:

$$0.5 \text{ inch}/20 \text{ miles}$$

Next, write the ratio representing the length. You know the scale length is 8 inches. The unknown length is x.

$$0.5 \text{ inch}/20 \text{ miles}=8 \text{ inches}/x \text{ miles}$$

Then, cross-multiply to solve for x.

$$0.5/20=8/x$$

$$0.5x=20\times 8$$

$$0.5x=160$$

Then, divide both sides by 0.5 to solve for x.

$$0.5x=160$$

$$0.5x/0.5=160/0.5$$

$$x=320$$

The answer is 320.

The width of Nevada is 320 miles.

Then, write the ratio representing the length. You know the scale length is 12.25 inches. The unknown length is x.

$$0.5 \text{ inch}/20 \text{ miles}=12.25 \text{ inches}/x \text{ miles}$$

Then, cross-multiply to solve for x.

$$0.5/20=12.25/x$$

$$0.5x=20\times 12.25$$

$$0.5x=245$$

Then, divide both sides by 0.5 to solve for x.

$$0.5x=245$$

$$0.5x/0.5=245/0.5$$

$$x=490$$

The answer is 490.

The length of Nevada is 490 miles.

Finally, find the area of Nevada.

$$A = lw$$

$$A=(320 \text{ miles})(490 \text{ miles})$$

$$A=156{,}800 \text{ square miles}$$

The answer is 156,800.

The area of Nevada is 156,800 mi^2.

Example 4.8.2.2

If the scale is 0.5 inches=100 miles, how many inches is 500 miles?

Solution

First, set up the proportion to solve.

$$0.5 \text{ inches}/100 \text{ miles}=x \text{ inches}/500 \text{ miles}$$

Next, cross multiply.

$$0.5100=x500$$

$$100x=0.5\times500$$

$$100x=250$$

Then, divide by 100 to solve for x.

$$100x=250$$

$$100x/100=250/100$$

$$x=2.5$$

The answer is 2.5.

The distance on the map will be 2.5 inches.

Example 4.8.2.3

If 1″=2000 miles , find each actual distance with a scale measurement of 3″.

Solution

First, set up a proportion. The scale in the drawing says that 1 inch=2000 miles, therefore the proportion is:

$$1 \text{ inch}/2000 \text{ miles}$$

Next, write the second ratio. You know the scale length is 3 inches. The unknown length is x.

$$1 \text{ inch}/2000 \text{ miles}=3 \text{ inches}/x \text{ miles}$$

Then, cross-multiply to solve for x.

$$1/2000=3/x$$

$$1x=2000\times3$$

$$x=6000$$

The answer is 6000.

The actual distance is 6000 miles.

Example 4.8.2.4

If 1″=2000 miles, find each actual distance with a scale measurement of 12″.

Solution

First, set up a proportion. The scale in the drawing says that 1 inch=2000 miles, therefore the proportion is:

$$1 \text{ inch}/2000 \text{ miles}$$

Next, write the second ratio. You know the scale length is 0.5″ inches. The unknown length is x.

$$1 \text{ inch}/2000 \text{ miles}=0.5 \text{ inches}/x \text{ miles}$$

Then, cross-multiply to solve for x.

$$1/2000=0.5/x$$

$$1x=2000\times0.5$$

$$x=1000$$

The answer is 1000.

The actual distance is 1000 miles.

Example 4.8.2.5

If 1″=2000 miles, find each actual distance with a scale measurement of 1/4″.

Solution

First, set up a proportion. The scale in the drawing says that 1 inch=2000 miles, therefore the proportion is:

$$1 \text{ inch}/2000 \text{ miles}$$

Next, write the second ratio. You know the scale length is 0.25″ inches. The unknown length is x.

$$1 \text{ inch}/2000 \text{ miles}=0.25 \text{ inches}/x \text{ miles}$$

Then, cross-multiply to solve for x.

$$1/2000=0.25/x$$

$$1x=2000\times0.25$$

$$x=500$$

The answer is 500.

The actual distance is 500 miles.

Review

Using the scale 1 inch=5.5 miles, figure out the number of inches needed to map each number of miles. Use proportions to figure out your answers.

1. 16.5 miles
2. 11 miles
3. 27.5 miles
4. 8.25 miles
5. 33 miles
6. 60.5 miles
7. 13.75 miles

Using the scale 0.5 inches=100 miles, figure out the number of actual miles represented by each scale measurement.

8. 1″
9. 2″
10. 3″
11. 1/4″
12. 3/4″
13. 1(1/2)″
14. 2(1/2)″
15. 5(1/2)″
16. 7″

Review (Answers)

To see the Review answers, open this PDF file and look for section 4.9.

Vocabulary

Term	Definition
Proportion	A proportion is an equation that shows two equivalent ratios.
Scale Drawing	A scale drawing is a drawing that is done with a scale so that specific small units of measure represent larger units of measure.
Similar	Two figures are similar if they have the same shape, but not necessarily the same size.

Additional Resources

Video:



PLIX Interactive: **Map Quest: Desert**

Practice: **Find Scale or Actual Dimensions**

Real World Application: **Icy Intersections**

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4.8.3: Find Actual Dimensions

Scale Factor to Find Actual Dimensions



Figure 4.8.3.1

Sam is at the county fair looking at model train displays. The smallest one is an "N" gauge, which is a scale of 1:160. If the display area is 4 feet by 8 feet, how big an area does the display represent?

In this concept, you will learn how to use a scale factor to find actual dimensions.

Using Scale Factor to Find Actual Dimensions

A **ratio** compares two quantities.

Ratios can be written as fractions, with a colon or with the word “to.”

2/3, 2:3, and "2 to 3" are ratios.

A **proportion** is created when two ratios are found to be equivalent or equal.

1/2=3/6 is a proportion.

A **unit rate** is a comparison of two measurements, one of which has a value of 1.

55 miles per hour, 55 miles/1 hour is a unit rate.

A **unit scale** is a ratio that compares the dimensions of an actual object to the dimensions of a scale drawing or model that represents the actual object. Neither value in a unit scale has to equal 1.

The unit scale on a map may read 1/2 inch=100 feet.

The ratio would be written 0.5/100 .

To represent a line 500 feet long, the unit scale would be used to draw a line 2(1/2) inches long.

A line 4 inches long would represent an actual line of 800 feet.

Unit scales and proportions can be used to calculate actual distances from maps, drawings, or models.

Actual distances can be represented on maps, drawings, or models by using unit scales.

A **scale factor** is somewhat like a unit scale. It is a ratio that compares scale dimensions to actual dimension. It differs because it does not give any specific units.

A scale factor for a scale drawing might be 1/200, which means that the actual size is 200 times the drawing.

Scale factors can be used to determine both scale and actual sizes or dimensions.

Examples

Example 4.8.3.1

Earlier, you were given a problem about the model train displays at the fair.

The smallest one is an "N" gauge, which is a scale of 1:160. If the display area is 4 feet by 8 feet, how big an area does the display represent?

Solution

First, write the scale factor.

$$\text{scale/actual}=1/160$$

Next, write ratios to represent the unknown actual length and width of the display to the scale length and width of the display.

$$\text{Length}=\text{scale/actual}=8/w$$

$$\text{Width}=\text{scale/actual}=4/l$$

Then, write two proportions by setting the two length ratios equal to one another and the two width ratios equal to one another. The given unit is feet.

$$\text{Length}=4/l=1/160$$

$$\text{Width}=8/w=1/160$$

Next, cross multiply each equation.

$$L=4\times160$$

$$L=640 \text{ feet}$$

$$W=8\times160$$

$$W=1{,}280 \text{ feet}$$

Then, to find the area of the display, multiply length times width.

$$640 \text{ ft.}\times1{,}280 \text{ ft.}=819{,}200 \text{ sq. ft.}$$

The answer is 819,200 square feet.

Example 4.8.3.2

A small airplane has a wing span of 16 feet. The scale factor for a model is 1/48. Find the wing span of the model in inches.

Solution

First, write the scale factor.

$$\text{scale/actual}=1/48$$

Next, write a ratio to represent the actual length of the wingspan to the unknown scale length of the wingspan.

$$\text{scale/actual}=w/16$$

Then, write a proportion by setting the two ratios equal to one another. Remember that feet is the only unit given.

$$1/48=w/16$$

Next, cross multiply.

$$48w=16$$

$$w=13$$

Then, convert feet to inches.

$$1/3 \text{ foot} \times (12/1) \text{ inches/foot}=4 \text{ inches}$$

The answer is 4 inches. The wingspan on the model plane will be 4 inches long.

Example 4.8.3.3

The longest side of a triangular flower bed is 5.5 meters long. Leah wants to make a scale drawing of the flower bed. The scale factor for her drawing will be 1/20. What will be the length of the longest side of the flower bed in her drawing?

Solution

First, write the scale factor.

$$\text{scale/actual}=1/20$$

Next, write a ratio to represent the actual length of the side to the unknown scale length of the side.

$$\text{scale/actual}=l/5.5$$

Then, write a proportion by setting the two ratios equal to one another. Meters is the only unit given.

$$1/20=l/5.5$$

meters

Next, cross multiply.

$$5.5=20l$$

$$l=0.275 \text{ meters}$$

Then, convert meters to centimeters.

$$0.275 \text{ meters} \times (100/1) \text{ cm/m}=2.75 \text{ cm}$$

The answer is 27.5 centimeters.

Example 4.8.3.4

An ant that Alison observed was too small to draw at its actual size. So, Alison made the scale drawing shown below. The scale factor for the drawing is 5. Find the actual length of the ant Alison observed.

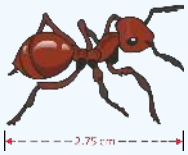


Figure 4.8.3.2

Solution

First, write the scale factor.

$$\text{scale/actual}=5/1$$

Next, write a ratio to represent the unknown actual length of the ant to the scale length of the ant.

$$\text{scale/actual}=2.75/l$$

Then, write a proportion by setting the two ratios equal to one another. Centimeters is the only unit given.

$$5/1=2.75/1 \text{ cm}$$

Next, cross multiply.

$$2.75=5l$$

$$l=0.55$$

$$l=0.55\text{cm}$$

Then, convert centimeters to millimeters.

$$0.55 \text{ cm} \times (10/1) \text{ mm/cm} = 5.5 \text{mm}$$

Example 4.8.3.5

The scale drawing below shows a rectangular carpet. The scale factor for the drawing is 1/24. What is the area, in square feet, of the actual carpet?

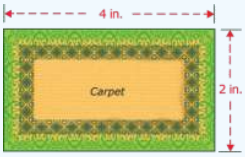


Figure 4.8.3.3

Solution

First, write the scale factor.

$$\text{scale/actual} = 1/24$$

Next, write ratios to represent the unknown actual length and width of the carpet to the scale length and width of the carpet.

$$\text{scale/actual} = 4/1 \quad \text{scale/actual} = 2/w$$

Then, write two proportions by setting the two length ratios equal to one another and the two width ratios equal to one another. The given unit is inches.

$$\text{Length} = 4/l = 12/4$$

$$\text{Width} = 2/w = 12/4$$

Next, cross multiply each equation.

$$L = 4 \times 24$$

$$L = 96 \text{ inches}$$

$$W = 2 \times 24$$

$$W = 48 \text{ inches}$$

Then, to find the area of the carpet, multiply length x width.

$$96'' \times 48'' = 4{,}608 \text{ sq. in.}$$

The answer is 4,608 square inches.

Review

Solve each problem. Keep in mind that several problems may have more than one part.

1. Calvin drew a map of his neighborhood. The scale factor he used for his map was 1/800. The actual distance between Calvin's house and his best friend Frank's house is 80 meters. What should be the distance, in centimeters, between those two places on his scale drawing?
2. If the distance from Calvin's house to the park is 40 meters, what would be the distance in centimeters?
3. If the distance from Calvin's house to the corner store is double the distance from his house to Frank's, what would be the distance on the map in centimeters?
4. If the distance from Calvin's house to his Grandmother's was halfway between his and Frank's, what would be the distance on the map in centimeters?
5. Madeline built a model of a boat. The actual length of the boat is 24 feet. The scale factor she used for the model was 1/36. What should be the length, in inches, of the model boat?
6. If the scale factor was 1/72, what would the length be in inches of the model boat?

7. A metal pipe is 2.5 meters long. Josh wants to make a scale drawing of the pipe. The scale factor for his drawing will be 1/100. What will be the length, in centimeters, of the metal pipe in his drawing?
8. Sydra observed a housefly that was too small to draw at its actual size. So she made a scale drawing, using 10 as a scale factor. The actual length of the housefly was 8 millimeters. What is the length of the housefly in Sydra's drawing in millimeters?
9. What is the length of the housefly in Sydra's drawing in centimeters?
10. Luis made a scale model of the doghouse he is going to build. The scale factor he used for this model was 1/24. He wants the actual height of the doghouse to be 6 feet. What should be the height of the doghouse in his scale model?
11. Jean-Marc used a scale factor of 5 to make this scale drawing of a moth.



Figure 4.8.3.4

In the drawing, the wingspan of the moth measures 3 centimeters. What was the actual wingspan, in millimeters, of the moth Jean-Marc observed?

12. Below is a scale drawing of a swimming pool. In the scale drawing, the diameter of the pool measures 1(1/2) inches. The scale factor for the drawing is 1/72. What is the actual diameter of the pool in feet?



Figure 4.8.3.5

13. Barbara made a scale model of the Washington Monument. The scale factor for her model is 1/1332. The height of her model is 5 inches. What is the actual height, in feet, of the Washington Monument?
14. Below is a map of a city park. This map was created using a scale factor of 1/300.



Figure 4.8.3.6

1. On the map, the distance between the sandbox and the swings is 2.5 centimeters. What is the actual distance between the sandbox and the swings in meters?
2. On the map, the distance between the sandbox and the jungle gym is 1.7 centimeters. What is the actual distance between the sandbox and the jungle gym in meters?

15. The scale drawing below shows the floor of Julian's bedroom.

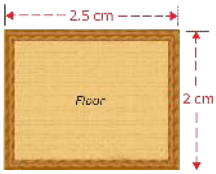


Figure 4.8.3.7

The scale factor for the drawing is 1/200.

1. What are the dimensions, in meters, of the actual floor?
2. What is the area, in square meters, of the actual floor?

Review (Answers)

To see the Review answers, open this PDF file and look for section 5.13.

Additional Resources

Video:



PLIX Interactive: **Football Stadium Sketch**

Practice: **Find Actual Dimensions**

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4.8.4: Find the Scale Factor

Use Scale Factor When Problem Solving

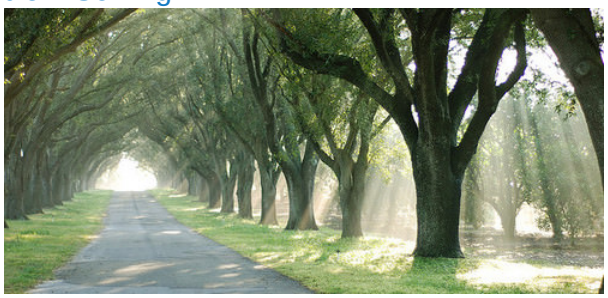


Figure 4.8.4.1

Lifan's driveway has a length of 24 feet. If the scale is 2 inches:4 feet, what is the scale factor? In a diagram, how many inches would Lifan draw to represent his driveway?

In this concept, you will learn to use scale factors when problem solving.

Scale Factor

The scale can be used to help you with scale dimensions or actual dimensions. This scale is key in problem solving.

If you look at the scale 2:1, you can use this information to determine the **scale factor**. The scale factor is the relationship between the **scale dimension** and the measurement comparison between the scale measurement of the model and the actual length. In this case the scale factor is 1/2.

Let's look at an example.

What is the scale factor if 3 inches is equal to 12 feet?

First, write the ratio.

$$3/12$$

Next, simplify the fraction.

$$3/12=1/4$$

The answer is 1/4.

The scale factor is 1:4.

Now let's look at a problem where you are applying this information.

If the scale dimension is 4, then you can figure out the **actual dimension**. Look at this **proportion**:

$$1:2=4:x$$

First, put the proportion in fraction form.

$$1/2=4/x$$

Next, cross multiply to solve for x.

$$1/2=4/x$$

$$1x=2\times4$$

$$x=8$$

The answer is 8.

This is the actual dimension.

Let's look at a real world problem.

The plans for a flower garden show that it is 6 inches wide on the plan. If the scale for the flower garden is 1:12, what is the actual width of the flower garden?

First, write the proportion.

$$1:12=6:x$$

Next, put the proportion in fraction form.

$$1/12=6/x$$

Then, cross multiply to solve for x.

$$1/12=6/x$$

$$1x=12\times6$$

$$x=72$$

The answer is 72.

The actual width of the flower garden is 72 inches.

Examples

Example 4.8.4.1

Earlier, you were given a problem about Lifan and his long driveway. The scale is 2 inches:4 feet and the driveway is 24 feet long.

Solution

First, write the proportion. Note that 2:4 is the scale factor.

$$2:4=x:24$$

Next, put the proportion in fraction form.

$$2/4=x/24$$

Then, cross multiply to solve for x.

$$2/4=x/24$$

$$4x=2\times24$$

$$4x=48$$

Then, divide both sides by 4 to solve for x.

$$4x=48$$

$$4x/4=484$$

$$x=12$$

The answer is 12.

The scale dimension of Lifan's driveway is 12 inches.

Example 4.8.4.2

Find the missing actual dimension if the scale factor is 2″:3′ and the scale measurement is 6″.

Solution

First, write the proportion.

$$2:3=6:x$$

Next, put the proportion in fraction form.

$$2/3=6/x$$

Then, cross multiply to solve for x.

$$2/3=6/x$$

$$2x=3\times6$$

$$2x=18$$

Then, divide both sides by 2 to solve for x.

$$2x=18$$

$$2x/2=18/2$$

$$x=9$$

The answer is 9.

The actual dimension is 9 feet.

Example 4.8.4.3

Find the missing actual dimension if the scale factor is 1/4″:4′ and the scale measurement is 8″.

Solution

First, write the proportion.

$$1/4:4=8:x$$

Next, put the proportion in fraction form.

$$1/4/4=8/x$$

$$1/16=8/x$$

Then, cross multiply to solve for x.

$$1/16=8/x$$

$$1x=8\times16$$

$$x=128$$

The answer is 128.

The actual dimension is 128 feet.

Example 4.8.4.4

Find the missing actual dimension if the scale factor is 1/4″:4′ and the scale measurement is 12′.

Solution

First, write the proportion.

$$1/4:4=x:12$$

Next, put the proportion in fraction form.

$$1/4/4=x/12$$

$$1/16=x/12$$

Then, cross multiply to solve for x.

$$1/16=x/12$$

$$16x=1\times12$$

$$16x=12$$

Then, divide both sides by 16 to solve for x .

$$16x=12$$

$$16x/16=12/16$$

$$x=12/16$$

$$x=3/4$$

The answer is 3/4.

The actual dimension is 3/4 inches.

Example 4.8.4.5

Find the missing actual dimension if the scale factor is 1/4″:4′ and the scale measurement is 16″.

Solution

First, write the proportion.

$$1/4:4=16:x$$

Next, put the proportion in fraction form.

$$1/4/4=16/x$$

$$1/16=16/x$$

Then, cross multiply to solve for x.

$$1/16=16/x$$

$$1x=16\times16$$

$$x=256$$

The answer is 256.

The actual dimension is 256 feet.

Review

Figure out each scale factor.

1. 2 inches/8 feet
2. 13 inches/12 feet
3. 6 inches/24 feet
4. 11 inches/33 feet
5. 16 inches/32 feet
6. 18 inches/36 feet
7. 6 inches/48 feet
8. 6 inches/12 feet

Solve each problem.

9. A rectangle has a width of 2 inches. A similar rectangle has a width of 9 inches. What scale factor could be used to convert the larger rectangle to the smaller rectangle?

10. A drawing of a man is 4 inches high. The actual man is 64 inches tall. What is the scale factor for the drawing?

11. A map has a scale of 1 inch=4 feet. What is the scale factor of the map?

12. A drawing of a box has dimensions that are 2 inches, 3 inches, and 5 inches. The dimensions of the actual box will be 3(1/4) times the dimensions in the drawing. What are the dimensions of the actual box?

13. A room has a length of 10 feet. Hadley is drawing a scale drawing of the room, using the scale factor 1/50. How long will the room be in Hadley's drawing?

14. The distance from Anna's room to the kitchen is 15 meters. Anna is making a diagram of her house using the scale factor of 1/150. What will be the distance on the diagram from Anna's room to the kitchen?

15. On a map of Cameron's town, his house is 9 inches from his school. If the scale of the map is 1/400, what is the actual distance, in feet, from Cameron's house to his school?

Review (Answers)

To see the Review answers, open this PDF file and look for section 4.7.

Vocabulary

Term	Definition
Actual Dimension	The actual dimensions are the real–life measures of the object or building.
Proportion	A proportion is an equation that shows two equivalent ratios.
Scale Dimension	A scale dimension is the measurement used to represent actual dimensions in a drawing or on a map.

Additional Resources

Video:



Practice: **Find the Scale Factor**

Real World Application: **Mapped**

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CHAPTER OVERVIEW

5: Capacity and Volume

- 5.1: Visually Identify and Compare Measures of Capacity
- 5.2: Compare Customary Units of Capacity
  - 5.2.1: Compare Cups and Pints
  - 5.2.2: Compare Pints and Quarts
  - 5.2.3: Compare Cups and Quarts
  - 5.2.4: Compare Gallons and Quarts
  - 5.2.5: Compare Cups Pints and Quarts
  - 5.2.6: Compare Pints Quarts and Gallons
  - 5.2.7: Customary Units of Volume Comparisons
- 5.3: Convert Customary Units of Capacity
  - 5.3.1: Convert between Cups and Pints
  - 5.3.2: Convert between Pints and Quarts
  - 5.3.3: Convert between Quarts and Gallons
  - 5.3.4: Convert between Cups and Quarts
  - 5.3.5: Convert between Pints and Gallons
  - 5.3.6: Convert between Cups and Gallons
  - 5.3.7: Convert between Cups, Pints and Quarts
  - 5.3.8: Convert between Gallons, Pints and Quarts
  - 5.3.9: Convert between Cups, Pints, Quarts and Gallons
- 5.4: Compound Customary Units of Capacity
  - 5.4.1: Overview of Customary Unit Compound Conversion
  - 5.4.2: Convert Pints into Compound Units
  - 5.4.3: Convert Quarts into Compound Units
  - 5.4.4: Convert Gallons into Compound Units
  - 5.4.5: Select Correct Conversion Units for Capacity Operations
  - 5.4.6: Compare Compound Customary Units of Capacity
  - 5.4.7: Order Compound Customary Units of Capacity
- 5.5: Customary Capacity Operations
  - 5.5.1: Add Customary Units of Capacity
  - 5.5.2: Add Customary Units of Capacity Applications
  - 5.5.3: Subtract Customary Units of Capacity
  - 5.5.4: Add and Subtract Customary Units of Capacity
  - 5.5.5: Customary Units of Capacity Applications
- 5.6: Metric Capacity in Liters
  - 5.6.1: Compare Capacity in Liters
  - 5.6.2: Higher Order Capacity Conversion of Liters
- 5.7: Metric Capacity Operations using Liters
  - 5.7.1: Find Capacity in Metric Units Using Pictures
  - 5.7.2: Addition and Subtraction of Liters Applications

5.7.3: Multiplication and Division of Liters Applications
5.7.4: Multi-step Metric Capacity Applications
5.8: Metric Capacity Operations Using Milliliters
5.8.1: Add Mililiters
5.8.2: The Four Basic Operations Using Milliliters
5.8.3: Higher Order Metric Capacity in Milliliters Applications
5.9: Convert Metric Units of Capacity
5.9.1: Best Unit of Measure Liters and Milliliters
5.9.2: Metric Conversion of Liters and Milliliters to find Equivalent Units
5.9.3: Mixed Operations Addition and Subtraction Metric Capacities
5.9.4: Multiply and Divide Then Convert - Mixed Metric Capacities Applications
5.9.5: Multi-Step - Four-Operations Applications
5.9.6: Convert between Kiloliters, Milliliters, and Liters
5.10: Compound Metric Units of Capacity
5.10.1: Convert between Liters and Milliliters
5.10.2: Add and Convert to find Liters and Milliliters
5.10.3: Add Subtract and Convert to find Liters and Milliliters
5.10.4: Addition and Subtraction Multi-Step Compound Unit Applications
5.10.5: Multiply and Convert to find Liters and Milliliters Applications
5.10.6: Divide and Convert to find Liters and Milliliters Applications
5.10.7: Multiply, Divide and Convert to find Liters and Milliliters Applications
5.10.8: Mixed-Operation Multi-Step Compound-Conversion Applications

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5.1: Visually Identify and Compare Measures of Capacity

Resources

Video:

Estimating Capacity Using Water (Metric Units)

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Practice: **Visually Identify and Compare Measures of Capacity**

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5.2.1: Compare Cups and Pints

5.2.2: Compare Pints and Quarts

5.2.3: Compare Cups and Quarts

5.2.4: Compare Gallons and Quarts

5.2.5: Compare Cups Pints and Quarts

5.2.6: Compare Pints Quarts and Gallons

5.2.7: Customary Units of Volume Comparisons

5.2.1: Compare Cups and Pints

Resources

Video:

Comparing Cups and Pints by Formula

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Practice: **Compare Cups and Pints**

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5.2.2: Compare Pints and Quarts

Resources

Video:

Comparing Pints and Quarts by Pictures

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Practice: **Compare Pints and Quarts**

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5.2.3: Compare Cups and Quarts

Resources

Video:

Comparing Cups and Quarts by Formula

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Request ID: _rgLVVwlPlCrUukv5nlXRaU_0R2H-yo5U8Rd5K06ff7cB7pzCLY3DA==
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Practice: **Compare Cups and Quarts**

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5.2.4: Compare Gallons and Quarts

Resources

Video:

Comparing Gallons and Quarts by Pictures

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Practice: **Compare Gallons and Quarts**

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5.2.5: Compare Cups Pints and Quarts

Resources

Video:

Comparing and Ordering Quarts, Pints and Cups

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Practice: **Compare Cups Pints and Quarts**

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5.2.6: Compare Pints Quarts and Gallons

Resources

Video:

Overview of Comparison of Capacity (Gallons, Pints, and Quarts)

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Practice: **Compare Pints Quarts and Gallons**

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5.2.7: Customary Units of Volume Comparisons

Resources

Video:

Capacity Comparison Problems with Illustrations - Word Problems

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Request ID: ZZcSwXEFZ7LaI4itS7lLmQLbY20EnNLZw4dTsyHJu8XVE0lWpwOnyg==
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Practice: **Customary Units of Volume Comparisons**

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5.3.1: Convert between Cups and Pints

5.3.2: Convert between Pints and Quarts

5.3.3: Convert between Quarts and Gallons

5.3.4: Convert between Cups and Quarts

5.3.5: Convert between Pints and Gallons

5.3.6: Convert between Cups and Gallons

5.3.7: Convert between Cups, Pints and Quarts

5.3.8: Convert between Gallons, Pints and Quarts

5.3.9: Convert between Cups, Pints, Quarts and Gallons

5.3.1: Convert between Cups and Pints

Resources

Video:

Converting Pints to Cups

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Practice: **Convert between Cups and Pints**

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5.3.2: Convert between Pints and Quarts

Resources

Video:

Converting Pints and Quarts by Pictures

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Practice: **Convert between Pints and Quarts**

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5.3.3: Convert between Quarts and Gallons

Resources

Video:

Converting Capacities Using Pictures (English Units)

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Practice: **Convert between Quarts and Gallons**

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5.3.4: Convert between Cups and Quarts

Resources

Video:

Converting Quarts and Cups by Pictures

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Practice: **Convert between Cups and Quarts**

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5.3.5: Convert between Pints and Gallons

Resources

Video:

Converting Pints to Gallons

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Practice: **Convert between Pints and Gallons**

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5.3.6: Convert between Cups and Gallons

Resources

Video:

Converting Gallons to Cups

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Practice: **Convert between Cups and Gallons**

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5.3.7: Convert between Cups, Pints and Quarts

Resources

Video:

Overview of Conversion Between Cups, Pints, and Quarts

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Practice: **Convert between Cups, Pints and Quarts**

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5.3.8: Convert between Gallons, Pints and Quarts

Resources

Video:

Selecting the Correct Capacity Conversion (English Units)

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Practice: **Convert between Gallons, Pints and Quarts**

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5.3.9: Convert between Cups, Pints, Quarts and Gallons

Identification of Equivalent Customary Units of Capacity



Figure 5.3.9.1

Junior is planning a hiking trip. According to the survival guide book he has been reading, the average person needs 1 **gallon** of water to drink per day. If he plans on taking a 3 day hike, how many fluid ounces of water will Junior need?

In this concept, you will learn about customary units of capacity.

Identifying Equal Customary Units of Capacity

Capacity is the volume or the amount of liquid an item can hold. There are several customary units of capacity.

Here are the common units of capacity from smallest to largest.

1. Fluid ounces (fl oz)
2. Cups
3. Pints
4. Quarts
5. Gallons

You may have to figure out how many cups are in a **pint** or how many quarts are in a gallon. These types of conversions are often necessary when doing an activity involving liquids, like cooking. To convert different units of capacity, you need to know how much of one unit is equal to another unit. Here is a table that shows equivalent customary units of capacity.

Customary Units of Volume:

Large to small: multiply

fluid ounces (fl oz)	cups (c)	pints (pt)	quarts (qt)	gallons (gal)
8	1			
16	2	1		
32	4	2	1	
128	16	8	4	1

Small to large: divide

Figure 5.3.9.2

To use the table, match up one of the red numbers with the units you are changing to. For example, the basic relationship between cups and fluid ounces is 1 **cup** = 8 fl oz. Between quarts and pints, the basic relationship is 1 qt = 2 pt. Between gallons and pints: 1 gal = 8 pt.

Use the information in the table to convert customary units of capacity.

36 fluid ounces = _____ cups

First, figure out if you need to multiply or divide. Check the units. Divide when converting a smaller unit to a larger unit, fluid ounces to cups.

Then, check the table for the unit equivalence.

8 fl oz = 1 cup

Finally, divide the number of ounces by 8.

36 ÷ 8 = 4(1/2)

The answer is 32 fluid ounces is equal to 4(1/2) cups.

Here is another conversion problem.

4 quarts = _____ ounces

First, figure out if you need to multiply or divide. Check the units. Multiply when converting a larger unit to a smaller unit, quarts to ounces.

Then, check the table for the unit equivalence.

32 fl oz = 1 qt

Finally, multiply the number of quarts by 32.

32 × 4 = 128

The answer is 4 quarts is equal to 128 fluid ounces.

Examples

Example 5.3.9.1

Earlier, you were given a problem about Junior planning a hiking trip.

Junior wants to know how many fluid ounces of water he needs for a 3 day hike if average person needs 1 gallon of water per day. Convert 3 gallons to fluid ounces to find how many fluid ounces of water Junior should take.

Solution

3 gallons = _____ fluid ounces

First, check if you will multiply or divide. A gallon is a larger unit than a **fluid ounce**. Multiply when converting a larger unit to a smaller unit.

Then, find the unit equivalence.

1 gallon = 128 fluid ounces

Next, multiply the number of gallons by the unit equivalence.

3 × 128 = 384

3 gallons = 384 fluid ounces

Junior will need 384 fluid ounces for a 3 day hike.

Example 5.3.9.2

Use the table to find equivalent customary units of capacity.

Marcus has a 5 gallon jug of water. How many fluid ounces is that?

Solution

First, check if you will multiply or divide. The problem is converting gallons to ounces. Multiply when converting a larger unit to a smaller unit.

5 gallons = _____ fl oz

Then, check the table for the unit equivalence.

1 gallon = 128 fl oz

Finally, multiply the number of gallons by 128.

$5 \times 128 = 640$

The answer is 5 gallons is equal to 640 fluid ounces.

Example 5.3.9.3

Convert the following unit of capacity: 5 quarts = ____ pints.

Solution

First, check if you will multiply or divide. Multiply when converting a larger unit to a smaller unit.

Then, find the unit equivalence.

1 **quart** = 2 pints

Finally, multiply the number of quarts by 2.

$5 \times 2 = 10$

The answer is 5 quarts is equal to 10 pints.

Example 5.3.9.4

Convert the following unit of capacity: 6.5 gallons = ____ quarts.

Solution

First, check if you will multiply or divide. Multiply when converting a larger unit to a smaller unit.

Then, find the unit equivalence.

1 gallon = 4 quarts

Finally, multiply the number of gallons by 4.

$6.5 \times 4 = 26$

The answer is 6.5 gallons is equal to 26 quarts.

Example 5.3.9.5

Convert the following unit of capacity: 20 fl oz = ____ cups.

Solution

First, check if you will multiply or divide. Divide when converting a smaller unit to a larger unit.

Then, find the unit equivalence.

8 fl oz = 1 cup

Finally, divide the number of fluid ounces by 8.

$20 \div 8 = 248 = 212$

The answer is 20 fluid ounces is equal to 212 cups.

Review

Convert the following units of capacity.

1. 3 cups = ____ fl oz
2. 32 fl oz = ____ cups
3. 4 cups = ____ pints
4. 8 pints = ____ cups

5. 2 quarts = ____ pints
6. 8 gallons = ____ quarts
7. 24 quarts = ____ gallons
8. 2 quarts = ____ gallons
9. 1 gallon = ____ pints
10. 16 fl oz = ____ pints
11. 2 gallons = ____ fl oz
12. 10 gallons = ____ fl oz
13. 384 fl oz = ____ gallons
14. 384 fl oz = ____ pints
15. 384 fl oz = ____ cups

Review (Answers)

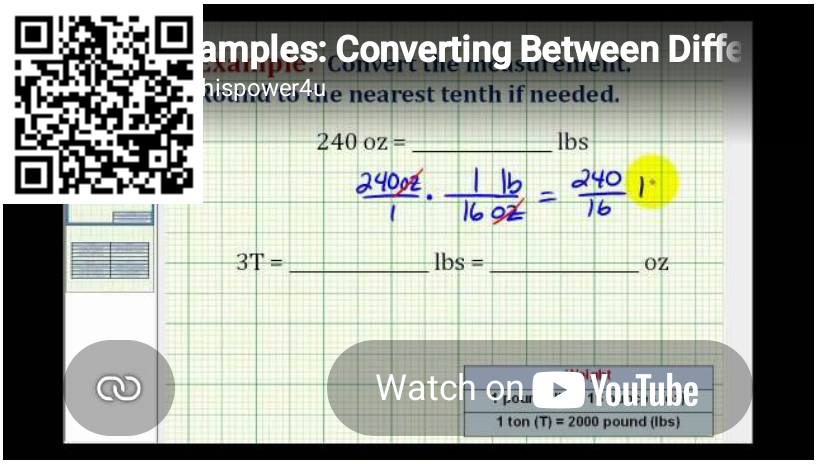
To see the Review answers, open this PDF file and look for section 7.14.

Vocabulary

Term	Definition
Cup	A cup is a small customary unit for measuring liquid capacity. One cup is equal to eight ounces or about 0.25 liters.
Customary System	The customary system is the measurement system commonly used in the United States, including: feet, inches, pounds, cups, gallons, etc.
Fluid Ounce	A fluid ounce is a customary unit for measuring liquid capacity. Soft drinks are measured in fluid ounces.
Gallon	A gallon is a unit of liquid capacity. One gallon is equivalent to four quarts.
Pint	A pint is a unit of liquid capacity. One pint is equivalent to two cups.
Quart	A quart is a unit of capacity that is equivalent to two pints.

Additional Resources

Video:



PLIX Interactive: **Comparing Standard Units of Volume**

Practice: **Convert between Cups, Pints, Quarts and Gallons**

Real World Application: **Super Soup**

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5.4.1: Overview of Customary Unit Compound Conversion

5.4.2: Convert Pints into Compound Units

5.4.3: Convert Quarts into Compound Units

5.4.4: Convert Gallons into Compound Units

5.4.5: Select Correct Conversion Units for Capacity Operations

5.4.6: Compare Compound Customary Units of Capacity

5.4.7: Order Compound Customary Units of Capacity

5.4.1: Overview of Customary Unit Compound Conversion

Resources

Video:

Overview of Conversion Among Units of Measure for Capacity (English Units)

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5.4.2: Convert Pints into Compound Units

Resources

Video:

Converting Pints and Cups into Cups

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Practice: **Convert Pints into Compound Units**

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5.4.3: Convert Quarts into Compound Units

Resources

Video:

Converting Quarts and Cups into Cups

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Practice: **Convert Quarts into Compound Units**

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5.4.4: Convert Gallons into Compound Units

Resources

Video:

Converting Gallons and Quarts into Cups

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Practice: **Convert Gallons into Compound Units**

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5.4.5: Select Correct Conversion Units for Capacity Operations

Resources

Video:

Converting Capacities Using Illustrations (English Units)

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Request ID: rJhyE3zarwcsU3ZqCnBVagcX2QqAb4ixUNSMiCF7FoodITyU3qxb5g==
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Practice: **Select Correct Conversion Units for Capacity Operations**

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5.4.6: Compare Compound Customary Units of Capacity

Resources

Video:

Comparing Compound Unit Capacities (English Units)

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Practice: **Compare Compound Customary Units of Capacity**

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5.4.7: Order Compound Customary Units of Capacity

Resources

Video:

Arranging and Ordering Capacities (English Units)

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Practice: **Order Compound Customary Units of Capacity**

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5.5.1: Add Customary Units of Capacity

5.5.2: Add Customary Units of Capacity Applications

5.5.3: Subtract Customary Units of Capacity

5.5.4: Add and Subtract Customary Units of Capacity

5.5.5: Customary Units of Capacity Applications

5.5.1: Add Customary Units of Capacity

Resources

Video:

Capacity Problems with Illustrations - Word Problems

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Practice: **Add Customary Units of Capacity**

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5.5.2: Add Customary Units of Capacity Applications

Resources

Video:

Addition of Sequential Capacities - Word Problems

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Practice: **Add Customary Units of Capacity Applications**

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5.5.3: Subtract Customary Units of Capacity

Resources

Video:

Subtracting Capacities in Compound Units (English Units)

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```
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Request ID: 4hmLQnDWbPRRGA6aR18hJHlm849VUF_sPcaWIi6RS5fsYGjD3uyW9g==
```

Practice: **Subtract Customary Units of Capacity**

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5.5.4: Add and Subtract Customary Units of Capacity

Resources

Video:

Mixed Adding and Subtracting of Capacities (English Units)

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```
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Request ID: Y5Kz-gfhag3bWxhhiHsQOEt0iIKkW4mQrmx8NbB9vdln7I6kyvvJXw==
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Practice: **Add and Subtract Customary Units of Capacity**

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5.5.5: Customary Units of Capacity Applications

Resources

Video:

Overview of Capacity - Word Problems

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Request ID: oC7vELSRgocYc_qKijlMKnxGSH7QVFf7jfC8avHnCtRBh41m_fOxOA==
```

Practice: **Customary Units of Capacity Applications**

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5.6.1: Compare Capacity in Liters

5.6.2: Higher Order Capacity Conversion of Liters

5.6.1: Compare Capacity in Liters

Resources

Video:

Overview of Capacity II (Metric Units)

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Request ID: 43ES-y-q4J-Bq8JelKbwCaPbZRi2zhE0zTpYBQUVDxde1HZ6eV6Efg==
```

Practice: **Compare Capacity in Liters**

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5.6.2: Higher Order Capacity Conversion of Liters

Resources

Video:

Overview of Capacity III (Metric Units)

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Practice: **Higher Order Capacity Conversion of Liters**

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5.7: Metric Capacity Operations using Liters

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5.7.1: Find Capacity in Metric Units Using Pictures

Resources

Video:

Finding the Capacity of Water with Illustrations (Metric Units)

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Practice: **Find Capacity in Metric Units Using Pictures**

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5.7.2: Addition and Subtraction of Liters Applications

Resources

Video:

One Step Metric Capacity with Addition and Subtraction - Word Problems

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```

Practice: **Addition and Subtraction of Liters Applications**

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5.7.3: Multiplication and Division of Liters Applications

Resources

Video:

Multiplication and Division Metric Capacity - Word Problems

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Practice: **Multiplication and Division of Liters Applications**

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5.7.4: Multi-step Metric Capacity Applications

Resources

Video:

Multi-step Problems Using the Four Operations - Word Problems

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```

Practice: **Multi-step Metric Capacity Applications**

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5.8: Metric Capacity Operations Using Milliliters

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5.8.1: Add Milliliters

Resources

Video:

Overview of Measuring Capacity (Metric Units)

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Practice: **Add Milliliters**

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5.8.2: The Four Basic Operations Using Milliliters

Resources

Video:

Multi-step Problems - Four Operations with Single Units (Metric Capacities) - Word Problems

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Practice: **The Four Basic Operations Using Milliliters**

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5.8.3: Higher Order Metric Capacity in Milliliters Applications

Resources

Video:

Challenge Problems - Four Operations with Single Units (Metric Capacities) - Word Problems

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Request ID: WXpq4zwp4i7YWaW81PBWitcLMk-4guBDEHR_OMui1fISOlrvWrI3yg==
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Practice: **Higher Order Metric Capacity in Milliliters Applications**

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5.9: Convert Metric Units of Capacity

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5.9.1: Best Unit of Measure Liters and Milliliters

Resources

Video:

Choosing the Correct Unit with Liters Or Milliliters

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Practice: **Best Unit of Measure Liters and Milliliters**

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5.9.2: Metric Conversion of Liters and Milliliters to find Equivalent Units

Equivalent Metric Units of Capacity



Devon works for a catering company. She is preparing the food for a party with 100 guests. Before she goes shopping for ingredients, she has to calculate how much food they will be making. She usually makes 375 milliliters of soup per person. How many liters of soup will Devon be making for the party?

In this concept, you will learn to identify equivalent metric units of capacity.

Metric Units of Capacity

Capacity is the total amount of liquid an object can contain. Capacity is often measured using the metric units of **liter** (L) and **milliliter** (mL). Note that milliliter also uses the metric prefix of "milli-" to indicate that 1 milliliter is a thousandths of a liter. Look at the equivalent metric units of capacity.

$$\begin{aligned} 1\,liter\,(L) &= 1,000\,milliliters\,(mL) \\ 1\,milliliter\,(mL) &= 0.001\,liter\,(L) \end{aligned} \tag{5.9.2.1}$$

When converting from a larger unit to a smaller unit, multiply by 1,000.

$$1\,L \times 1,000 = 1,000\,mL \tag{5.9.2.2}$$

When converting from a smaller unit to a larger unit, divide by 1,000.

$$1\,mL \div 1000 = 0.001\,L \tag{5.9.2.3}$$

Remember that multiplying by 1,000 is also the same as moving the decimal point 3 places to the right. Dividing by 1,000 is also the same as moving the decimal point 3 places to the left.

Here is a conversion problem.

Missing open brace for subscript

Convert liters to milliliters. Liters are larger than milliliters, so multiply by 1,000.

$$4\,L \times 1,000 = 4,000\,mL \tag{5.9.2.4}$$

4 liters is equivalent to 4,000 milliliters.

Example 5.9.2.1

Earlier, you were given a problem about Devon at the catering company.

Devon needs to find out how many liters of soup she needs for 100 guests if each serving is 375 milliliters.

First, find the total amount of what she needs to make in milliliters. Multiply 350 mL by 100.

$$350\,mL \times 100 = 35,000\,mL \tag{5.9.2.5}$$

Then, convert 35,000 milliliters to liters. A smaller unit is converting to a larger unit. Divide 35,000 mL by 1,000.

$$35,000\,mL \div 1,000 = 35\,L \tag{5.9.2.6}$$

Devon will need to make 35 liters of soup.

Example 5.9.2.2

Find the equivalent unit.

Jamie is transferring a liquid from one container to another. She transfers 2.5 liters. How many milliliters did she transfer?

First, identify the unit conversion, 2.5 liters to milliliters. A larger unit is converting to a smaller unit.

Missing open brace for subscript

Then, multiply by 1,000. You can also move the decimal point 3 places to the right.

$$2.5\,L \times 1,000 = 2,500\,mL \tag{5.9.2.7}$$

Jamie transferred 2,500 milliliters of liquid.

Example 5.9.2.3

Find the equivalent units.

Missing open brace for subscript

First, identify the unit conversion, 5 liters to milliliters. A larger unit is converting to a smaller unit.

Then, multiply by 1,000.

$$5\,L \times 1,000 = 5,000\,mL \tag{5.9.2.8}$$

5 liters is equivalent to 5,000 milliliters.

Example 5.9.2.4

Missing open brace for subscript

First, identify the unit conversion, 2,000 milliliters to liters. A smaller unit is converting to a larger unit.

Then, divide by 1,000.

$$2,000\,mL \div 1,000 = 2\,L \tag{5.9.2.9}$$

2,000 milliliters is equivalent to 2 liters.

Example 5.9.2.5

Missing open brace for subscript

First, identify the unit conversion, 2,000 milliliters to liters. A smaller unit is converting to a larger unit.

Then, divide by 1,000.

$$4,500\,mL \div 1,000 = 4.5\,L \tag{5.9.2.10}$$

4,500 milliliters is equivalent to 4.5 liters.

Review

Find the equivalent units.

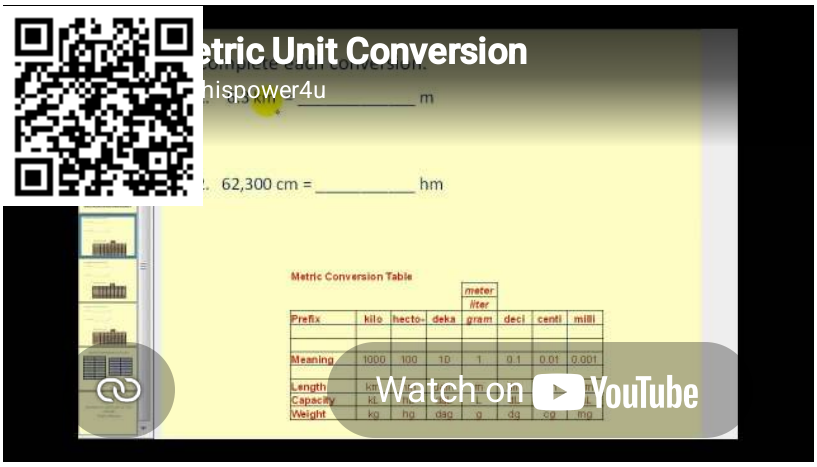
1. 4500 mL = _____ L
2. 6900 mL = _____ L
3. 4400 mL = _____ L
4. 5200 mL = _____ L
5. 1200 mL = _____ L

6. 1800 mL = _____ L
7. 2900 mL = _____ L
8. 1300 mL = _____ L
9. 2700 mL = _____ L
10. 3 L = _____ mL
11. 5.5 L = _____ mL
12. 8 L = _____ mL
13. 9.3 L = _____ mL
14. 34.5 L = _____ mL
15. 65.5 L = _____ mL

Answer

To see the Review answers, open this PDF file and look for section 4.18.

Resources



Additional Videos

Metric Unit Conversion

Conversion Between Metric Units

Converting Between Liters and Milliliters

Measuring Capacity in Milliliter - Overview

Measuring Capacity in Milliliter - Example 1

Measuring Capacity in Milliliter - Example 2

Capacity in Liters - Overview

Capacity in Liters - Example 1

Capacity in Liters - Example 2

Capacity in Liters - Example 3

Capacity in Liters - Example 4

Capacity in Liters - Example 5

Word Problems for Capacity in Liters - Overview

Word Problems for Capacity in Liters - Example 1

Word Problems for Capacity in Liters - Example 2

Word Problems for Capacity in Liters - Example 3

Word Problems for Capacity in Liters - Example 4

Word Problems for Capacity in Liters - Example 5

Overview of Conversion of Capacity Units (Metric Units)

Understanding Capacity - Enrichment - Example 1

Understanding Capacity - Enrichment - Example 2

Additional Practice and Other

Measuring Water Interactive

Meaningful Metrics - find out why understanding metric units of capacity is an important part of a pharmacy technician's job.

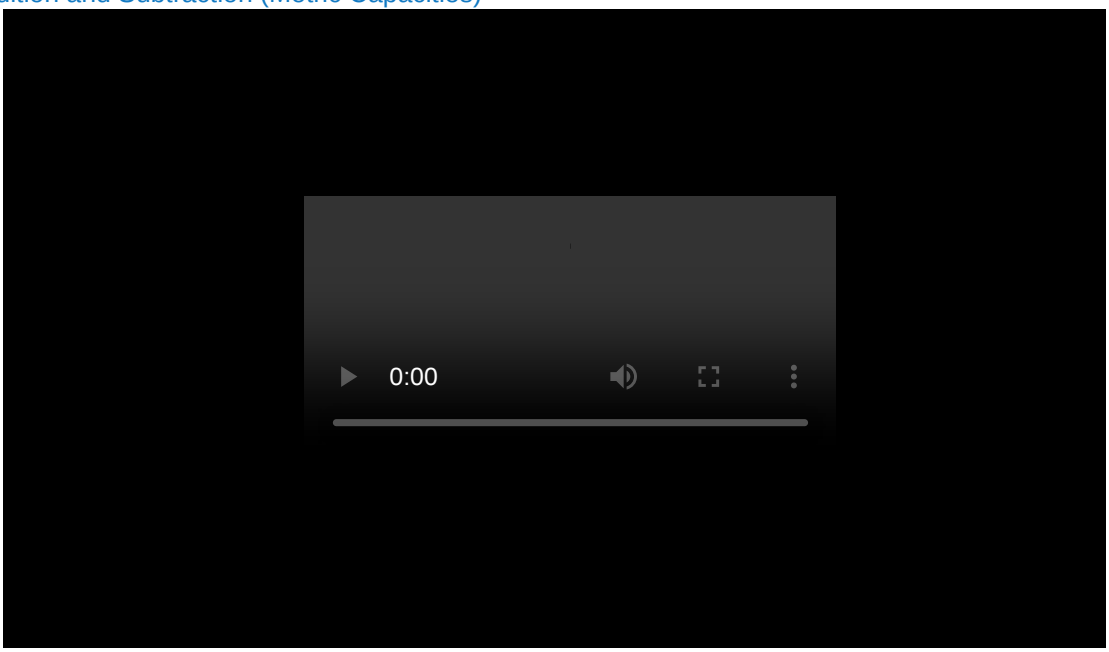
Metric Conversion of Liters and Milliliters to Find Equivalent Units Practice

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5.9.3: Mixed Operations Addition and Subtraction Metric Capacities

Add or subtract given volumes and represent them in both liters and milliliters.

Mixed Operations - Addition and Subtraction (Metric Capacities)



Practice Resource

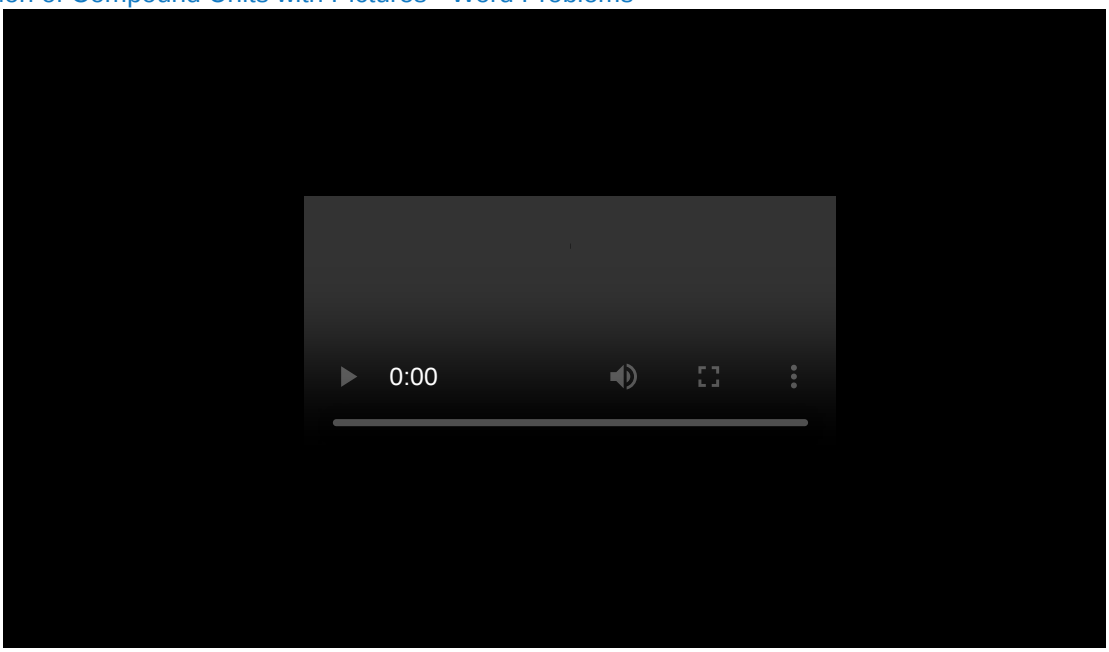
Mixed Operations Addition and Subtraction Metric Capacities Practice

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5.9.4: Multiply and Divide Then Convert - Mixed Metric Capacities Applications

Multiply to find the total volume and divide to find the volume of one part then represent the values using both liters and milliliters.

Multiplication and division of Compound Units with Pictures - Word Problems



Further Practice

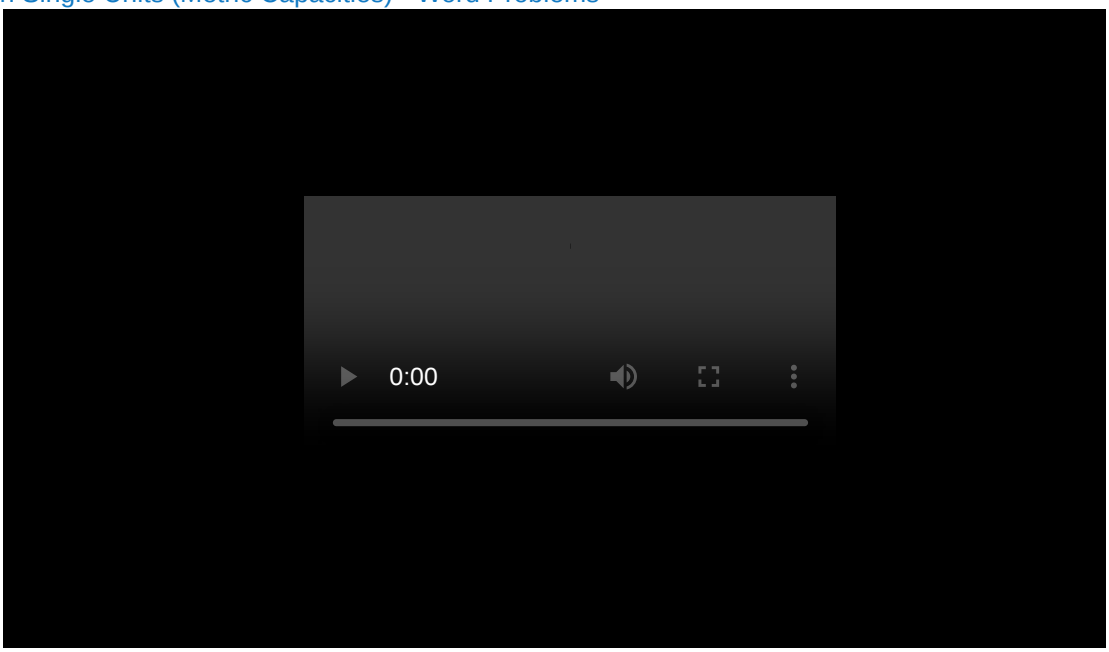
Multiply and Divide then Convert Mixed Metric Capacities Applications Practice

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5.9.5: Multi-Step - Four-Operations Applications

Use the four basic operations to find the unknown volume using given volumes.

Two-step Problems with Single Units (Metric Capacities) - Word Problems



Practice Resource

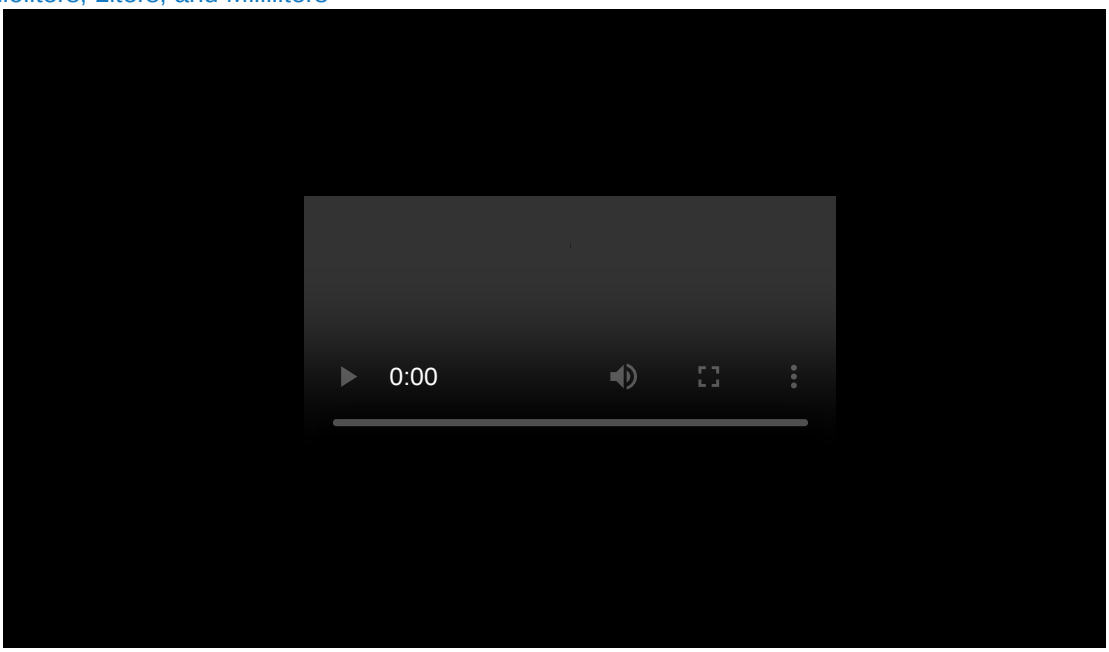
Multi-step Four Operations Applications Practice

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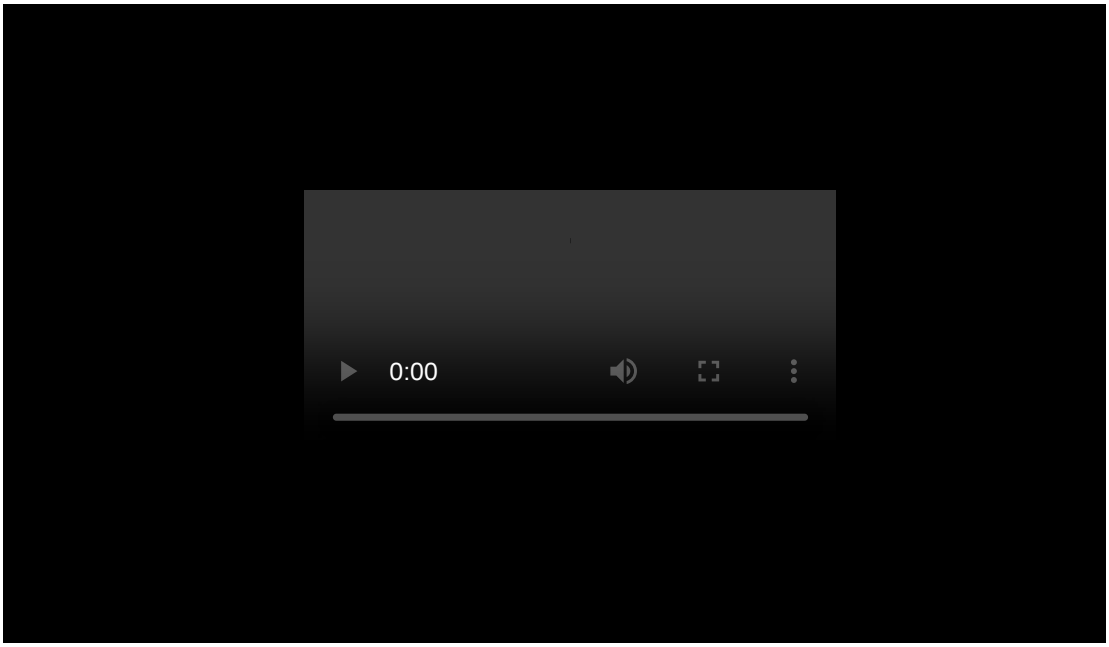
5.9.6: Convert between Kiloliters, Milliliters, and Liters

Convert interchangeably between kiloliters, milliliters, and liters by moving the decimal place left or right.

Converting Between Kiloliters, Liters, and Milliliters



Converting Between Kiloliters and Liters



Practice Resource

Convert Between Kiloliters Milliliters and Liters Practice

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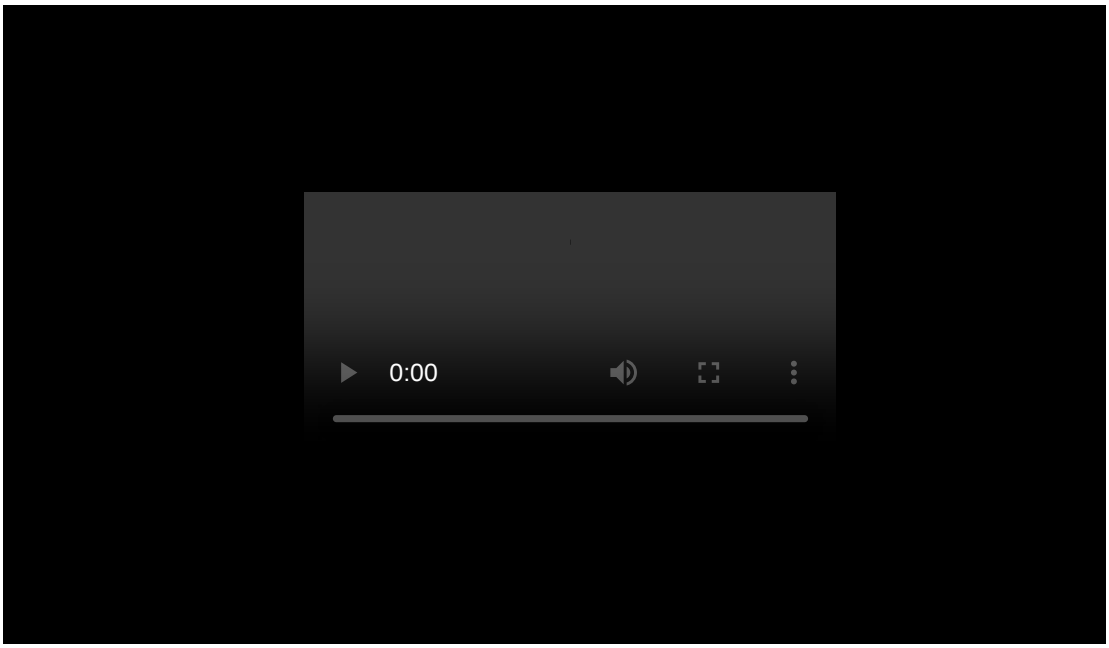
5.10: Compound Metric Units of Capacity

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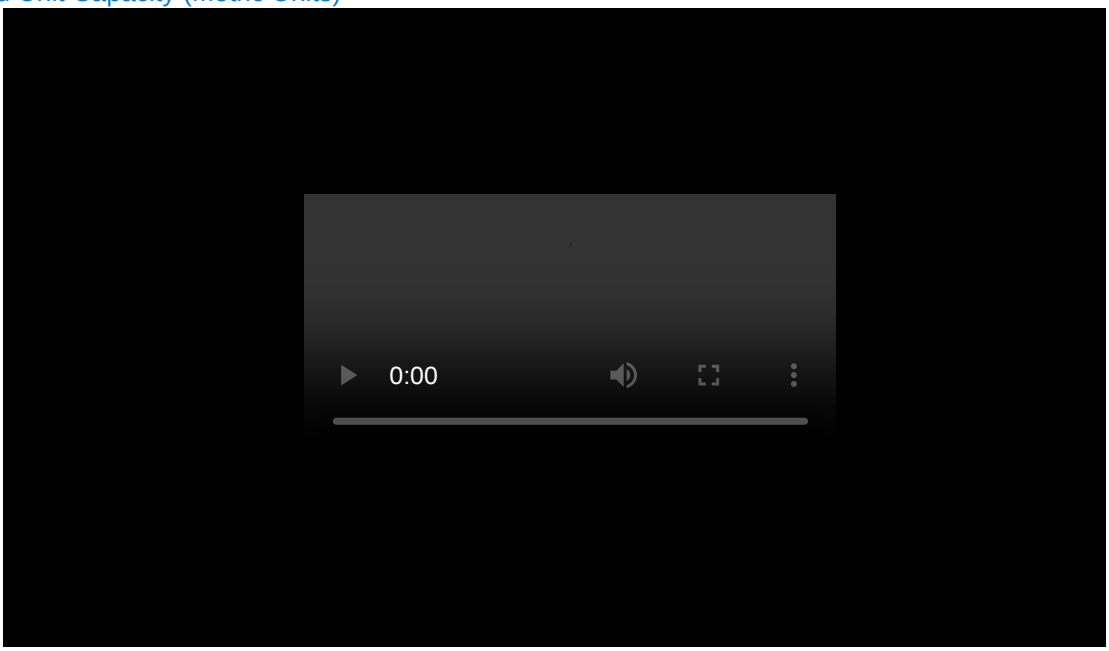
5.10.1: Convert between Liters and Milliliters

Moving the decimal 3 places to the left to convert from liters to milliliters and 3 places to the right for milliliters to liters.

Converting Between Liters and Milliliters II



Overview of Compound Unit Capacity (Metric Units)



Practice Resource

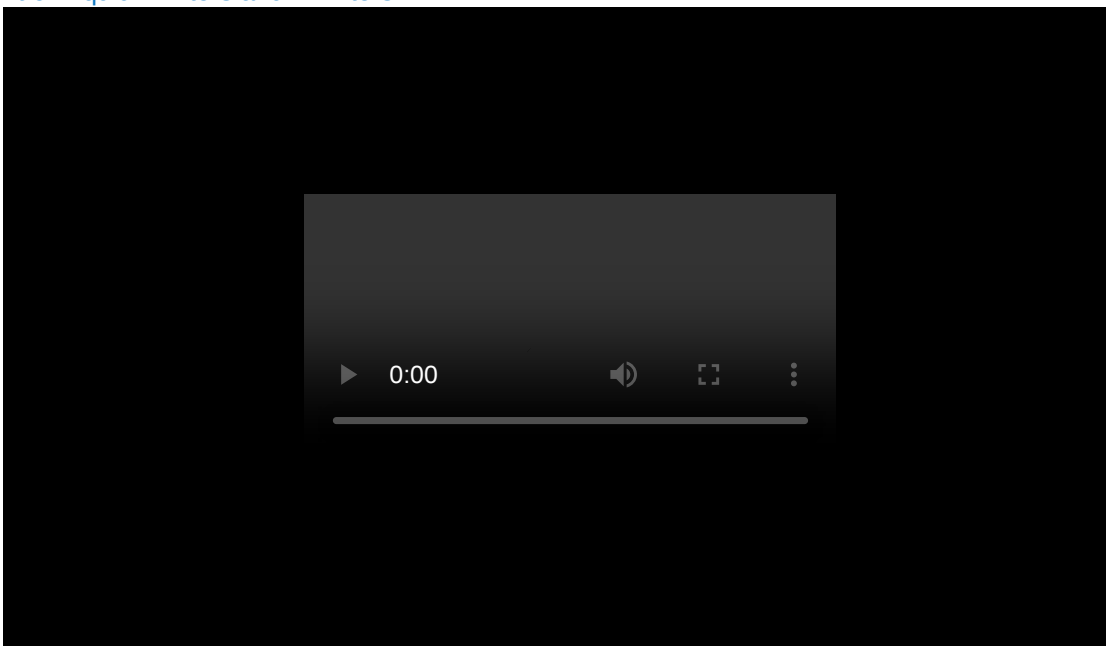
Convert between Liters and Milliliters Practice

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5.10.2: Add and Convert to find Liters and Milliliters

Look at beakers and find the volume of each liquid, then convert all volumes to the same unit so you can add them with ease. Then, represent them in liters and milliliters.

Finding the Total Amount of Liquid in Liters and Milliliters



Practice Resource

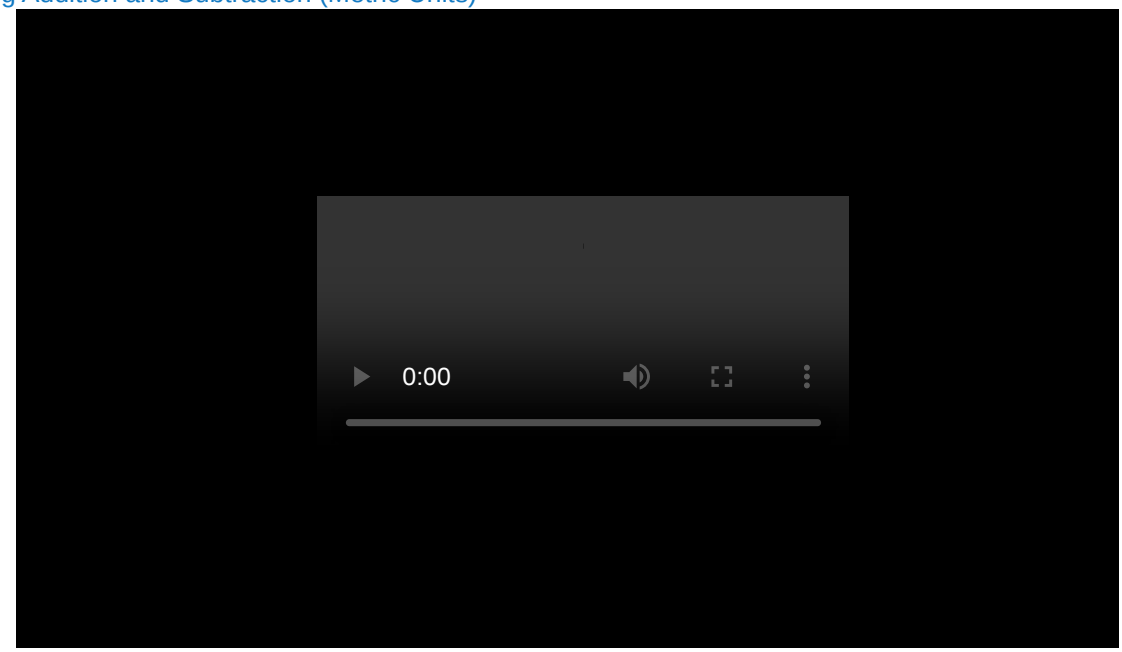
Add and Convert to Find Liters and Milliliters Practice

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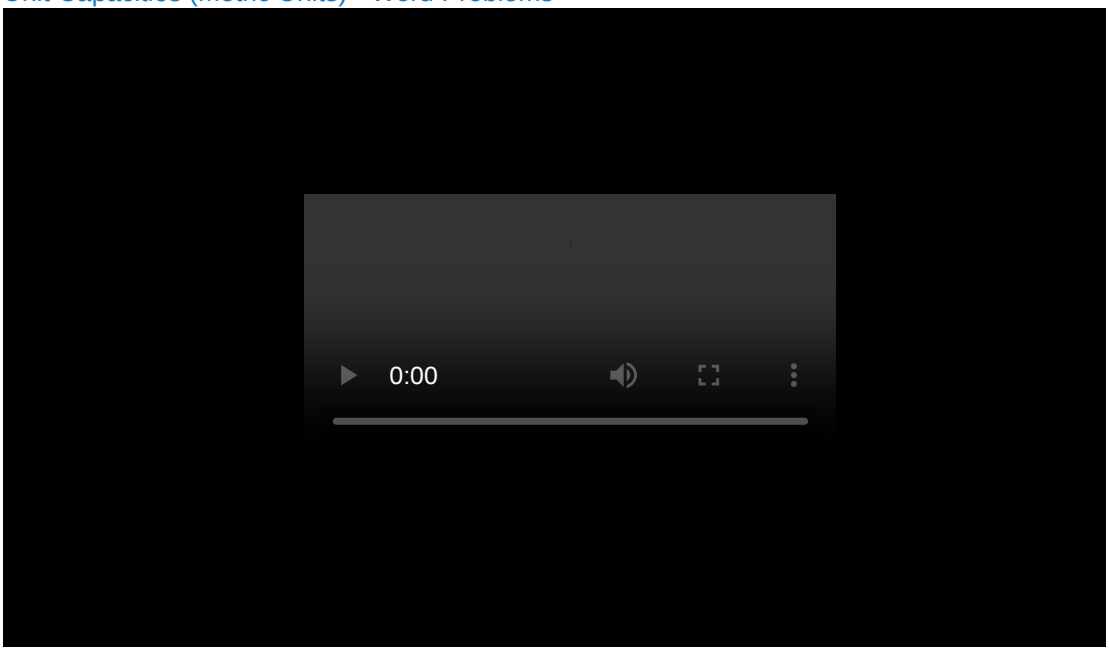
5.10.3: Add Subtract and Convert to find Liters and Milliliters

Convert the given volumes to the same units, then add or subtract. Put the final answer in liters and milliliters.

Combining Units Using Addition and Subtraction (Metric Units)



Addition of Compound Unit Capacities (Metric Units) - Word Problems



Practice Resource

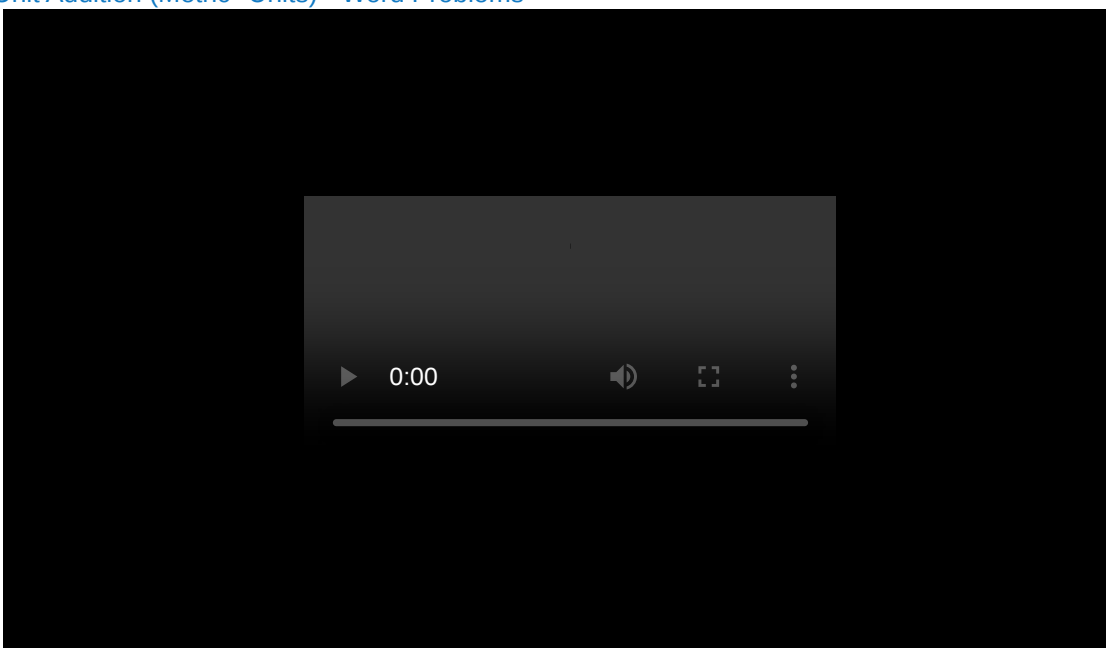
Add Subtract and Convert to Find Liters and Milliliters Practice

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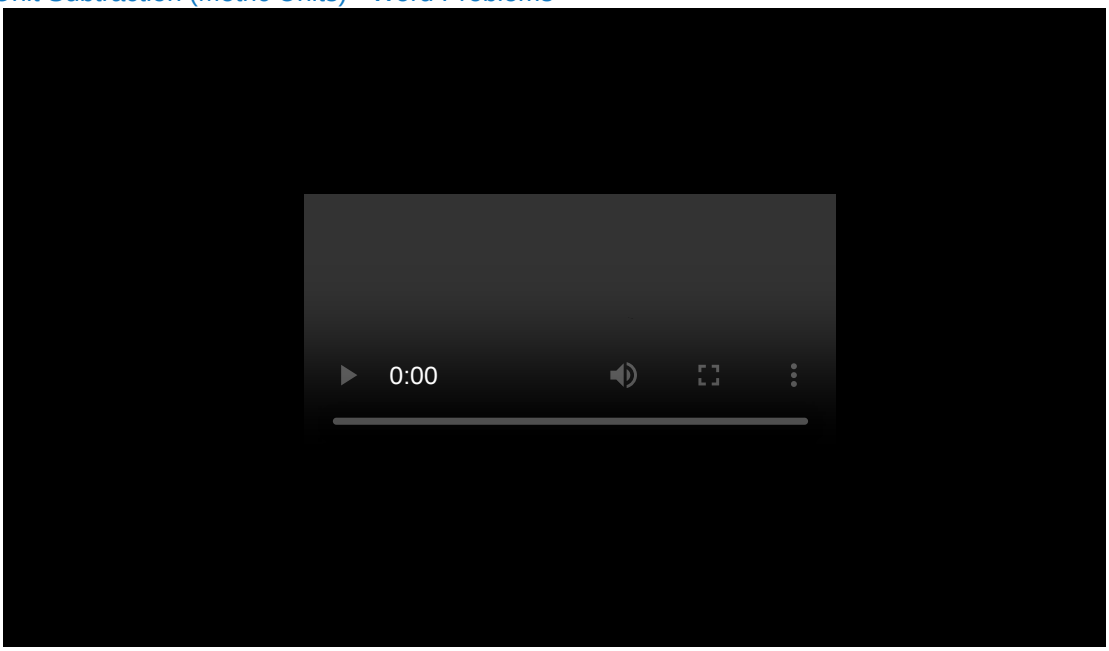
5.10.4: Addition and Subtraction Multi-Step Compound Unit Applications

Solve word problems using addition and subtraction to find the final amount of liquid in a container

Multi-step Compound Unit Addition (Metric--Units) - Word Problems



Multi-step Compound Unit Subtraction (Metric Units) - Word Problems



Practice Resource

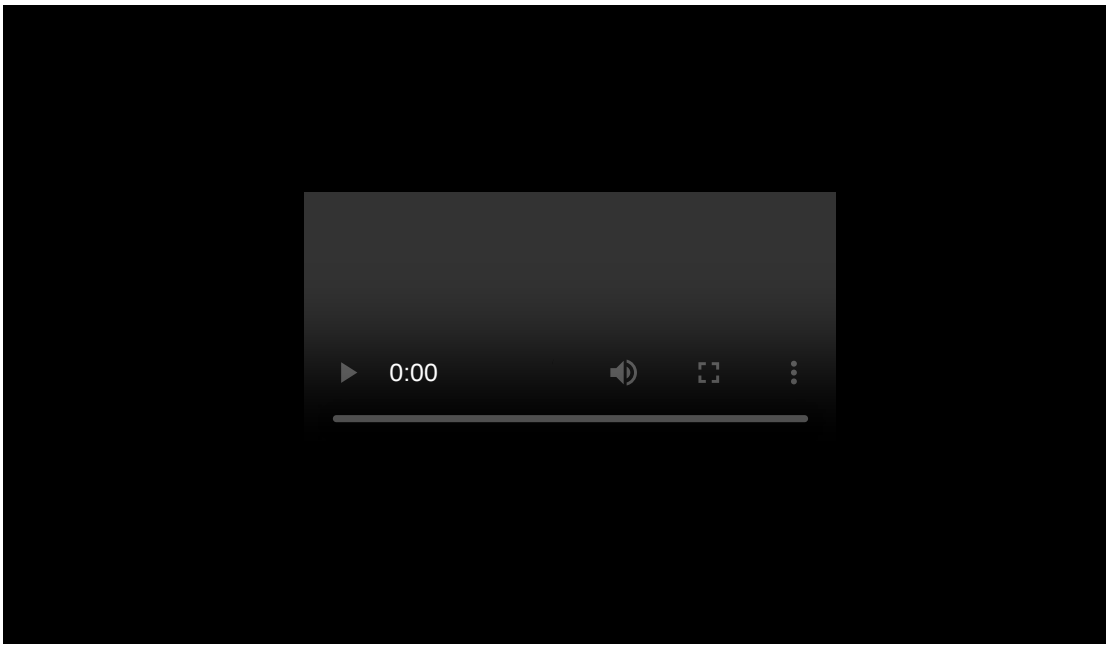
Addition and Subtraction Multi-step Compound Unit Applications Practice

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5.10.5: Multiply and Convert to find Liters and Milliliters Applications

Solve word problems that require you to multiply the proportional volume by the volume you are trying to acquire.

Compound Unit Multiplication - Word Problems



Practice Resource

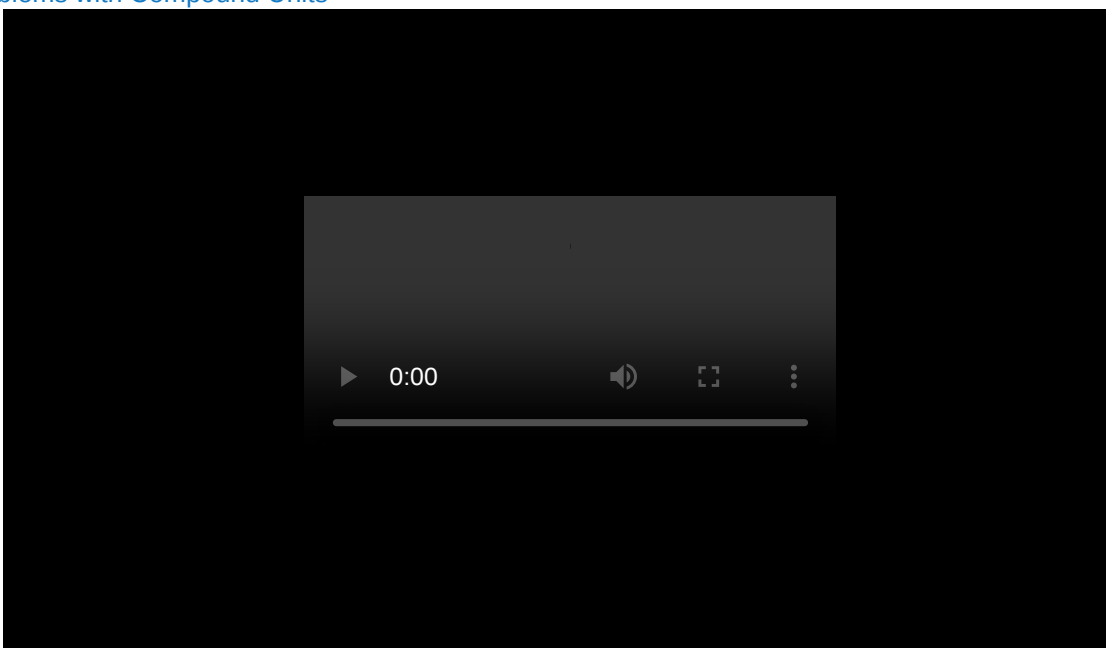
Multiply and Convert to Find Liters and Milliliters Applications Practice

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5.10.6: Divide and Convert to find Liters and Milliliters Applications

Use multi-step division to solve compound unit problems

Multi-step Division Problems with Compound Units



Practice Resource

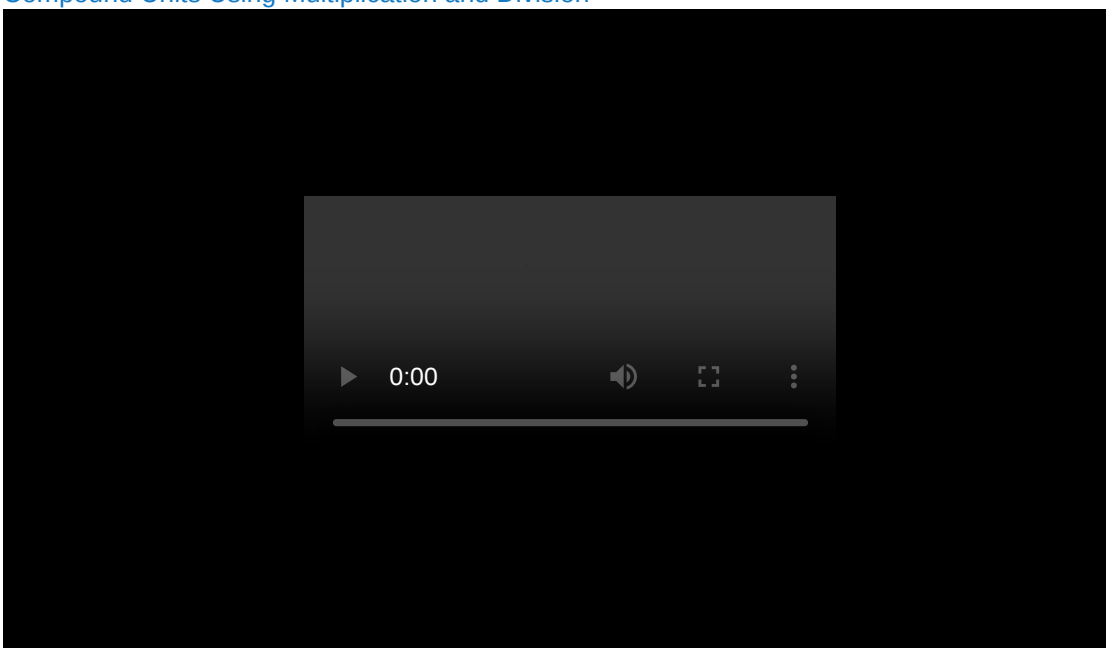
Divide and Convert to Find Liters and Milliliters Applications Practice

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5.10.7: Multiply, Divide and Convert to find Liters and Milliliters Applications

Convert all values into the same units than use multiplication and division to find the total cost or amount for the given value.

Mixed Operations with Compound Units Using Multiplication and Division



Practice Resource

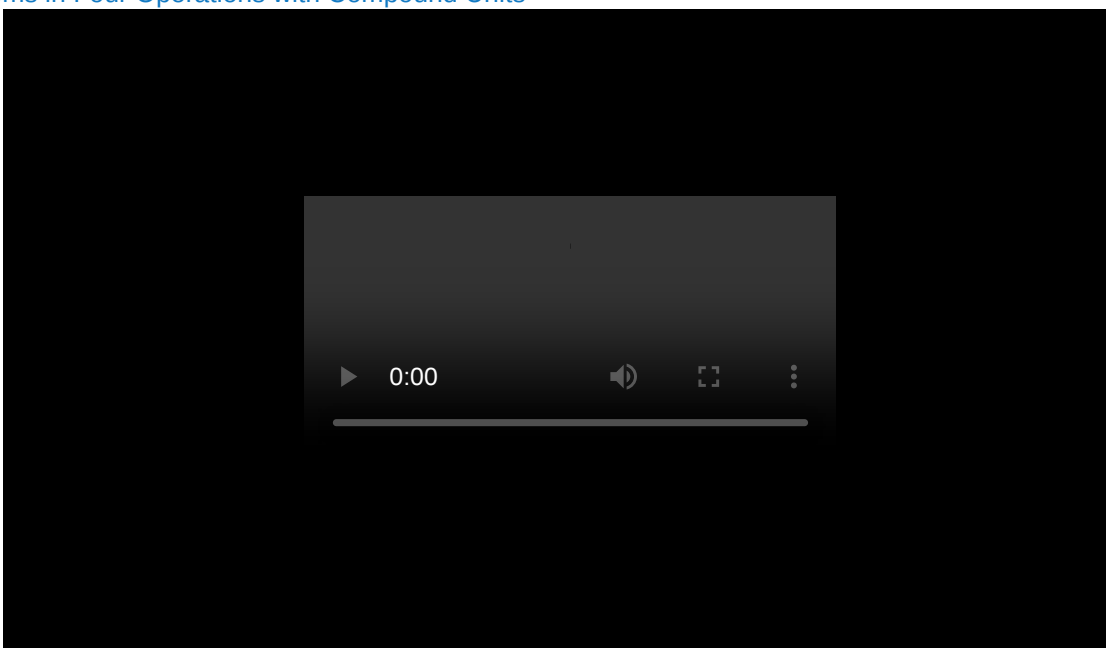
Multiply Divide and Convert to find Liters and Milliliters Applications Practice

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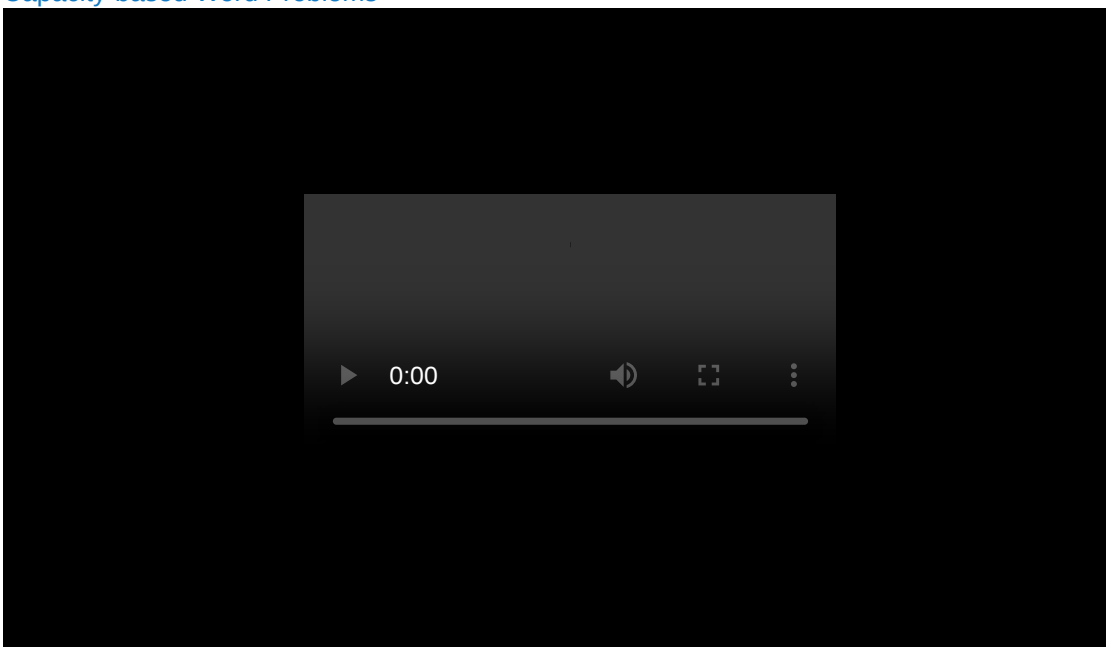
5.10.8: Mixed-Operation Multi-Step Compound-Conversion Applications

Word Problems requiring the use of mixed operations and multi-step compound unit conversion.

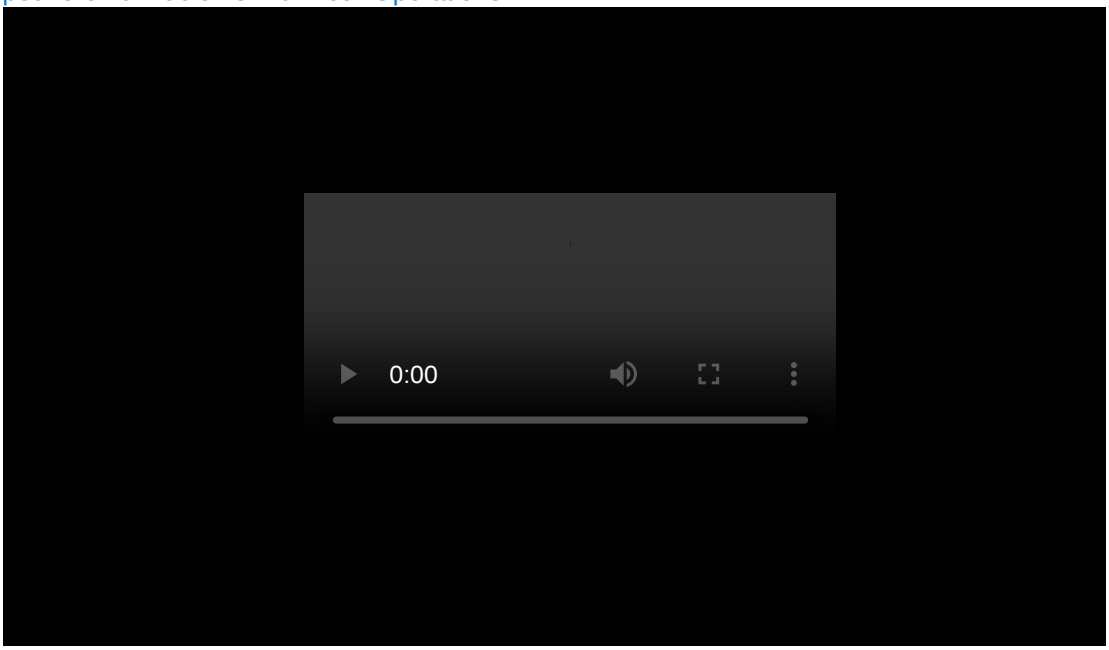
Multi-step Word Problems in Four Operations with Compound Units



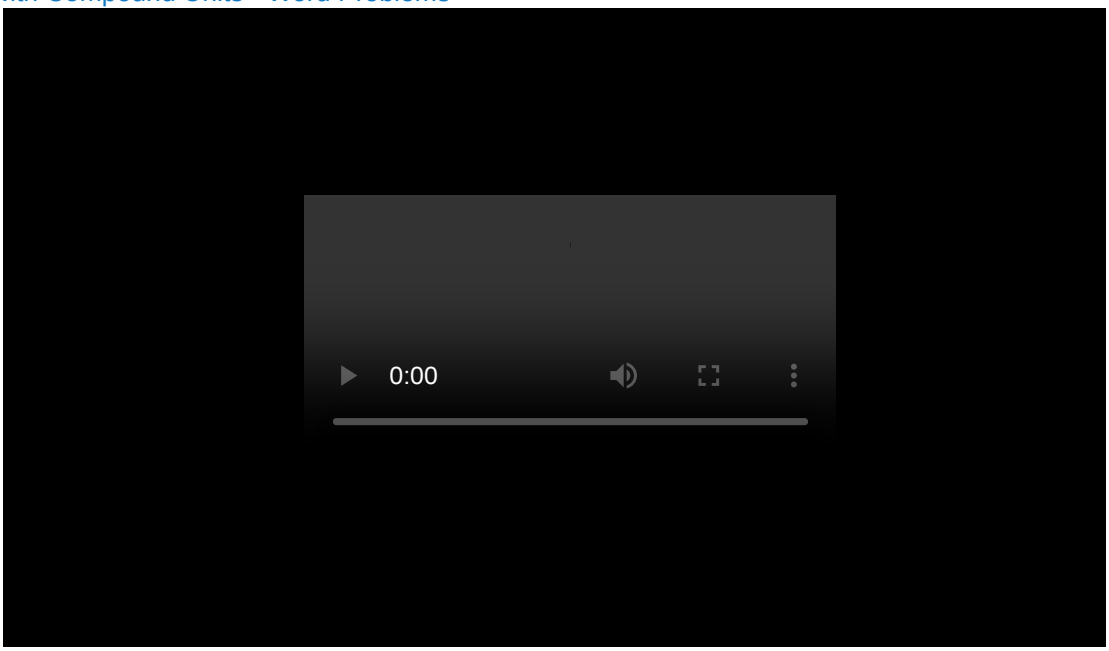
Overview of Multi-step Capacity-based Word Problems



Solving Two-Step Compound-unit Problems with Four Operations



Overview of Capacity with Compound Units - Word Problems



Practice Resource

Mixed Operation Multi-step Compound Conversion Applications Practice

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CHAPTER OVERVIEW

6: Weight and Mass

- 6.1: Measuring Weight and Mass
  - 6.1.1: Visually Identify Equal Weight
  - 6.1.2: Visually Compare Weight
  - 6.1.3: Identify and Order Lightest and Heaviest
- 6.2: Convert Customary Units of Weight
  - 6.2.1: Read the Compound Units in Pounds and Ounces
  - 6.2.2: Convert Pounds and Ounces into Ounces
  - 6.2.3: Convert Ounces into Pounds and Ounces
  - 6.2.4: Convert Between Ounces Pounds and Tons
  - 6.2.5: Convert then Compare Values of Compound Units
- 6.3: Customary Weight Operations
  - 6.3.1: Add Customary Units of Weight Including Applications
  - 6.3.2: Subtract Customary Units of Weight Including Applications
  - 6.3.3: Add and Subtract Compound Customary Units of Weight Applications
  - 6.3.4: Multiply and Divide Compound Customary Units of Weight Applications
  - 6.3.5: Four-Operation Compound Customary Units of Weight Applications
- 6.4: Metric Weight Operations
  - 6.4.1: Add Metric Weight
    - 6.4.1.1: Add Weights in Grams
    - 6.4.1.2: Add Weights in Kilograms
    - 6.4.1.3: Add Weights in Grams or Kilograms Applications
    - 6.4.1.4: Add Compound Units
  - 6.4.2: Subtract Metric Weight
    - 6.4.2.1: Subtract Weights in Grams
    - 6.4.2.2: Subtract Weights in Grams Applications
    - 6.4.2.3: Subtract Weights in Kilograms
    - 6.4.2.4: Subtract Compound Units
    - 6.4.2.5: Subtract and Convert Using Compound Units Applications
  - 6.4.3: Add and Subtract Metric Weight
    - 6.4.3.1: Add, Subtract and Compare Mass in Grams Multi-Step Applications
    - 6.4.3.2: Add and Subtract and Convert Compound Units
    - 6.4.3.3: Add, Subtract and Compare Grams and Kilograms Multi-Step Applications
  - 6.4.4: Multiply and Divide Metric Weight
    - 6.4.4.1: Multiply to Find the Weight in Grams or Kilograms
    - 6.4.4.2: Divide to Find the Weight in Grams or Kilograms
    - 6.4.4.3: Multiply and Divide to Find the Weight in Grams or Kilograms Applications
  - 6.4.5: Mixed Operations to find Metric Weight
    - 6.4.5.1: Use the Four Operations to Find Weight in Grams and/or Kilograms Applications
    - 6.4.5.2: Higher Order Four-Operations to Find Weight in Grams or Kilograms Applications

6.5: Convert Metric Units of Weight
6.5.1: Identify Weight in Kilograms and Grams
6.5.2: Convert Between Kilograms and Grams
6.5.3: Convert Between Kilograms and Grams and Milligrams

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6.1.1: Visually Identify Equal Weight

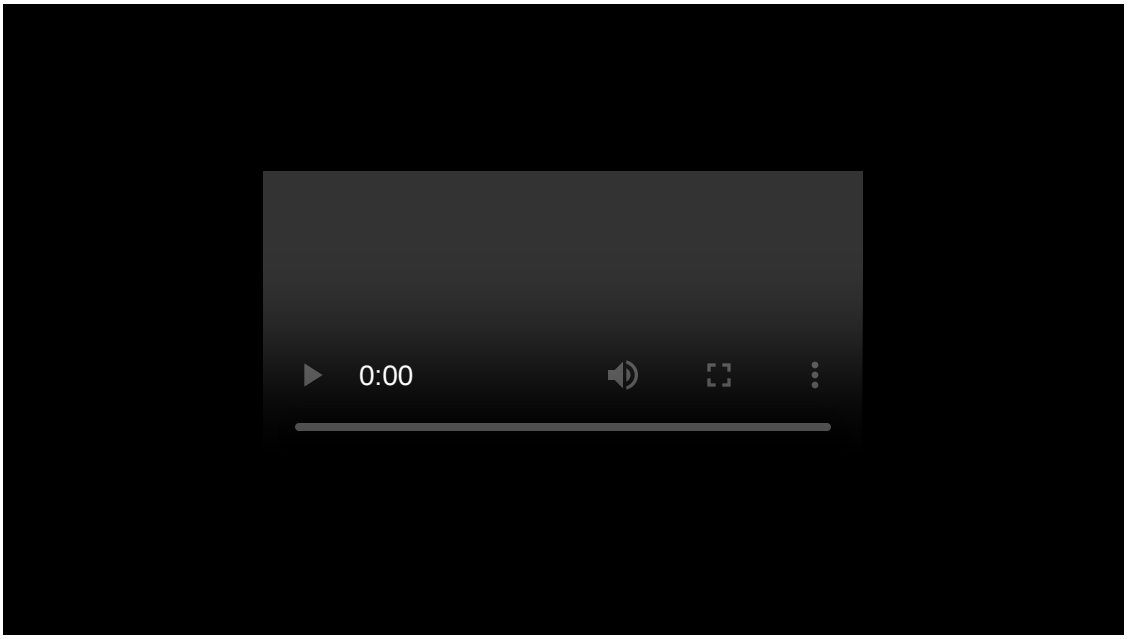
6.1.2: Visually Compare Weight

6.1.3: Identify and Order Lightest and Heaviest

6.1.1: Visually Identify Equal Weight

Determine how to balance a scale by comparing weights of two different objects.

Using Pictures to Balance a Sale (Metric Units)



Practice Resource

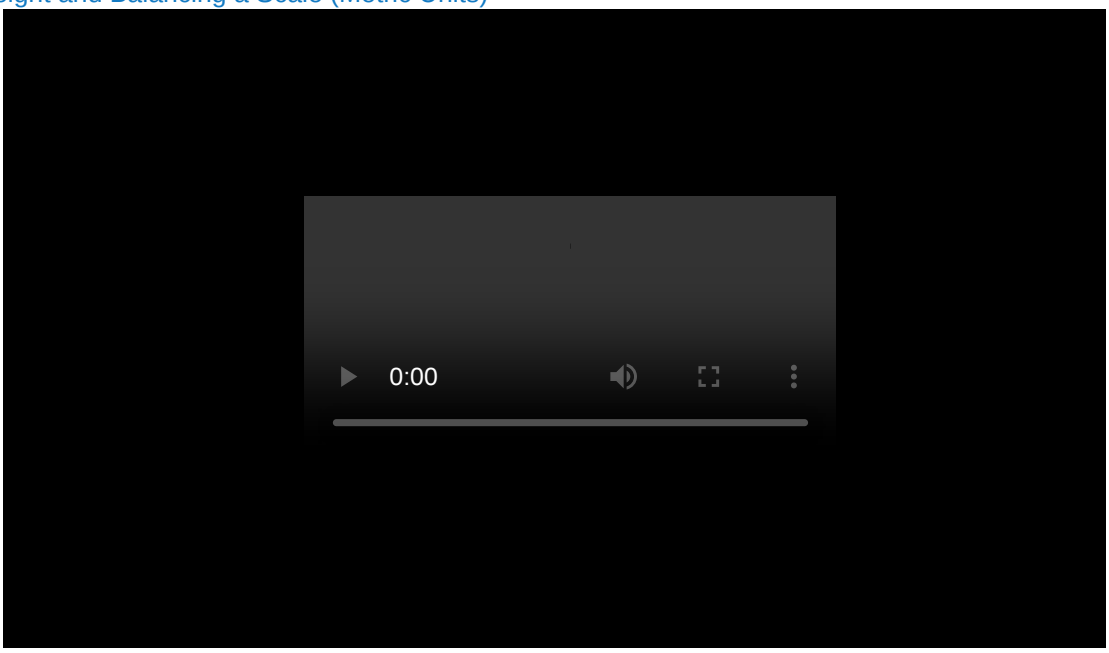
Visually Identify Equal Weight

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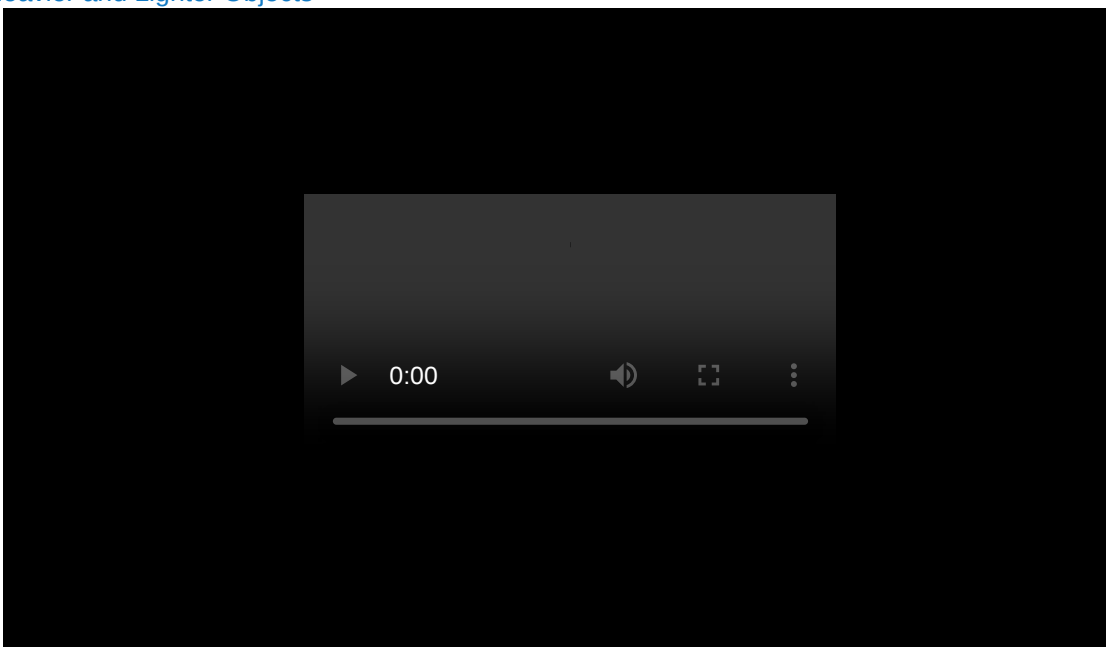
6.1.2: Visually Compare Weight

Look at balances and determine which item is the heaviest or lightest. The item that is heavier will be closer to the ground.

Visually Comparing Weight and Balancing a Scale (Metric Units)



Using Scales to Find Heavier and Lighter Objects



Practice Resource

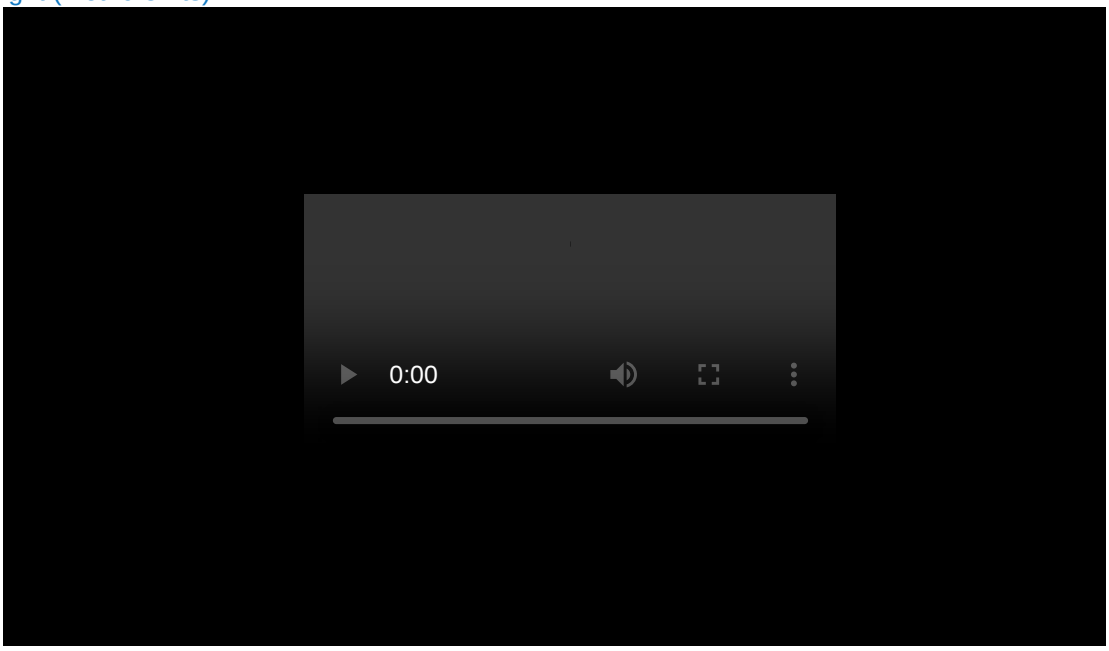
Visually Compare Weight

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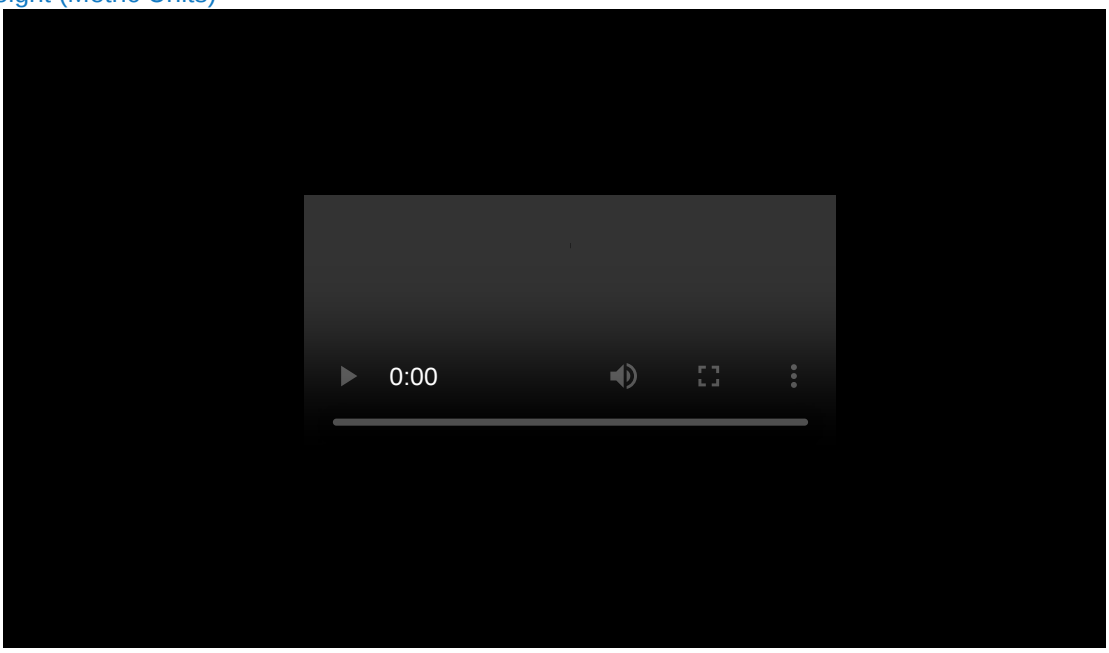
6.1.3: Identify and Order Lightest and Heaviest

Find the lightest and heaviest item by comparing weights that are in both grams and kilograms. Convert all values into the same units to make comparing easier.

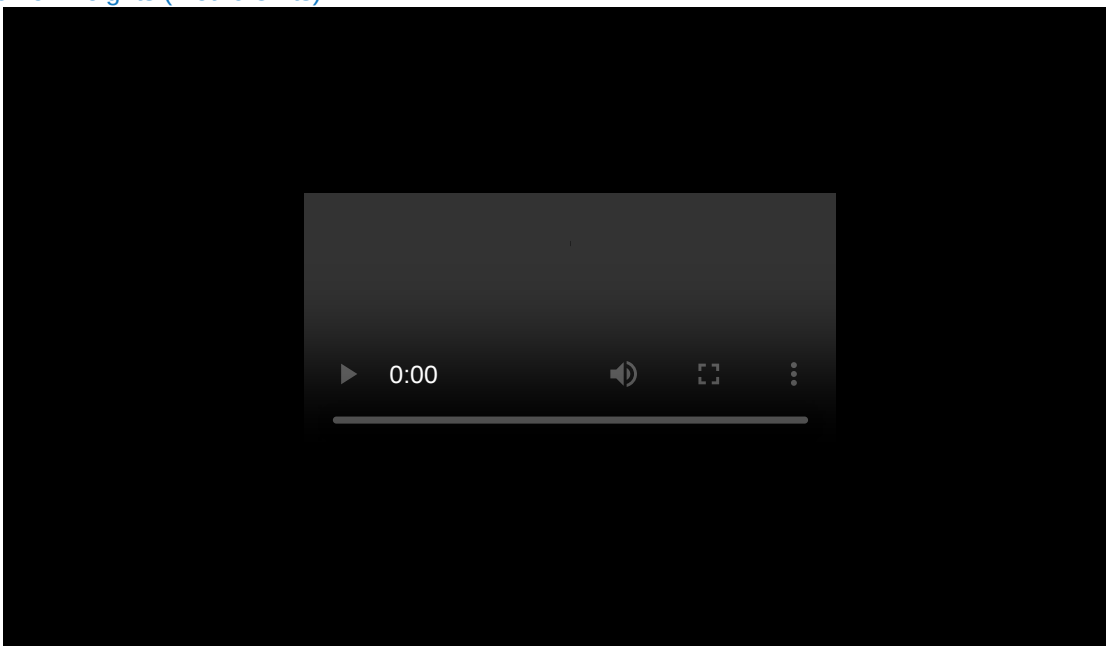
Ordering Based on Weight (Metric Units)



Selection Based on Weight (Metric Units)



Overview of Comparison of Weights (Metric Units)



Practice Resource

Identify and Order Lightest and Heaviest

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6.2.1: Read the Compound Units in Pounds and Ounces

6.2.2: Convert Pounds and Ounces into Ounces

6.2.3: Convert Ounces into Pounds and Ounces

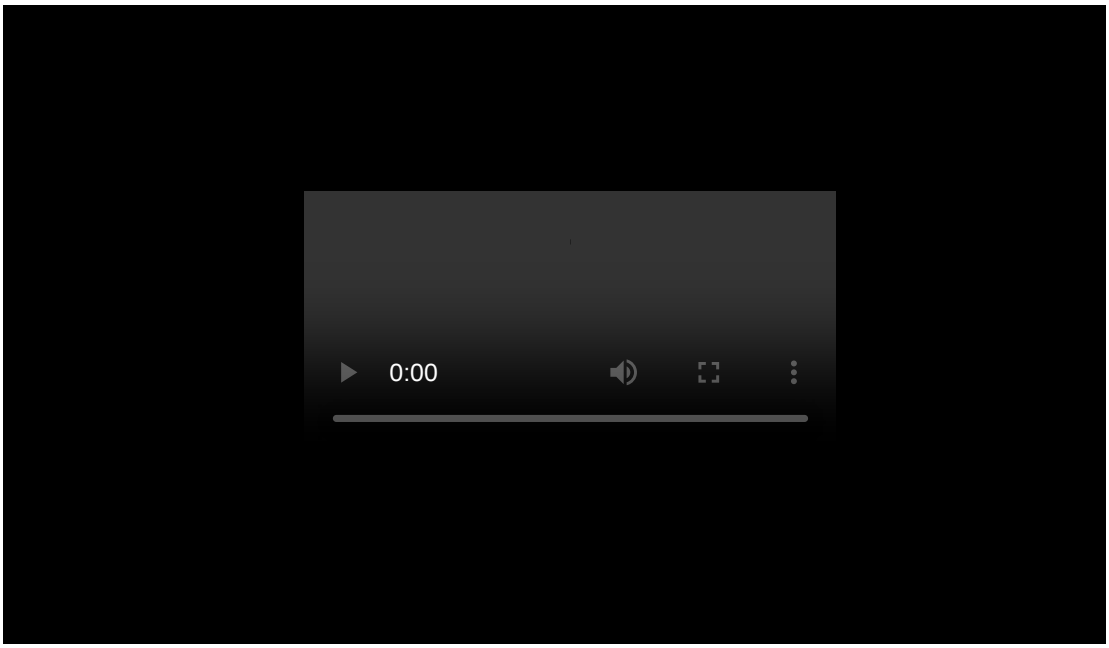
6.2.4: Convert Between Ounces Pounds and Tons

6.2.5: Convert then Compare Values of Compound Units

6.2.1: Read the Compound Units in Pounds and Ounces

Read a scale that includes both pounds and ounces. Pounds are represented with the bigger ticks with numbers. The smaller ticks are ounces.

Reading the Compound Units in Pounds and Ounces



Practice Resource

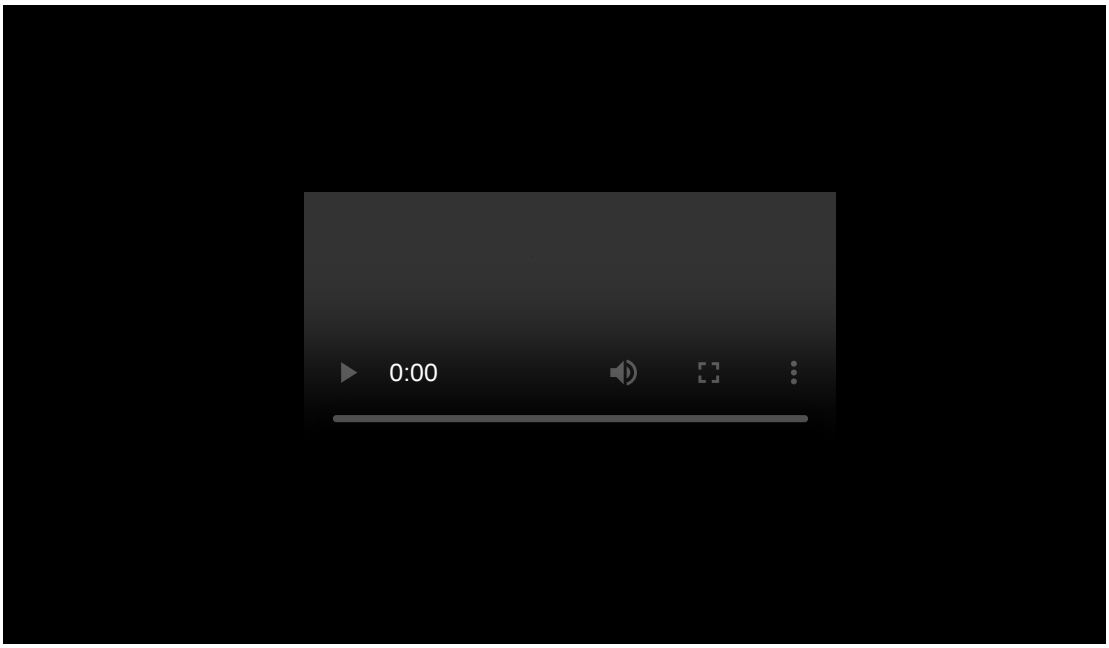
Read the Compound Units in Pounds and Ounces

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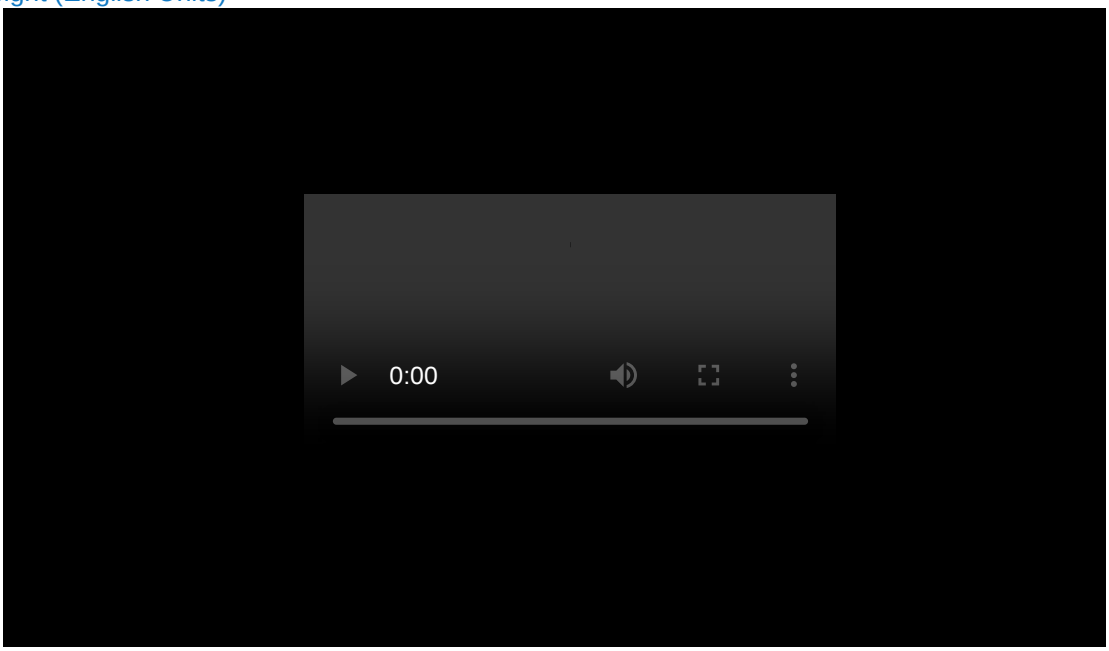
6.2.2: Convert Pounds and Ounces into Ounces

Convert pounds to ounces by multiplying by 16.

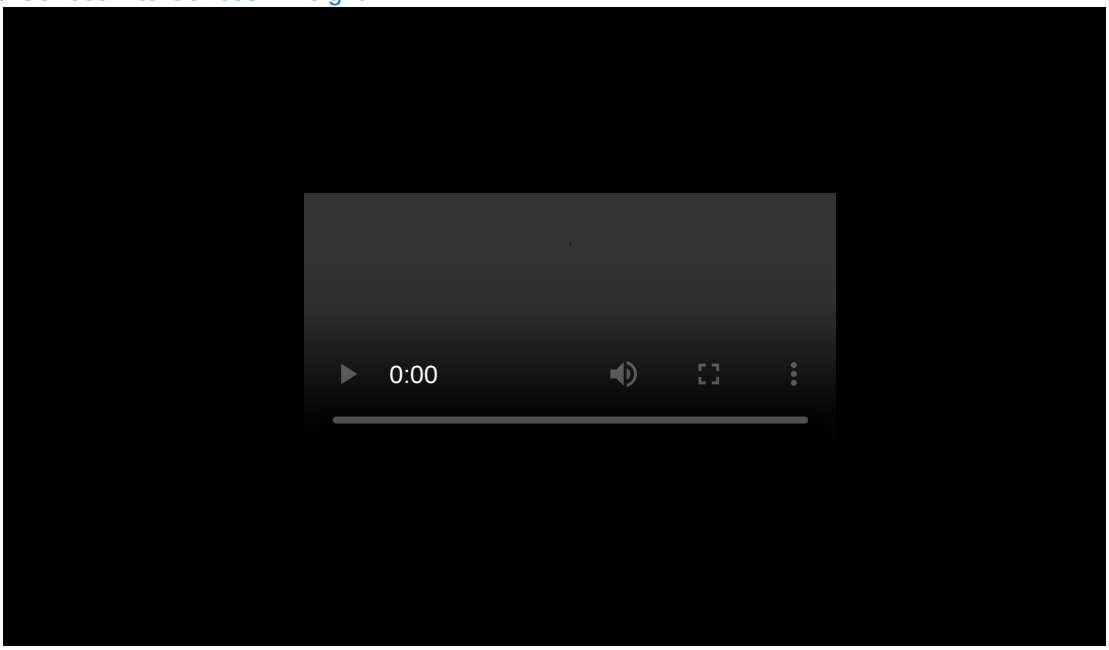
Conversion of Pounds and Ounces into Ounces



Overview of Unit of Weight (English Units)



Converting Pounds and Ounces into Ounces - Weight



Practice Resource

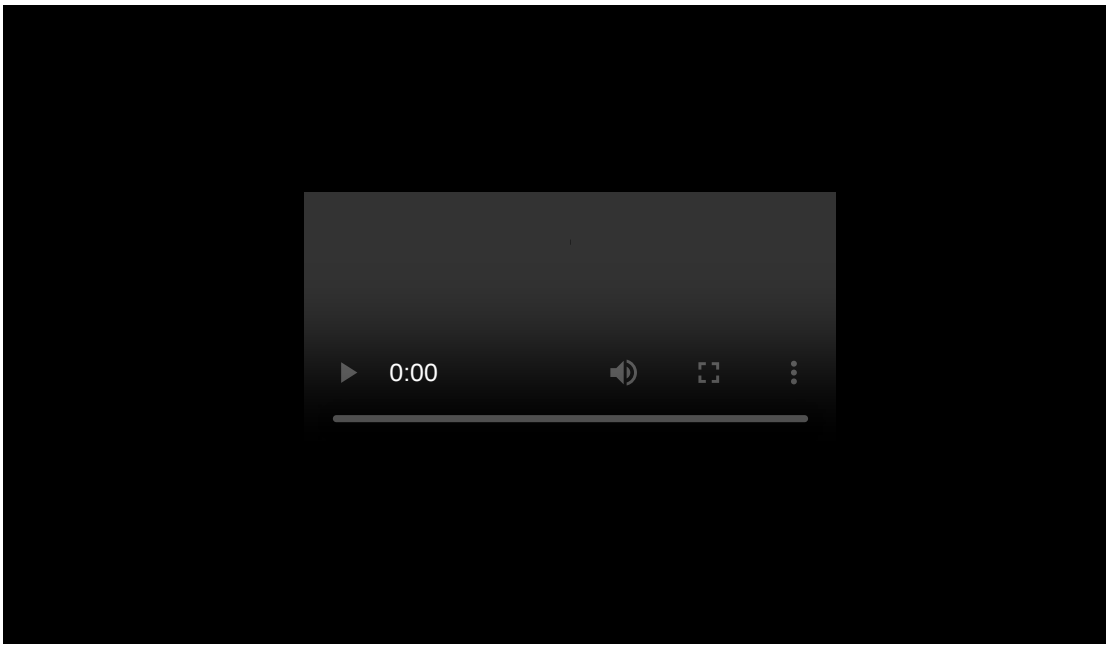
Convert Pounds and Ounces into Ounces

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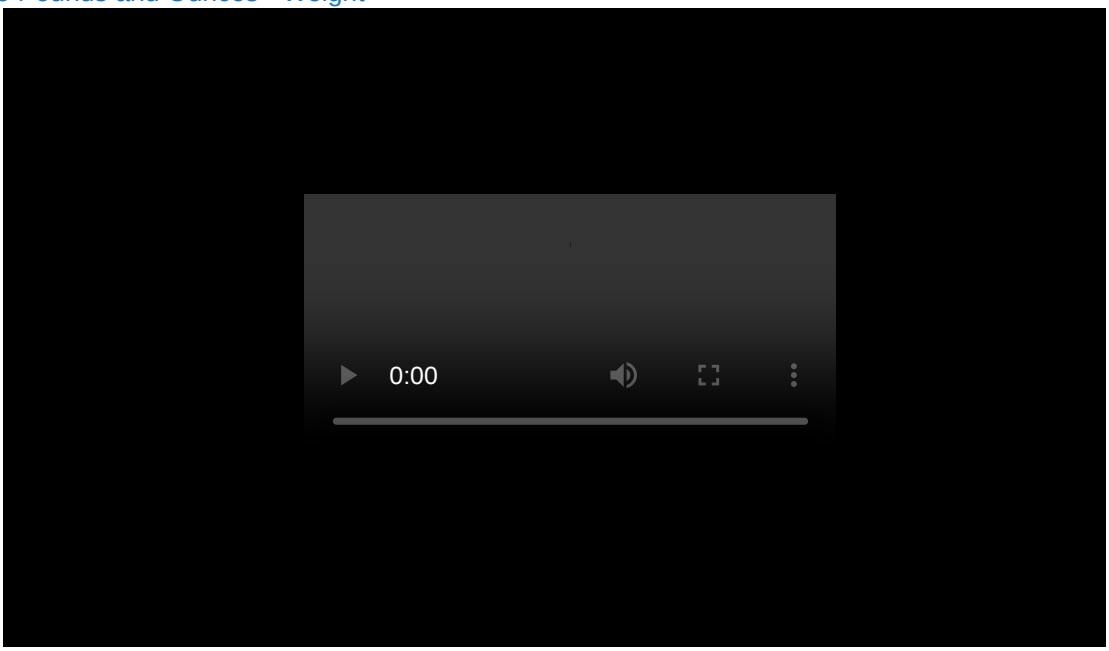
6.2.3: Convert Ounces into Pounds and Ounces

Convert ounces to pounds by dividing by 16

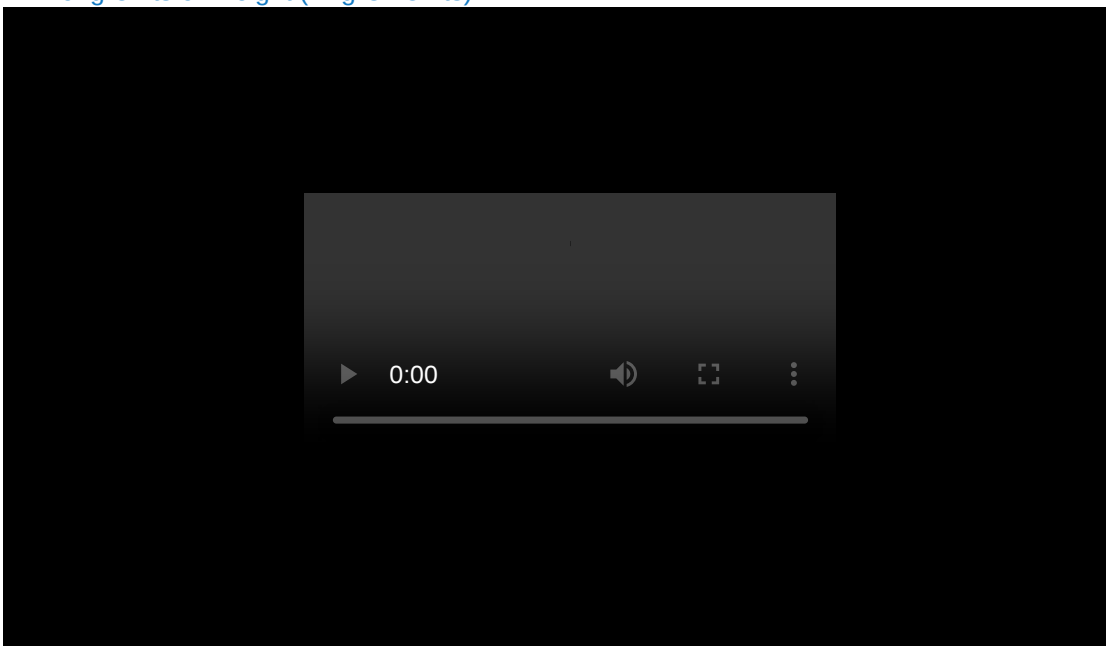
Conversion of Ounces into Pounds and Ounces



Converting Ounces into Pounds and Ounces - Weight



Overview of Conversion Among Units of Weight (English Units)



Practice Resource

Convert Ounces into Pounds and Ounces Practice

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6.2.4: Convert Between Ounces Pounds and Tons



Figure **6.2.4.1**

While reading a book about marine animals, Sarah learns that the average humpback whale can weigh 40 tons. Yesterday, she learned that a polar bear weighs about 1000 pounds. How many polar bears will equal the weight of a humpback whale?

In this concept, you will learn about customary units of weight.

Identifying Equal Customary Units of Weight

The United States uses the **customary system** of measurement. Measurements of length consist of units like inches, feet, yards and miles. The metric system is another system of measurement that is used in science and in most other countries.

Weight describes the heaviness or the way a mass of something, or someone, feels due to gravity. The customary units for measuring weight are **ounces**, pounds and tons.

Here are the customary units of weight from smallest to largest.

1. Ounce
2. Pound
3. **Ton**

When working with measures of weight, you can compare the equivalence of a small unit to a larger one. Remember, the word equivalent refers to something being equal to something else. Here are the customary units of equivalence.

Customary Units of Weight:

ounces (oz)	pounds (lb)	tons
16	1	
	2 000	1

Large to small: multiply

Small to large: divide

Figure **6.2.4.2**

You can find equivalent measures for each unit by using the information in the table. Convert from a larger unit to a smaller unit by multiplying. Convert from a smaller unit to a larger unit by dividing.

Use the information in the table to convert customary units of weight.

3 pounds = _____ ounces

First, figure out if you need to multiply or divide. Check the units. A pound is larger than an ounce, so you are going to multiply.

Then, check the table for the unit equivalence.

1 pound = 16 ounces

Finally, multiply the number of pounds times 16 to get the total number of ounces.

3 × 16 = 48

3 pounds is equivalent to 48 ounces.

Here is another conversion problem.

6,200 pounds = _____ tons

First, figure out if you need to multiply or divide. Check the units. You are converting a smaller unit to a larger unit, so divide.

Then, check the table for the unit equivalence.

2,000 pounds = 1 ton

Finally, divide the number of pounds by 2,000.

6,200 ÷ 2,000 = 3.1

6,200 pounds is equivalent to 3.1 tons.

Notice that the unit equivalent of 6,200 pounds to tons is not a whole number. Units of weight can be written as a fraction, a decimal, or with a remainder. A tenth of a ton is equal to 200 pounds.

Fractional answer: $6,200 \div 2,000 = \frac{6,200}{2,000} = 3\frac{200}{2,000} = 3\frac{1}{10} tons$

Decimal answer: $6,200 \div 2,000 = 3.1 tons$

Remainder answer: $6,200 \div 2,000 = 3\,R\,200 = 3\,tons\,200\,lbs$

Examples

Example 1

Earlier, you were given a problem about Sarah and the animals.

Sarah knows that a polar bear weighs about 1000 pounds and a humpback whale weighs about 40 tons. Convert 40 tons to pounds to find the number of polar bears it would take to equal the weight of a humpback whale.

40 tons = _____ pounds

First, check if you will multiply or divide. A ton is larger than a pound. Multiply when converting from a larger to a smaller unit.

Then, find the unit equivalence.

2,000 pounds = 1 ton

Next, multiply the number of tons by the unit equivalence.

40 times 2,000 = 80,000

Finally, divide the weight of the whale, in pounds, by the weight of the polar bear, in pounds.

80,000 pounds divided by 1000 pounds = 80

Sarah calculates that it will take about 80 polar bears to equal the weight of a humpback whale!

Example 2

Convert the customary unit of weight.

A male African elephant usually weighs between 6 and 8 tons. If this the range of his weight in tons, what is the range of his weight in pounds?

First, decide if this conversion requires multiplication or division. Converting a larger unit to a smaller unit requires multiplication.

6 tons = _____ pounds

8 tons = _____ pounds

Then, use the unit equivalence.

2,000 pounds = 1 ton

Finally, multiply the number of tons by 2000 to find the range in tons.

6 × 2,000 = 12,000

8 × 2,000 = 16,000

The range of weight of a male African elephant is between 12,000 and 16,000 pounds.

Example 3

Convert the customary unit of weight: 5 tons = ____ pounds.

First, check if you will multiply or divide. Multiply when converting a larger unit to a smaller unit.

Then, find the unit equivalence.

1 ton = 2,000 pounds

Finally, multiply 5 by 2,000.

5 × 2,000 = 16,000

The answer is 5 tons equals 16,000 pounds.

Example 4

Convert the customary unit of weight: 32 ounces = ____ pounds.

First, check if you will multiply or divide. Divide when converting a smaller unit to a larger unit.

Then, find the unit equivalence.

16 ounces = 1 pound

Finally, divide 32 ounces by 16.

32 ÷ 16 = 2

The answer is 32 ounces equals 2 pounds.

Example 5

Convert the customary unit of weight: 4,500 pounds = ____ tons.

First, check if you will multiply or divide. Divide when converting a smaller unit to a larger unit.

Then, find the unit equivalence.

2,000 pounds = 1 ton.

Finally, divide 4,500 by 2,000.

4,500 ÷ 2,000 = 2.25

The answer is 4,500 pounds equals 2.25 tons.

Review

Convert each customary unit of weight.

1. 32 ounces = ____ pounds
2. 6 pounds = ____ ounces
3. 5.5 pounds = ____ ounces
4. 60 ounces = ____ pounds
5. 9 pounds = ____ ounces
6. 4000 pounds = ____ tons
7. 4 tons = ____ pounds
8. 3.5 tons = ____ pounds
9. 6500 pounds = ____ tons
10. 7.25 tons = ____ pounds
11. 15 pounds = ____ ounces
12. 25 tons = _____ pounds
13. 64 ounces = ____pounds
14. 80 ounces = ____ pounds
15. 5 tons = _____ pounds

Answer

To see the Review answers, open this PDF file and look for section 7.13.

Ounces to Mail



Figure **6.2.4.3**

Have you ever wondered why you'd need to be able to convert and understand equivalent units of weight? Why would it matter whether something was calculated from ounces to pounds, or from pound to tons, or from tons to pounds, or from pounds back to ounces? Well, the reason's as simple as mailing a package with the United States Postal Service!

Why It Matters

Since January 2013, when you mail a package, the post office charges $1.95 for the first 3 ounces of weight. Each additional ounce thereafter costs $0.17. You need to understand pounds and ounces if you are planning to mail a package that weighs 2 pounds.



Figure **6.2.4.4**

How would you figure out the cost of this 2-pound package? Well, you know that there are 16 ounces in 1 pound. The package weighs 2 pounds, which is equivalent to 32 ounces. Given that the first 3 ounces cost $1.95 and each additional ounce is $0.17, we can figure out the cost for 32 ounces of package:

$1.95+$0.17(32−3)=$1.95+$0.17(29)=$1.95+$4.93=$6.88

See how the post office works: http://www.youtube.com/watch?v=KYFtalTNzKk



Explore More

Visit the following website to play a variety of interactive measurement games.

http://www.aasd.k12.wi.us/staff/boldtkatherine/MathResources3-6/Math_Measurement.htm

Practice Resource

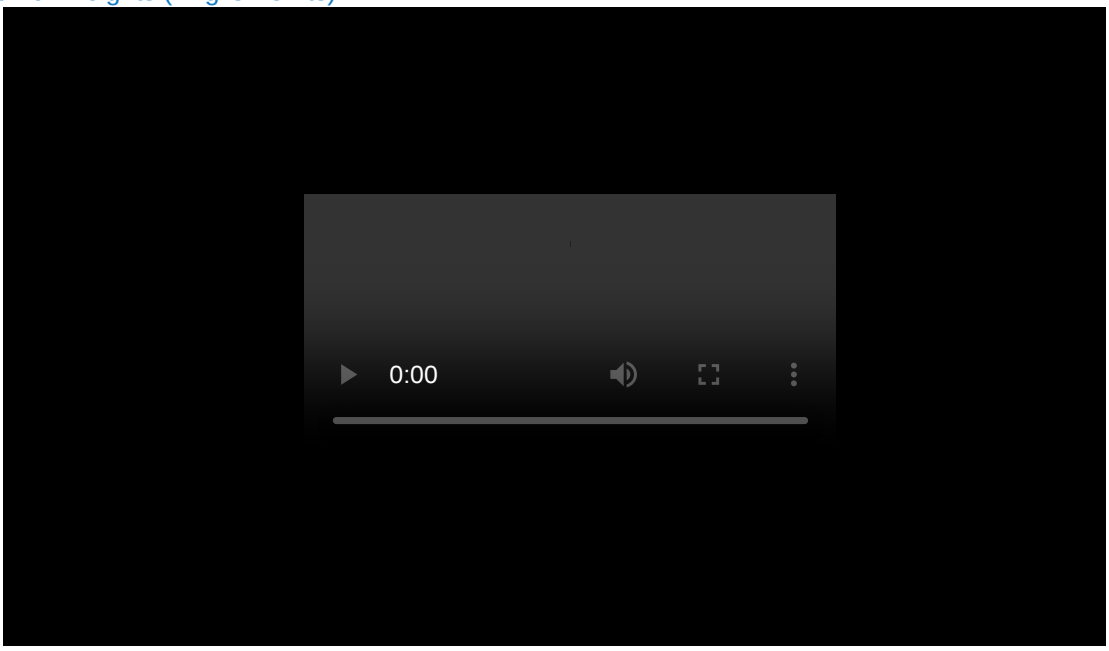
Convert between ounces, pounds, and tons

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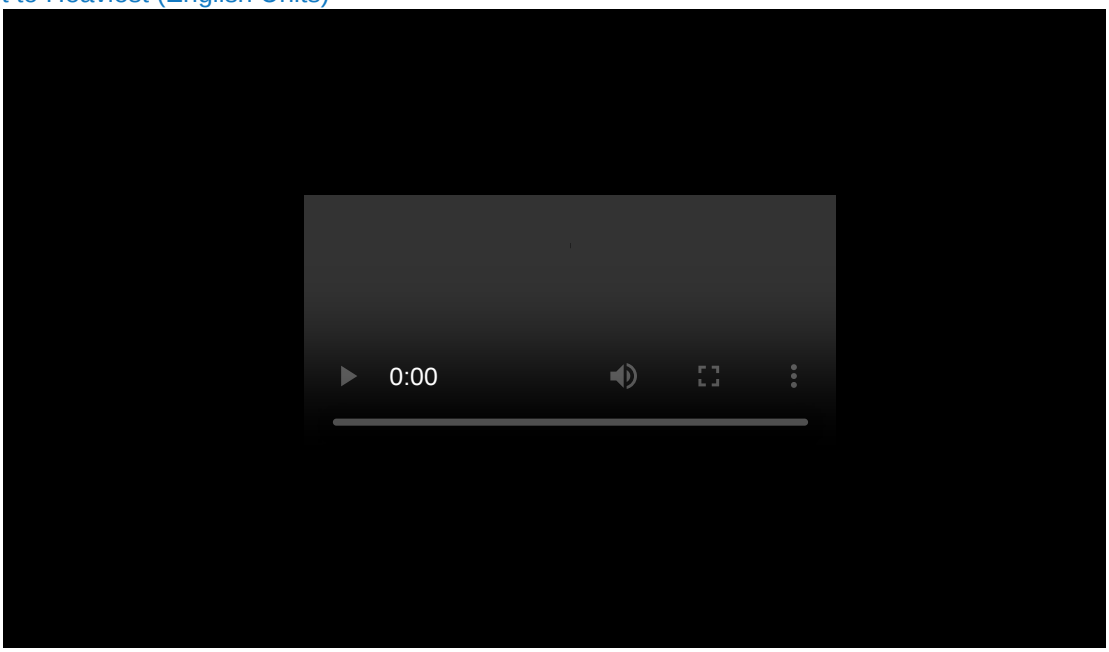
6.2.5: Convert then Compare Values of Compound Units

Order given weights from least to greatest (or vice versa) by converting the weights written in both pounds and ounces into just ounces to make comparing easier.

Overview of Comparison of Weights (English Units)



Arranging from Lightest to Heaviest (English Units)



Practice Resource

Convert then Compare Values of Compound Units Practice

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6.3.1: Add Customary Units of Weight Including Applications

6.3.2: Subtract Customary Units of Weight Including Applications

6.3.3: Add and Subtract Compound Customary Units of Weight Applications

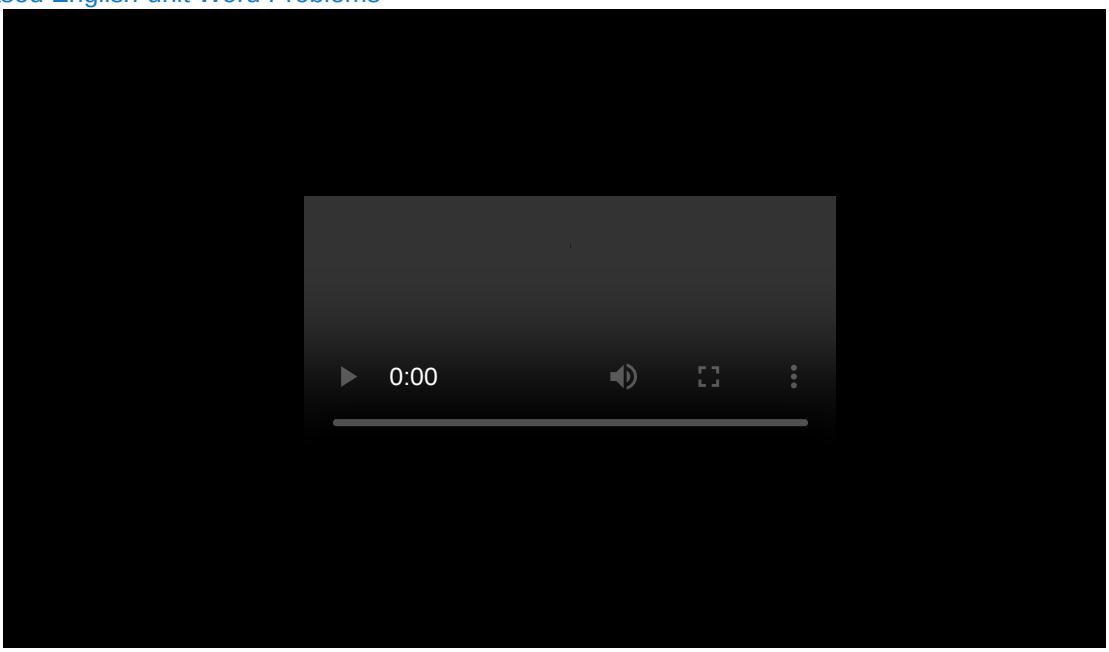
6.3.4: Multiply and Divide Compound Customary Units of Weight Applications

6.3.5: Four-Operation Compound Customary Units of Weight Applications

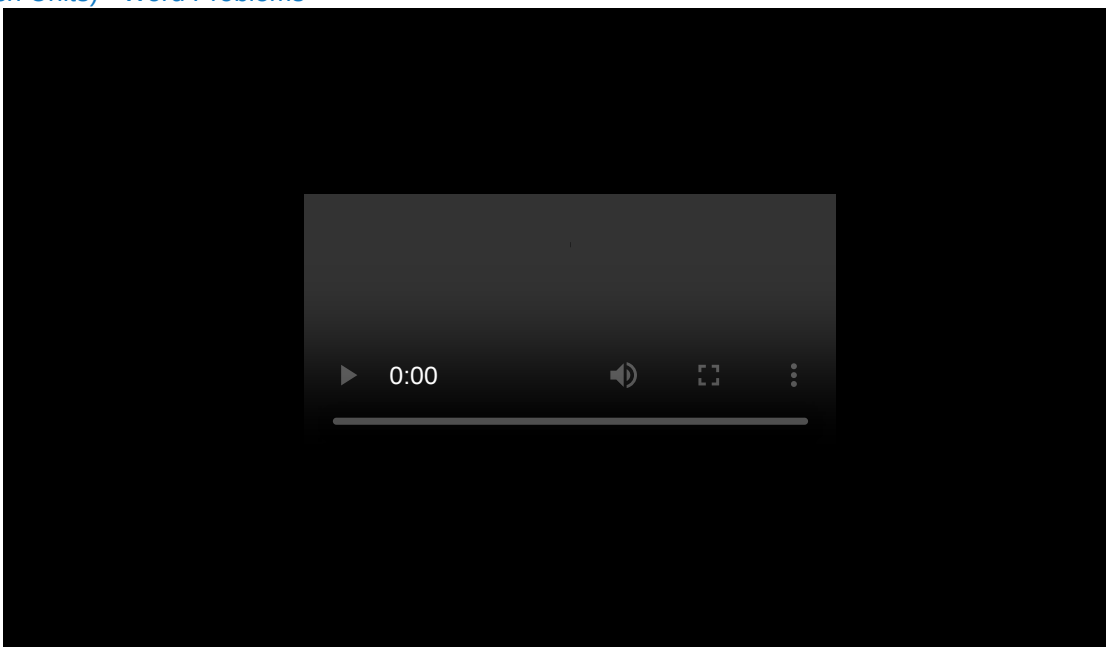
6.3.1: Add Customary Units of Weight Including Applications

Solve Word Problems involving pounds and ounces by adding the initial weight to the weight that is being added to give you the total weight.

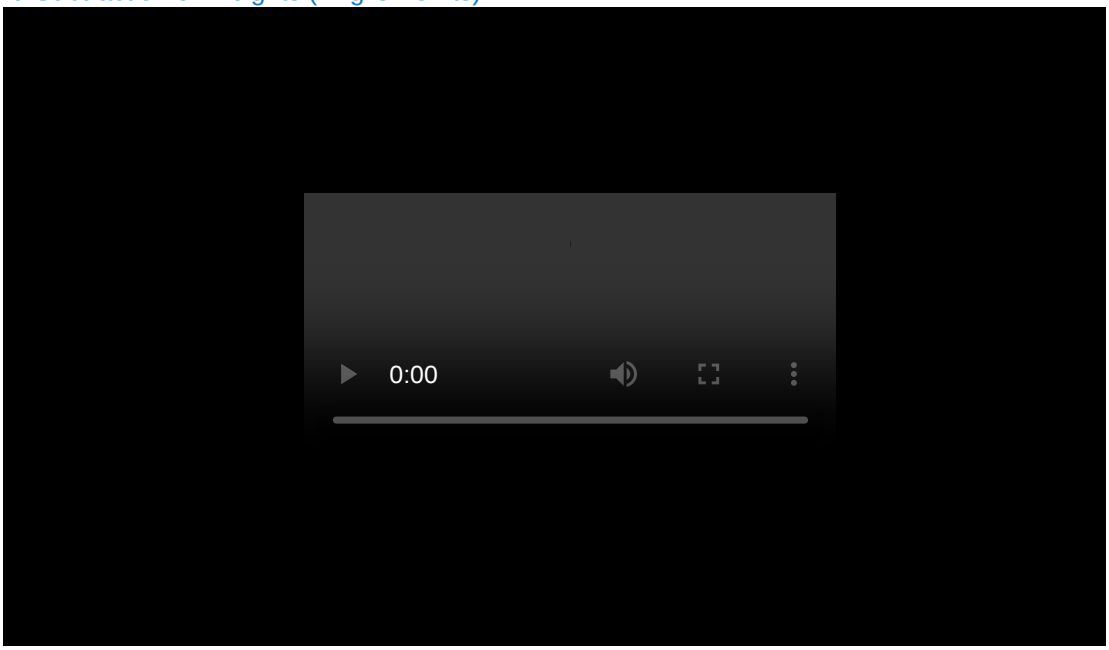
Overview of Weight-based English-unit Word Problems



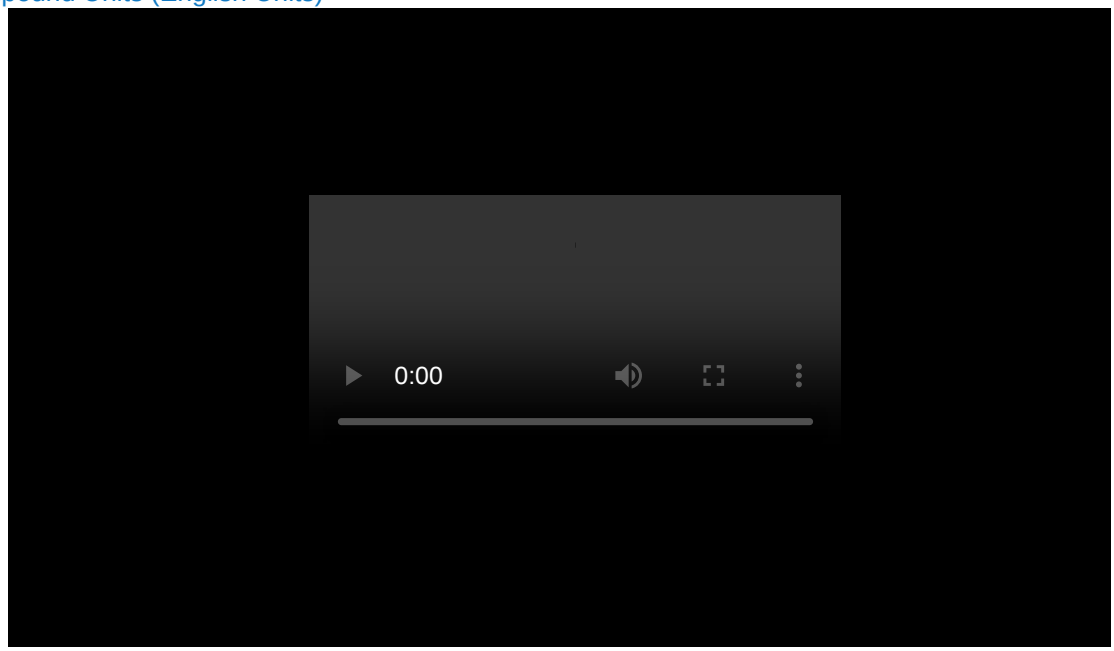
Adding Weights (English Units) - Word Problems



Overview of Addition and Subtraction of Weights (English Units)



Adding Weight in Compound Units (English Units)



Practice Resource

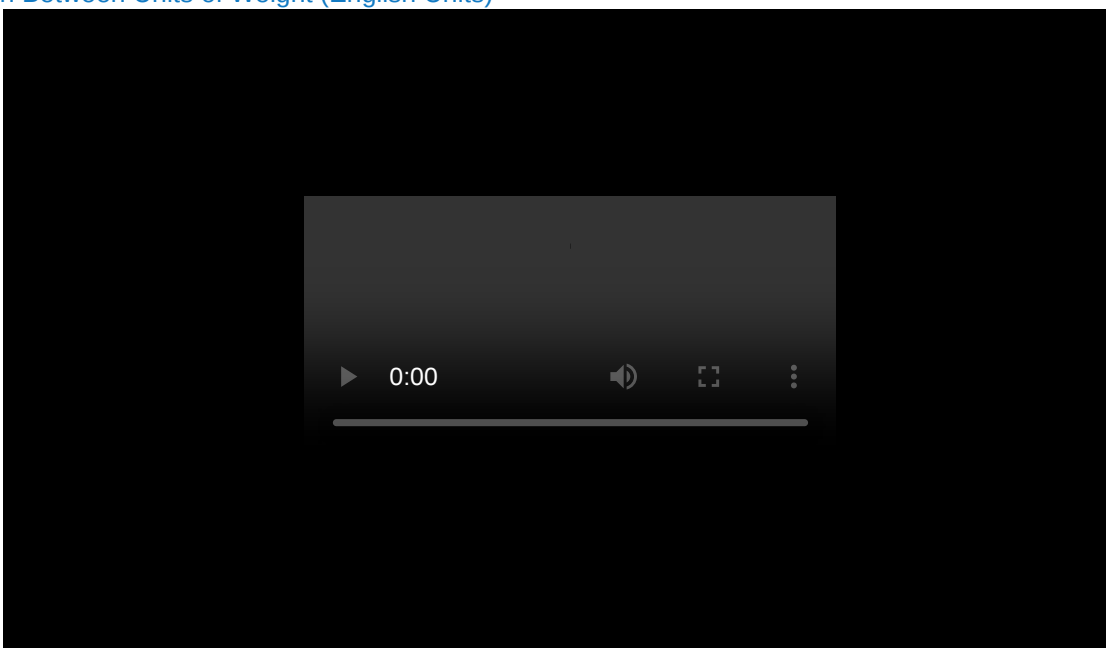
Add Customary Units of Weight Including Applications

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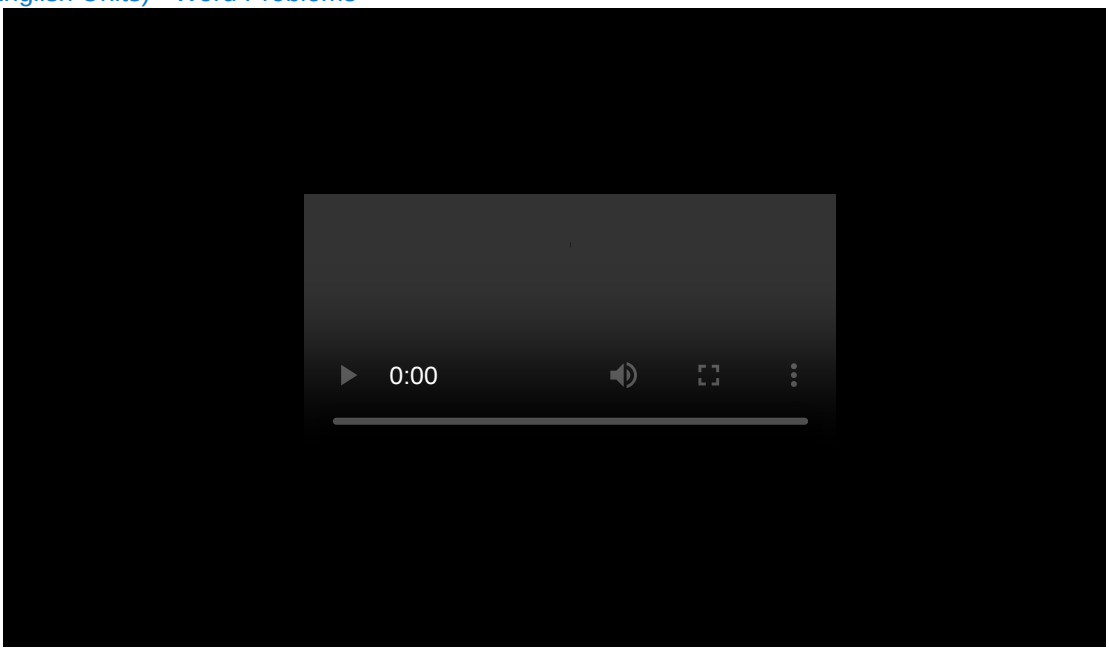
6.3.2: Subtract Customary Units of Weight Including Applications

Solve word problems involving pounds and ounces by subtracting the initial weight by the final to get the total difference between the two.

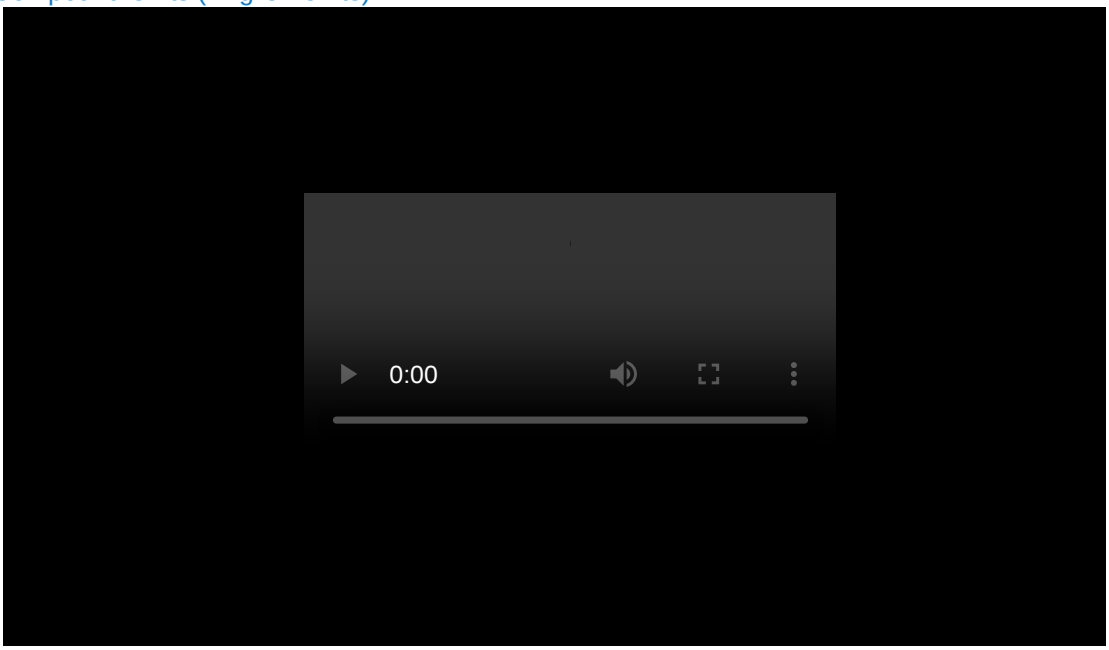
Overview of Conversion Between Units of Weight (English Units)



Subtracting Weights (English Units) - Word Problems



Subtracting Weight in Compound Units (English Units)



Practice Resource

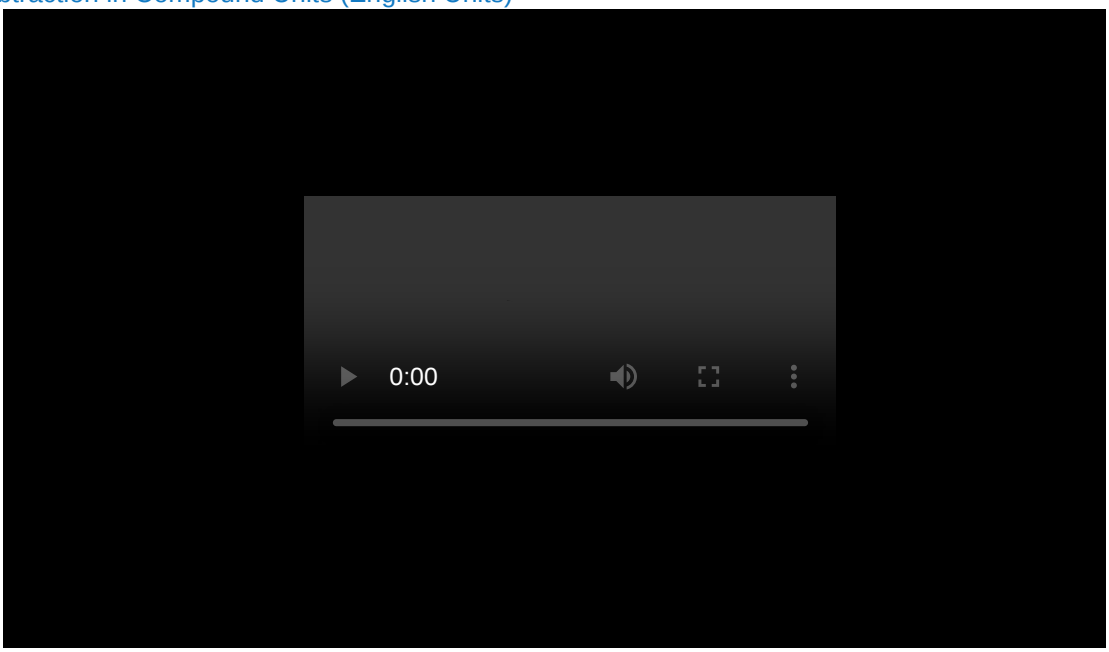
Subtract Customary Units of Weight Including Applications

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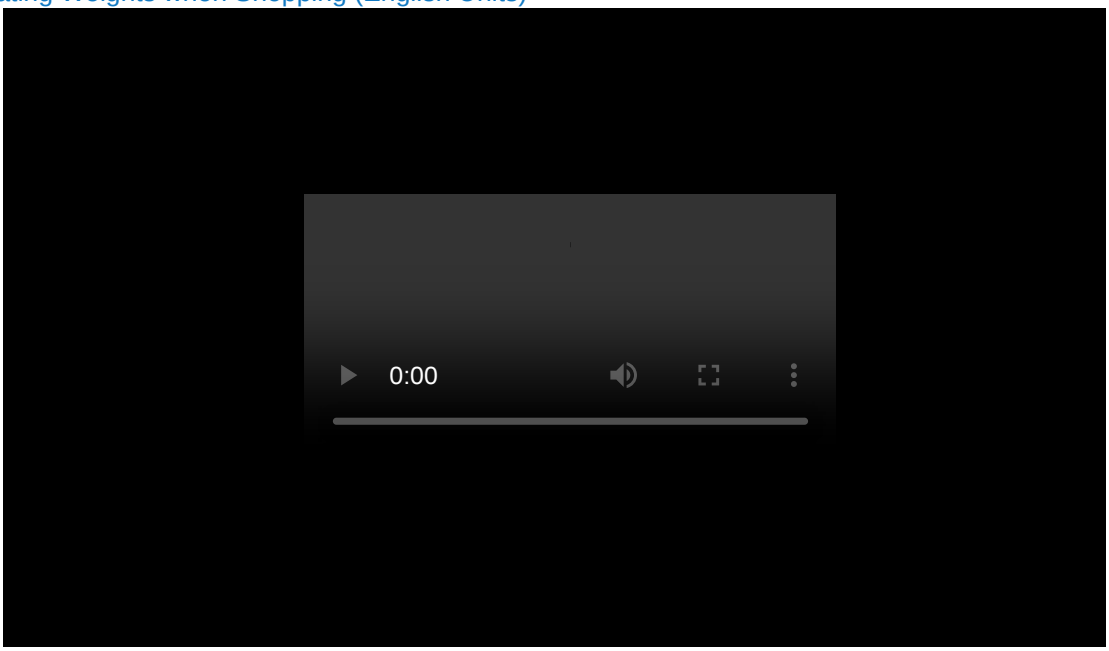
6.3.3: Add and Subtract Compound Customary Units of Weight Applications

Use both addition and subtraction to solve for word problems by finding the weight, in ounces and pounds, of a certain object or all of the objects.

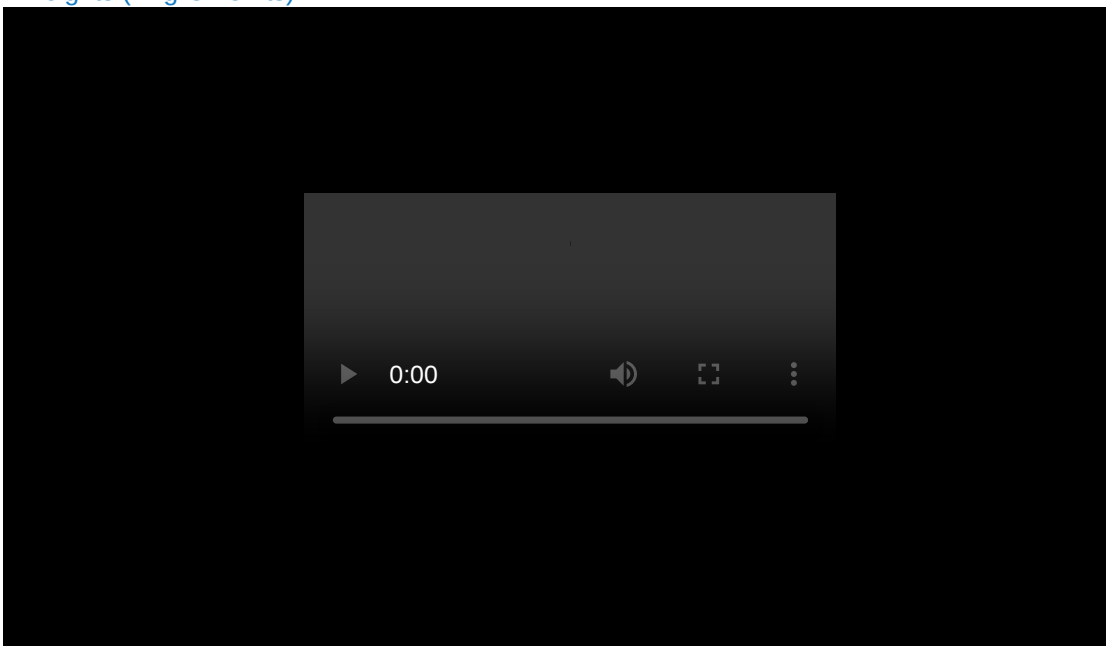
Mixed Addition and Subtraction in Compound Units (English Units)



Comparing and Calculating Weights when Shopping (English Units)



Two-step Subtraction of Weights (English Units)



Practice Resource

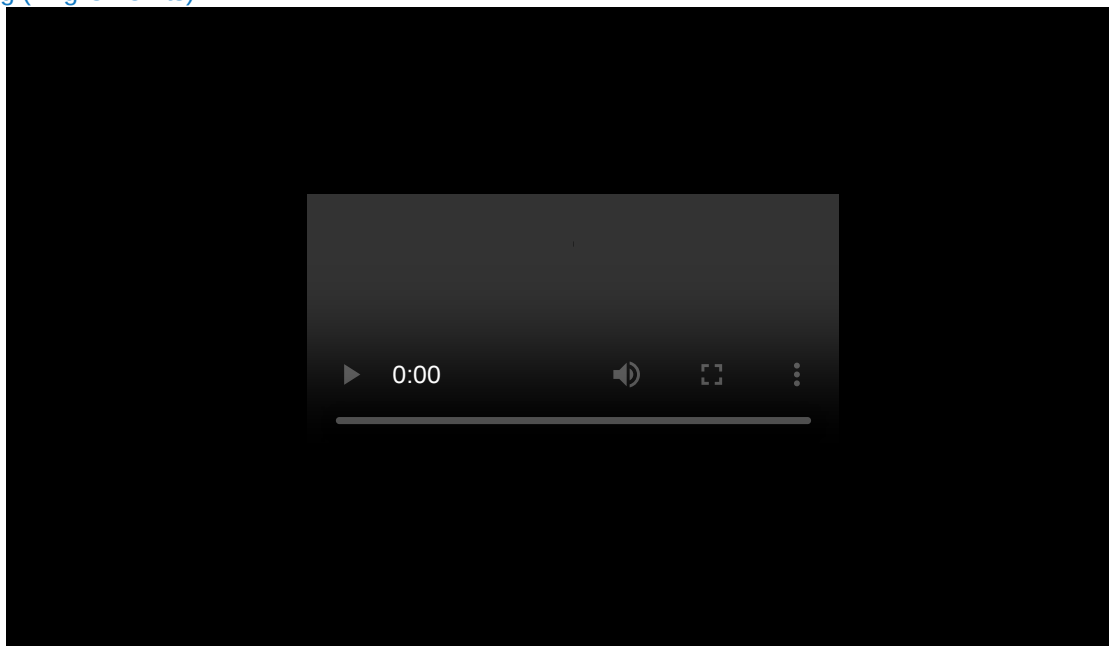
Add and Subtract Compound Customary Units of Weight Applications Practice

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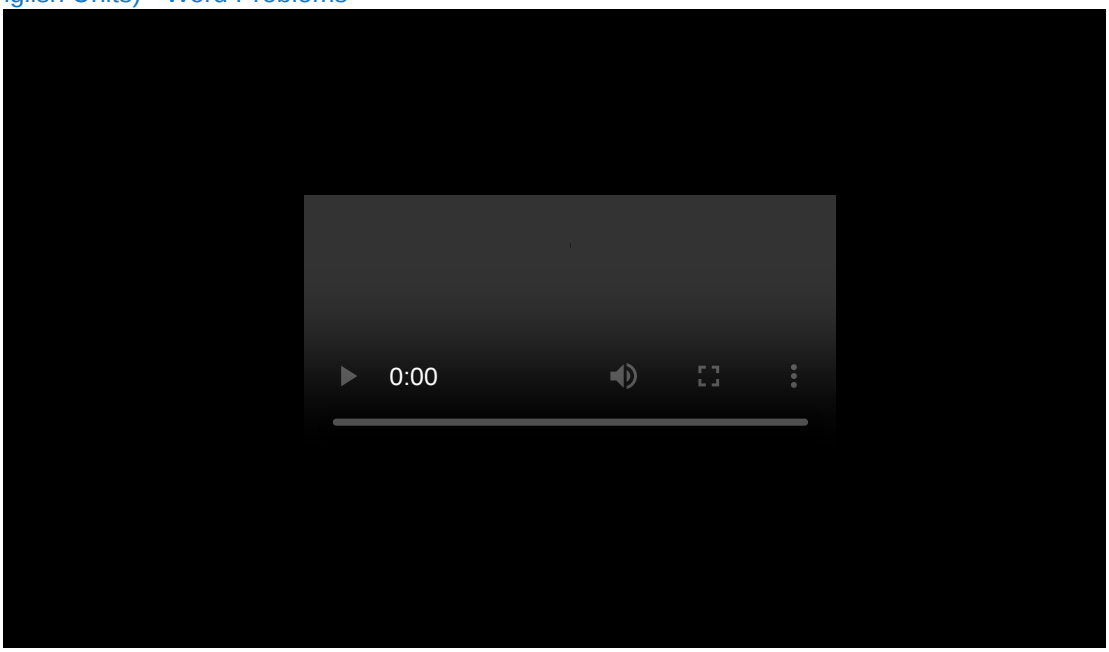
6.3.4: Multiply and Divide Compound Customary Units of Weight Applications

Use multiplication to solve for word problems by finding the total weight, in ounces and pounds, of all the objects combined. Use division to find the individual weights, in ounces and pounds, of each object.

Multiplying and Dividing (English Units)



Multiplying Weights (English Units) - Word Problems



Practice Resource

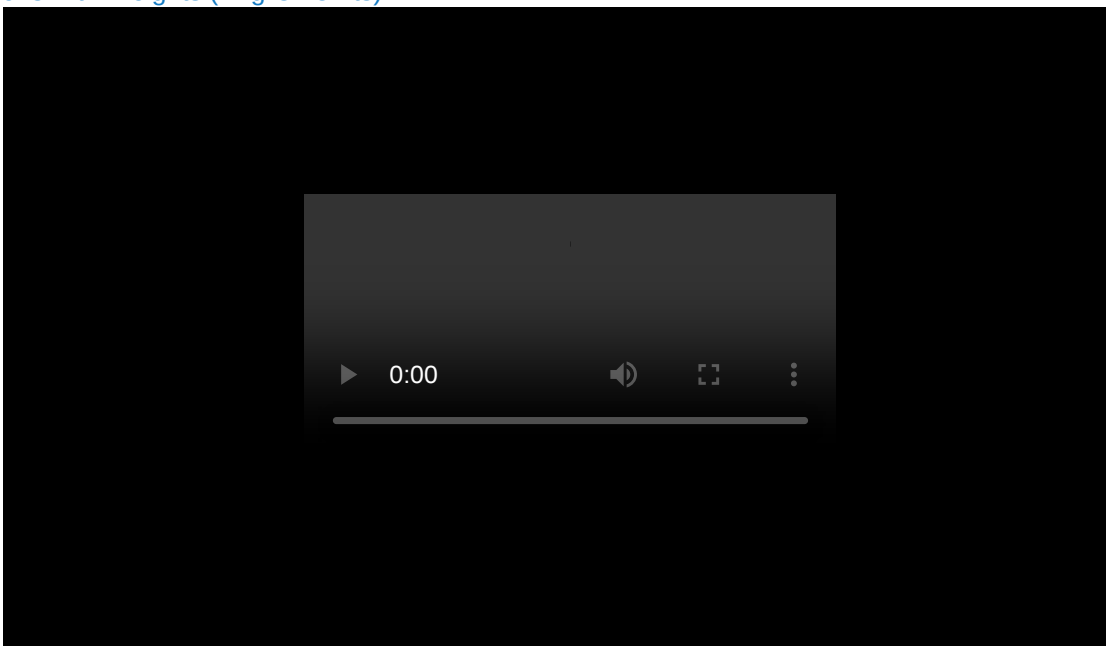
Multiply and Divide Compound Customary Units of Weight Applications Practice

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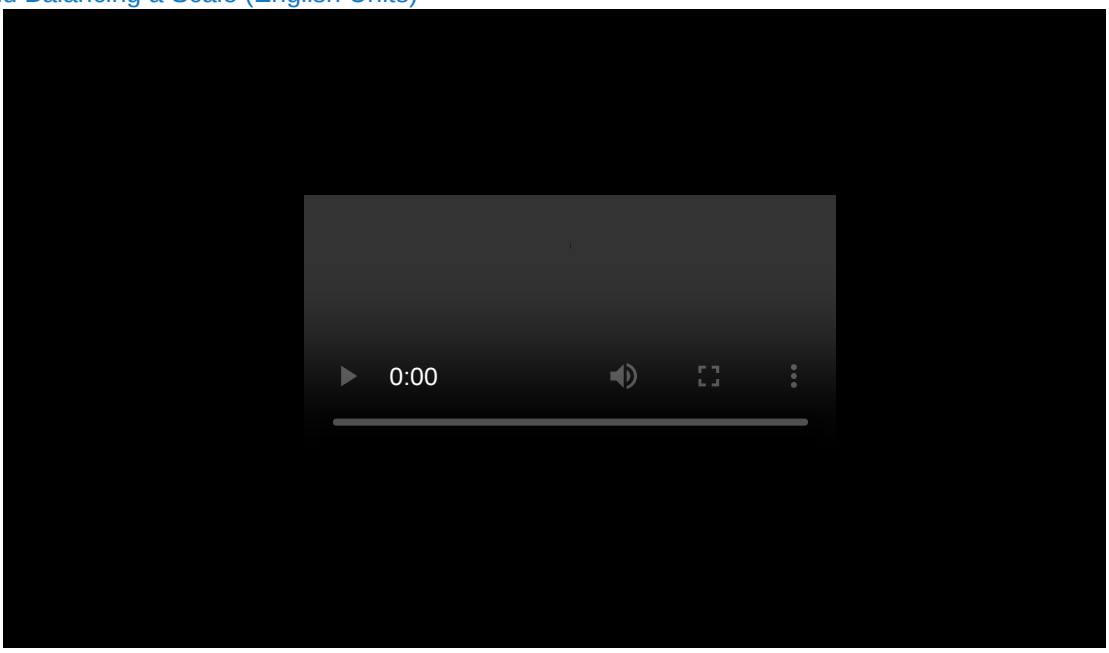
6.3.5: Four-Operation Compound Customary Units of Weight Applications

Use the four basic operations to compare weights of object in both ounces (oz) and pounds (lbs) and determine which amount is greater. Also use the four basic operations to determine weights of a single object.

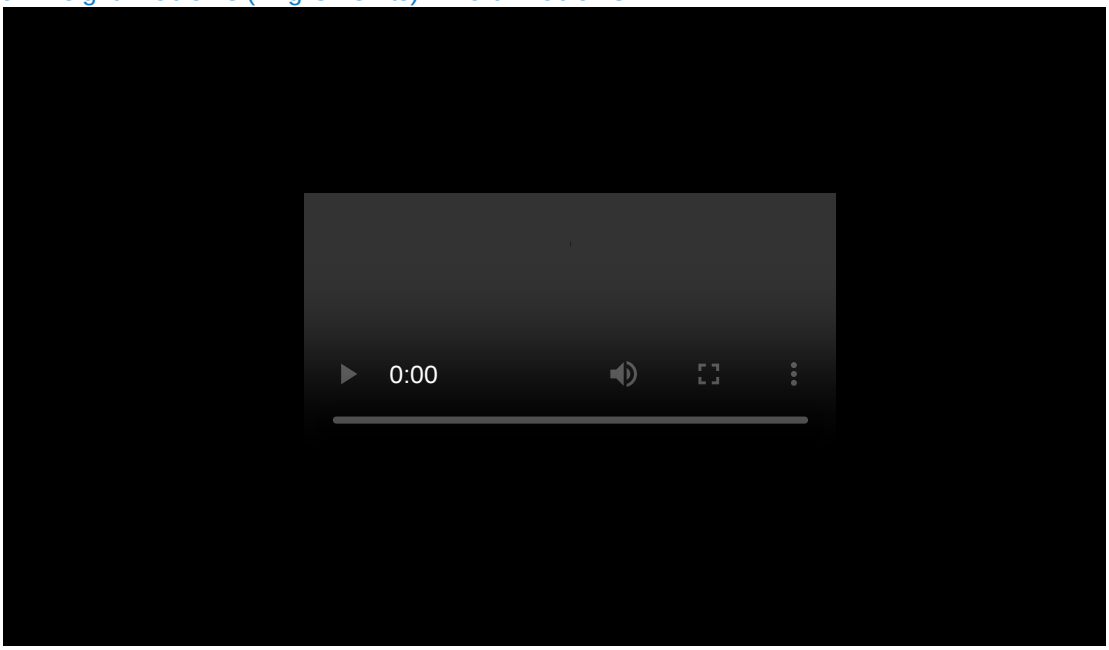
Using the Four Operations with Weights (English Units)



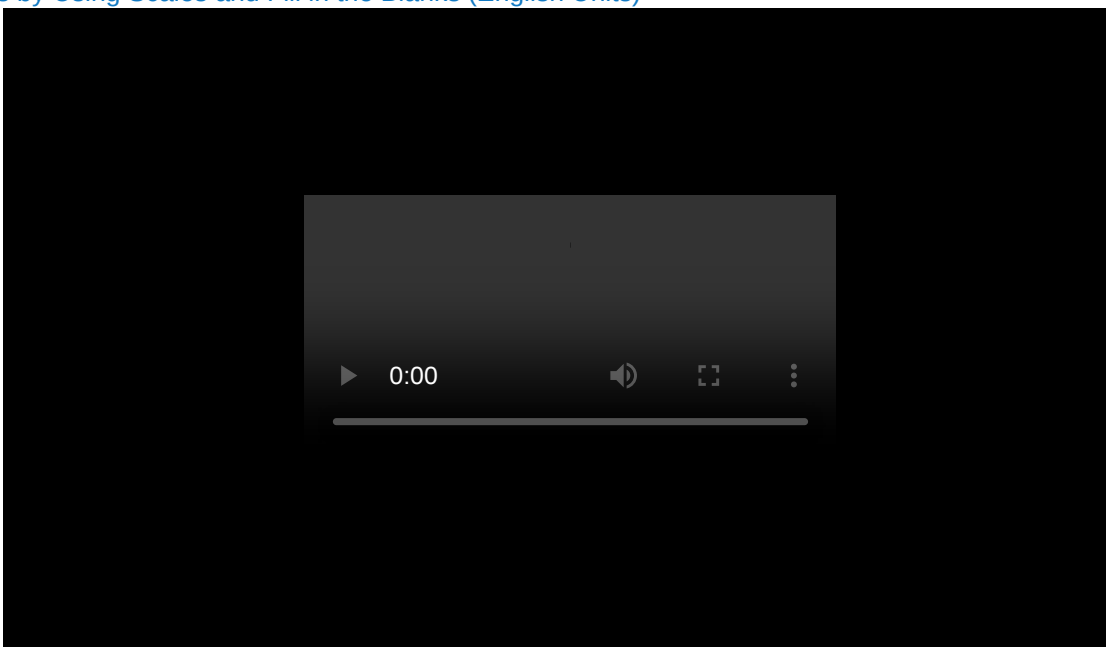
Comparing Weights and Balancing a Scale (English Units)



Multi-step Four-operation Weight Problems (English Units) - Word Problems



Comparing the Weights by Using Scales and Fill in the Blanks (English Units)



Practice Resource

Four Operation Compound Customary Units of Weight Applications Practice

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6.4.1: Add Metric Weight

6.4.1.1: Add Weights in Grams
6.4.1.2: Add Weights in Kilograms
6.4.1.3: Add Weights in Grams or Kilograms Applications
6.4.1.4: Add Compound Units

6.4.2: Subtract Metric Weight

6.4.2.1: Subtract Weights in Grams
6.4.2.2: Subtract Weights in Grams Applications
6.4.2.3: Subtract Weights in Kilograms
6.4.2.4: Subtract Compound Units
6.4.2.5: Subtract and Convert Using Compound Units Applications

6.4.3: Add and Subtract Metric Weight

6.4.3.1: Add, Subtract and Compare Mass in Grams Multi-Step Applications
6.4.3.2: Add and Subtract and Convert Compound Units
6.4.3.3: Add, Subtract and Compare Grams and Kilograms Multi-Step Applications

6.4.4: Multiply and Divide Metric Weight

6.4.4.1: Multiply to Find the Weight in Grams or Kilograms
6.4.4.2: Divide to Find the Weight in Grams or Kilograms
6.4.4.3: Multiply and Divide to Find the Weight in Grams or Kilograms Applications

6.4.5: Mixed Operations to find Metric Weight

6.4.5.1: Use the Four Operations to Find Weight in Grams and/or Kilograms Applications
6.4.5.2: Higher Order Four-Operations to Find Weight in Grams or Kilograms Applications

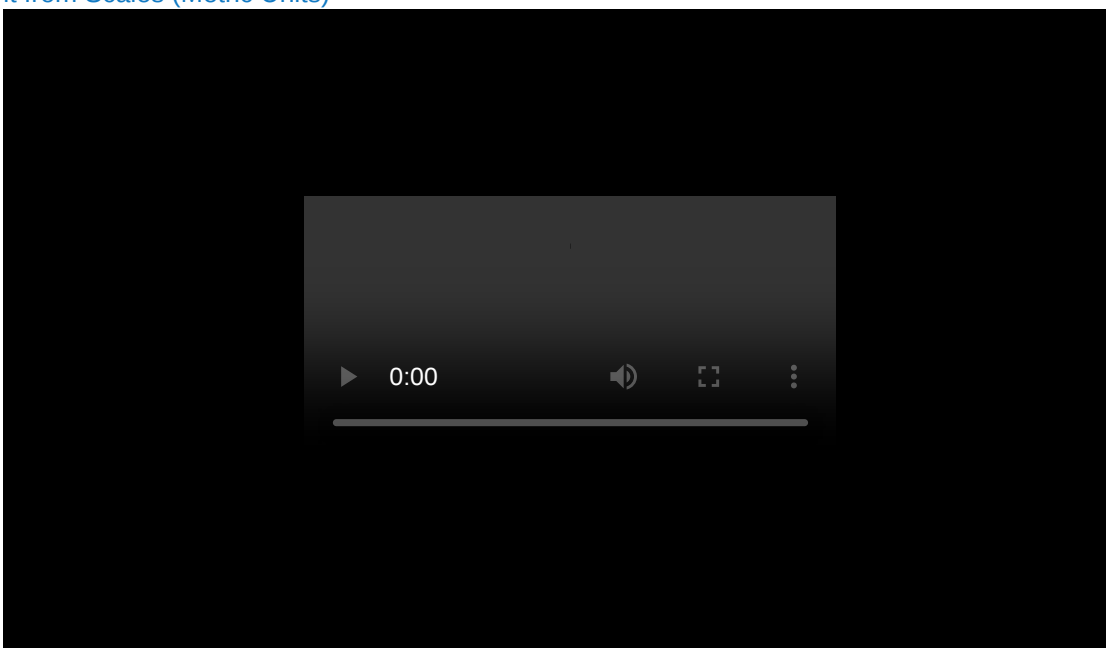
6.4.1: Add Metric Weight

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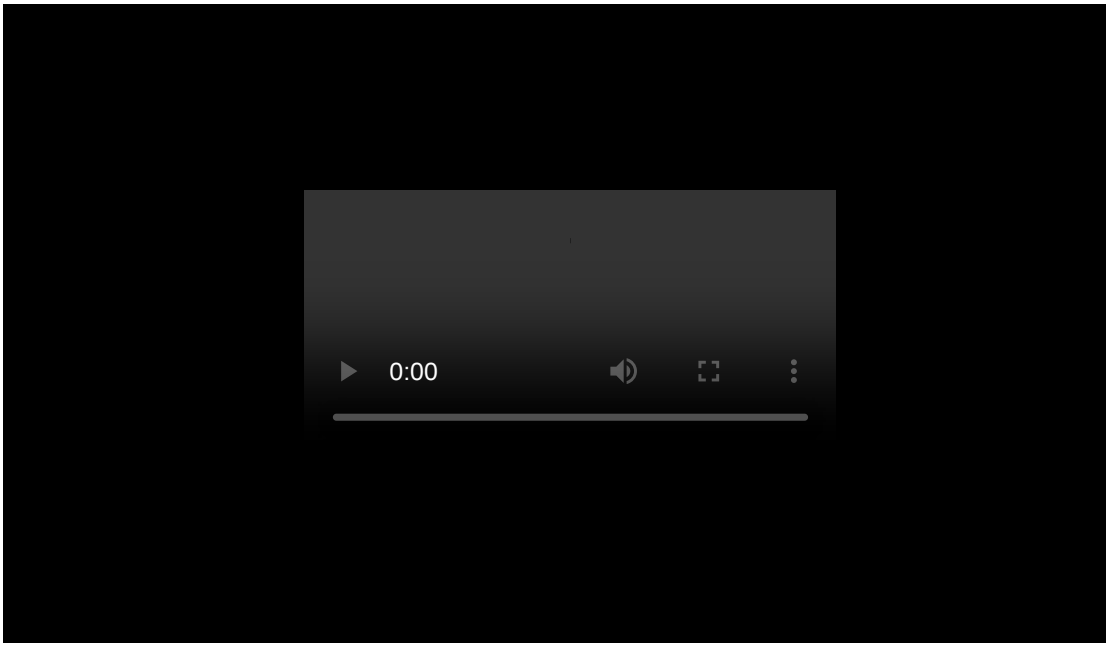
6.4.1.1: Add Weights in Grams

Observe a scale to determine weight and use equations to find the total sum of the weights in grams.

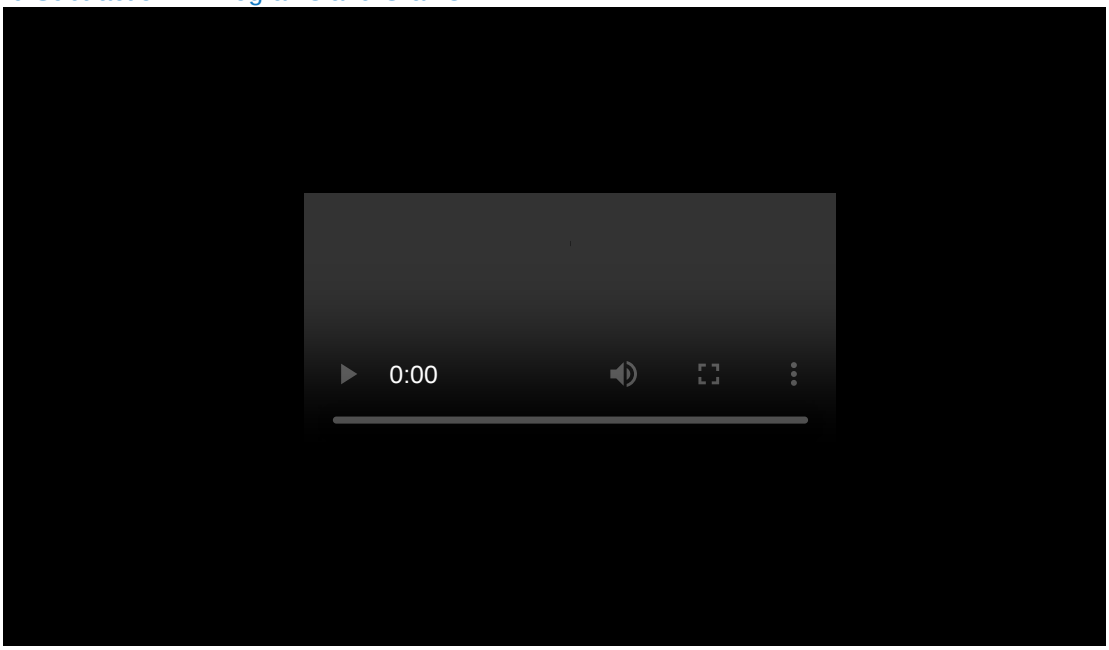
Calculating Total Weight from Scales (Metric Units)



Addition in Grams



Overview of Addition and Subtraction in Kilograms and Grams



Practice Resource

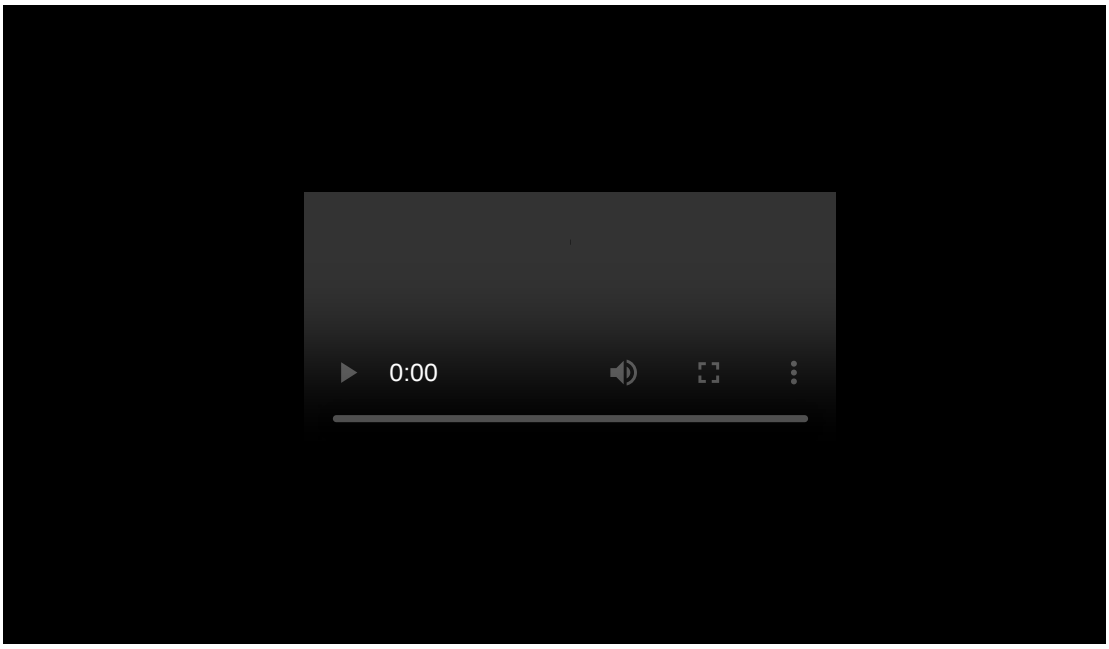
Add Weights In Grams Practice

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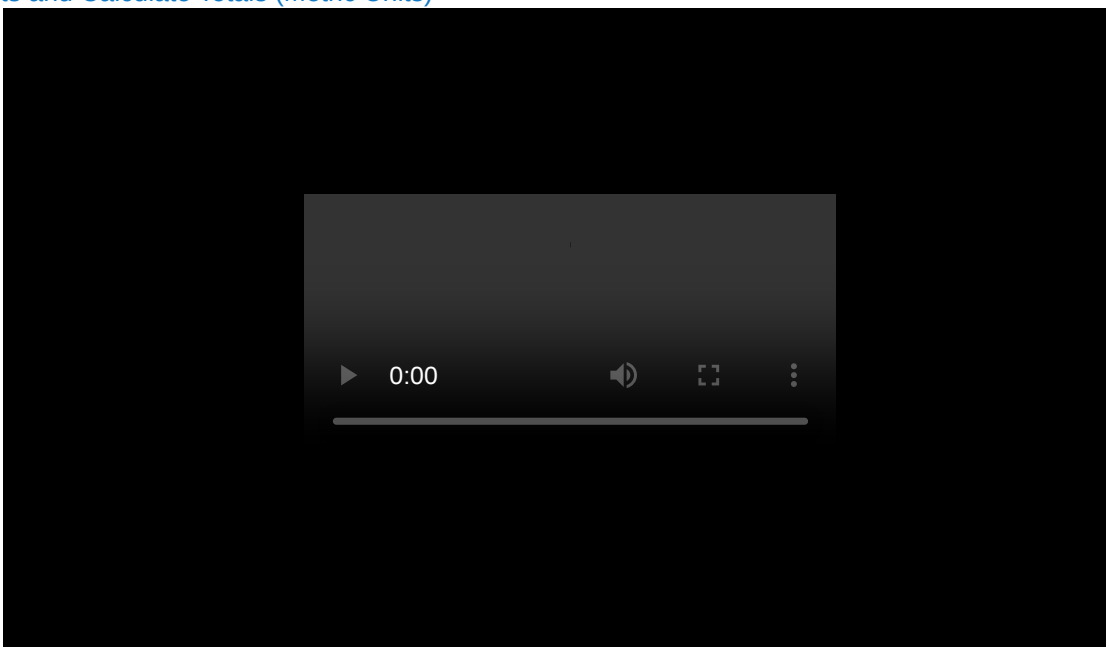
6.4.1.2: Add Weights in Kilograms

Observe a scale to determine weight and use equations to find the total sum of the weights in kilograms.

Addition in Kilograms



Visually Finding Weights and Calculate Totals (Metric Units)



Practice Resource

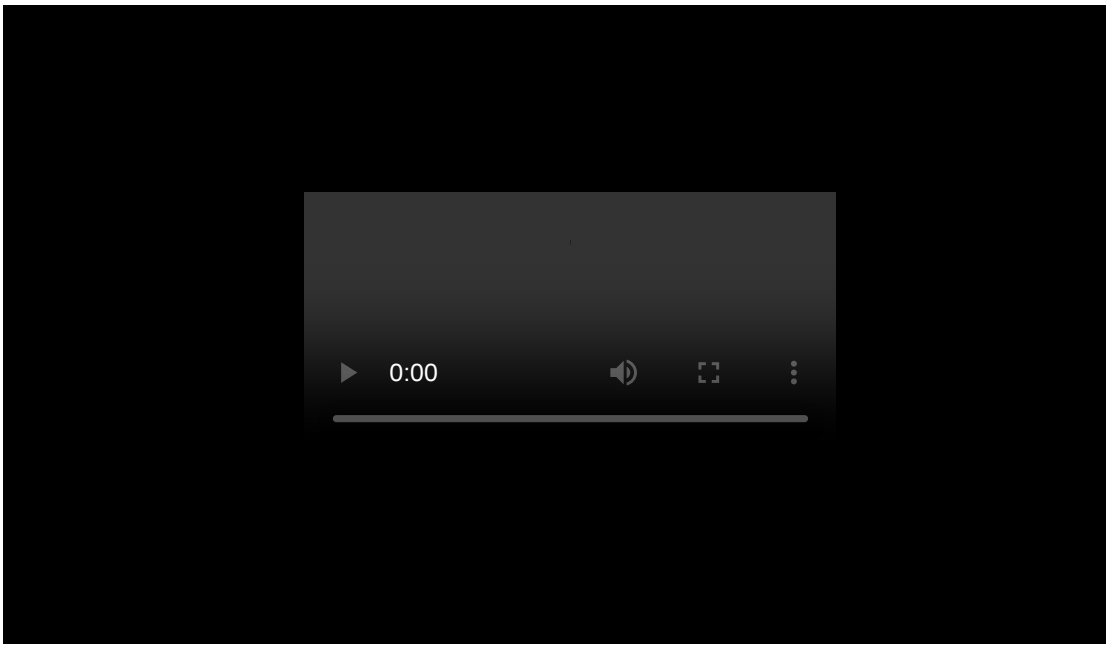
Add Weights in Kilograms Practice

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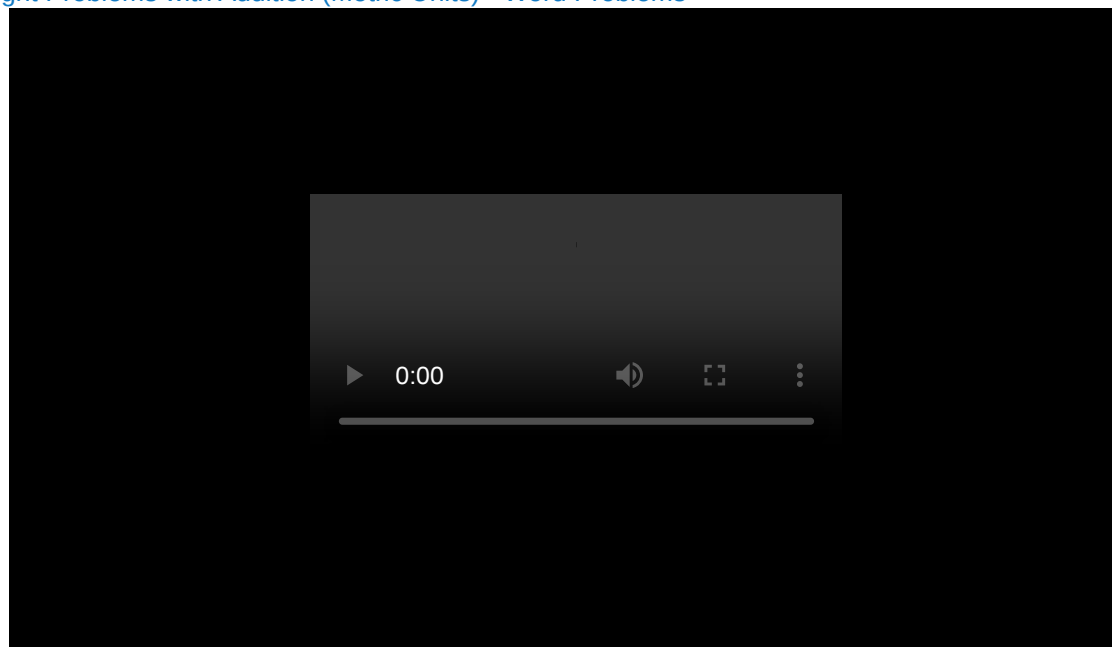
6.4.1.3: Add Weights in Grams or Kilograms Applications

Find the total weight of objects by adding grams or kilograms together to get the sum of weights

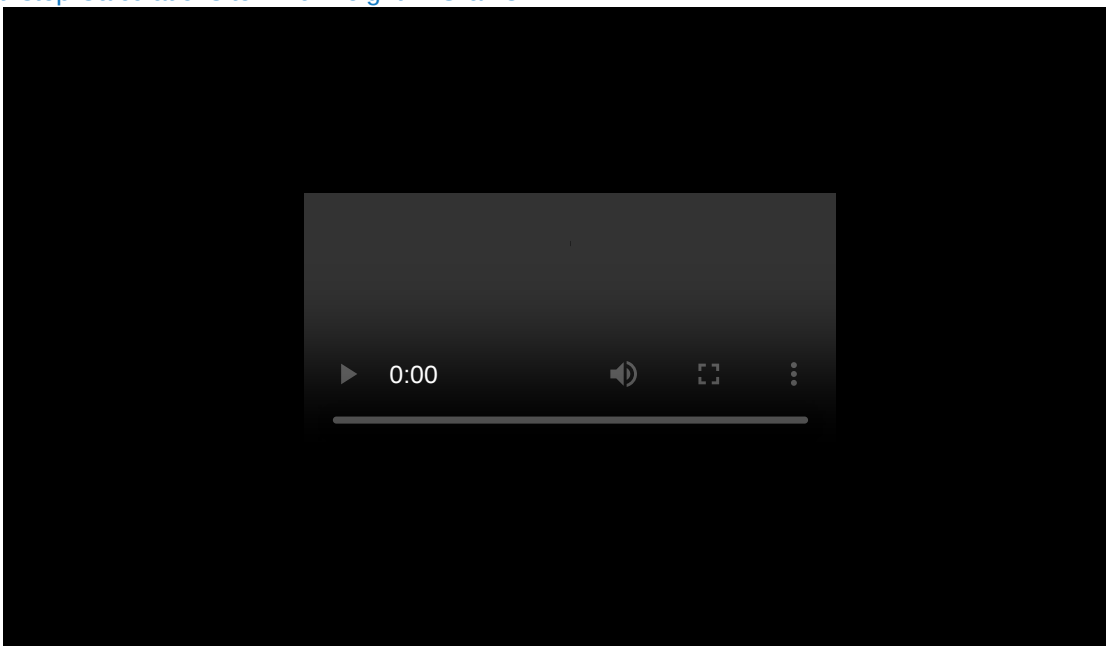
Overview of Weight in Metric Units



Solving Multi-step Weight Problems with Addition (Metric Units) - Word Problems



Using a Scale and Multi-step Calculations to FInd Weight in Grams II



Practice Resource

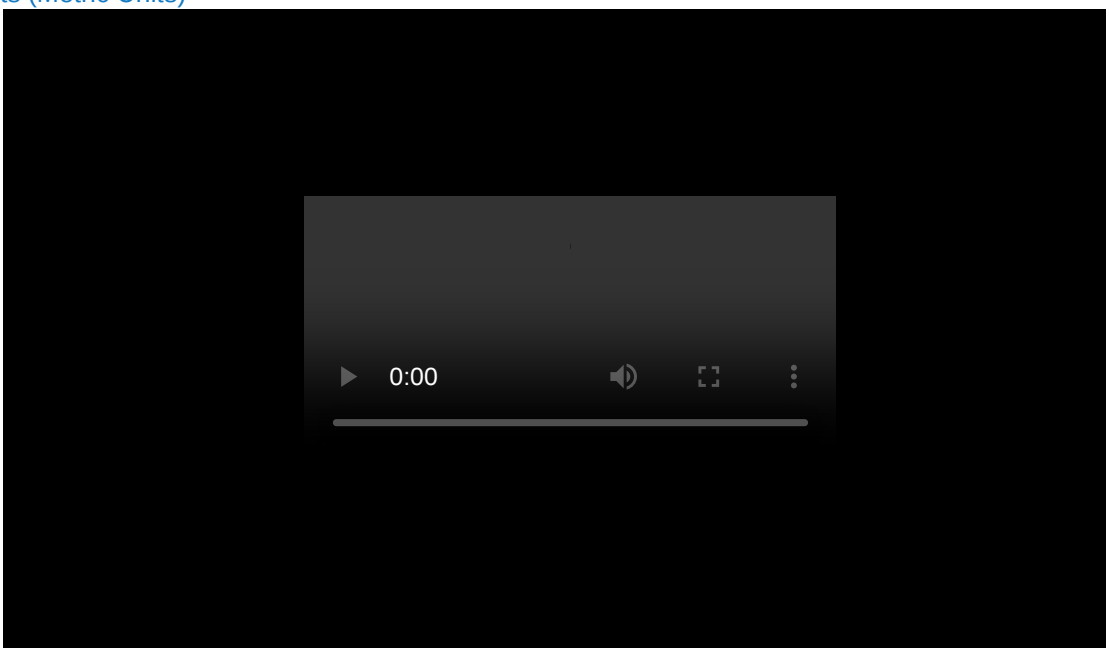
Add Weights in Grams or Kilograms Applications Practice

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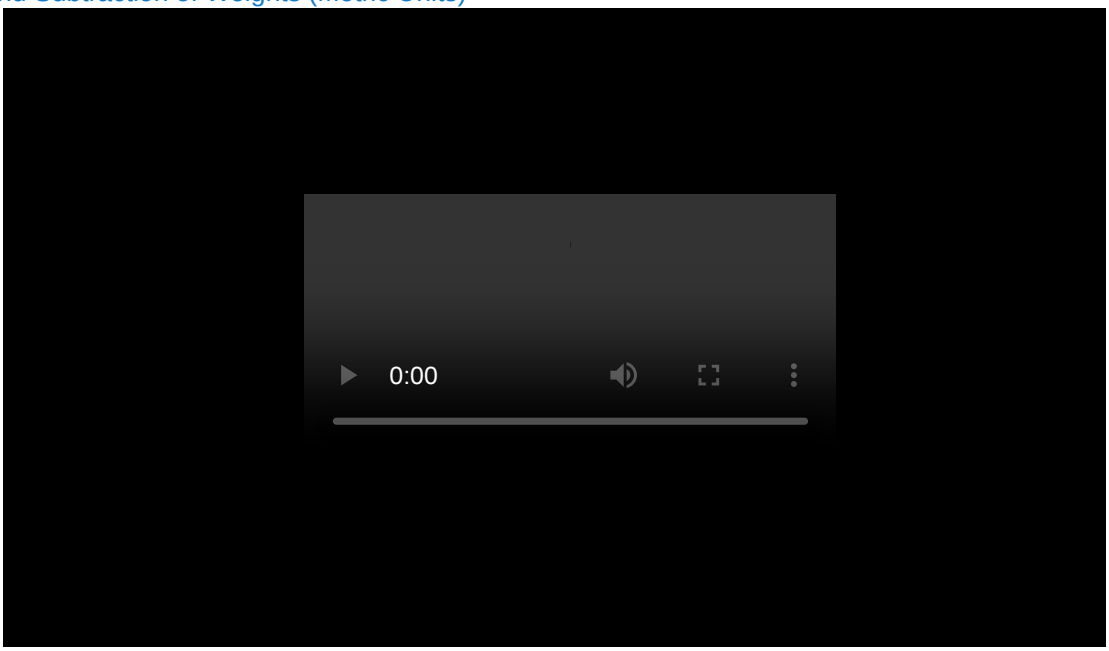
6.4.1.4: Add Compound Units

Word Problems requiring multi-step addition of compound units

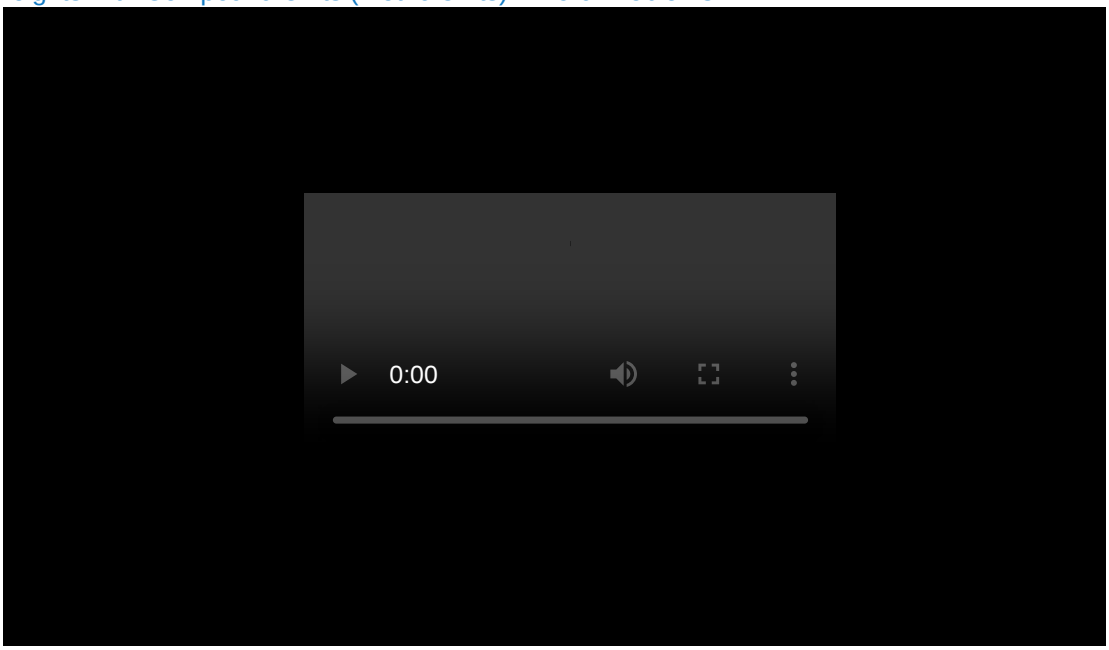
Adding Compound Units (Metric Units)



Overview of Addition and Subtraction of Weights (Metric Units)



Multi-step Addition of Weights with Compound Units (Metric Units) - Word Problems



Practice Resource

Add Compound Units Practice

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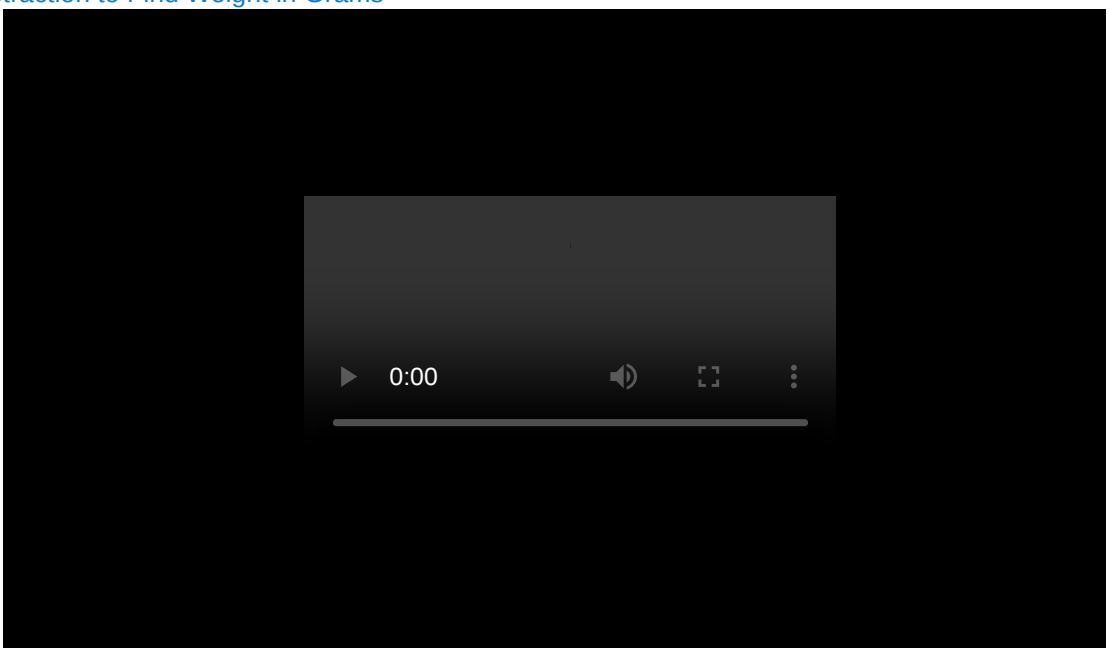
6.4.2: Subtract Metric Weight

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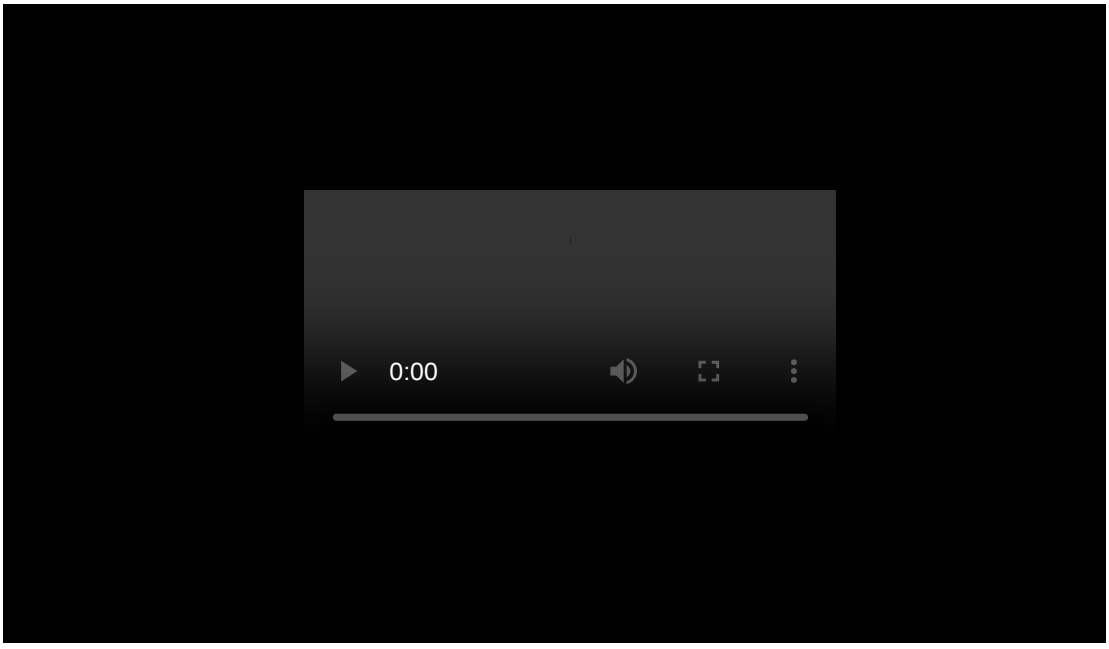
6.4.2.1: Subtract Weights in Grams

Solve for the difference by subtracting the whole by the known part to get the weight of the other part. Solve for equations that include grams.

Using a Scale and Subtraction to Find Weight in Grams



Subtraction in Grams



Practice Resource

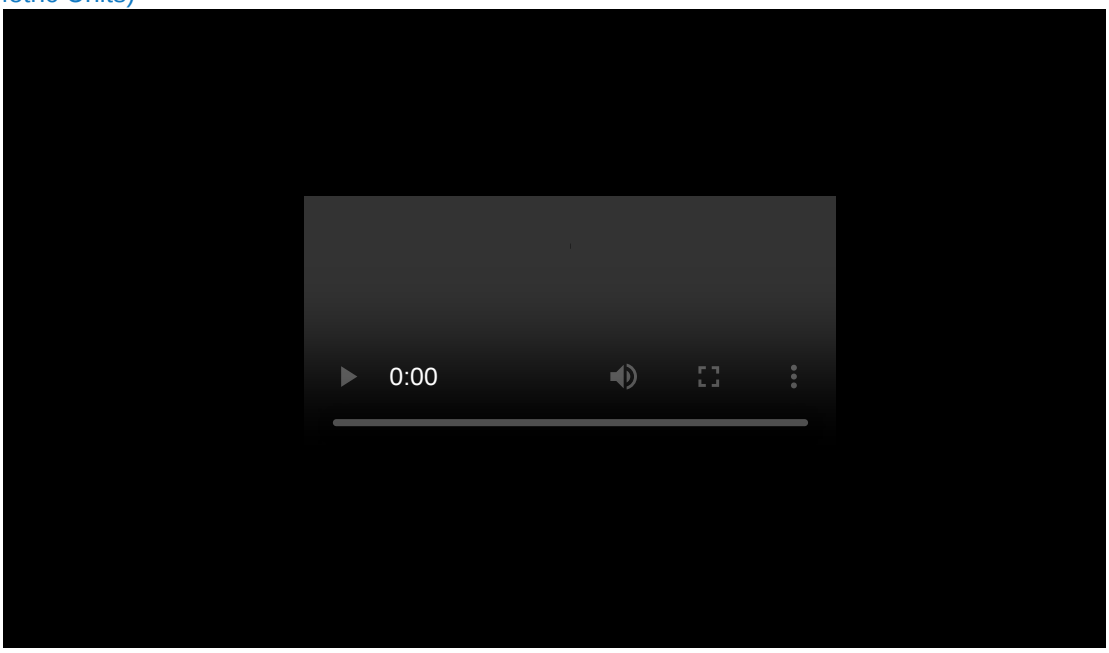
Subtract Weights in Grams Practice

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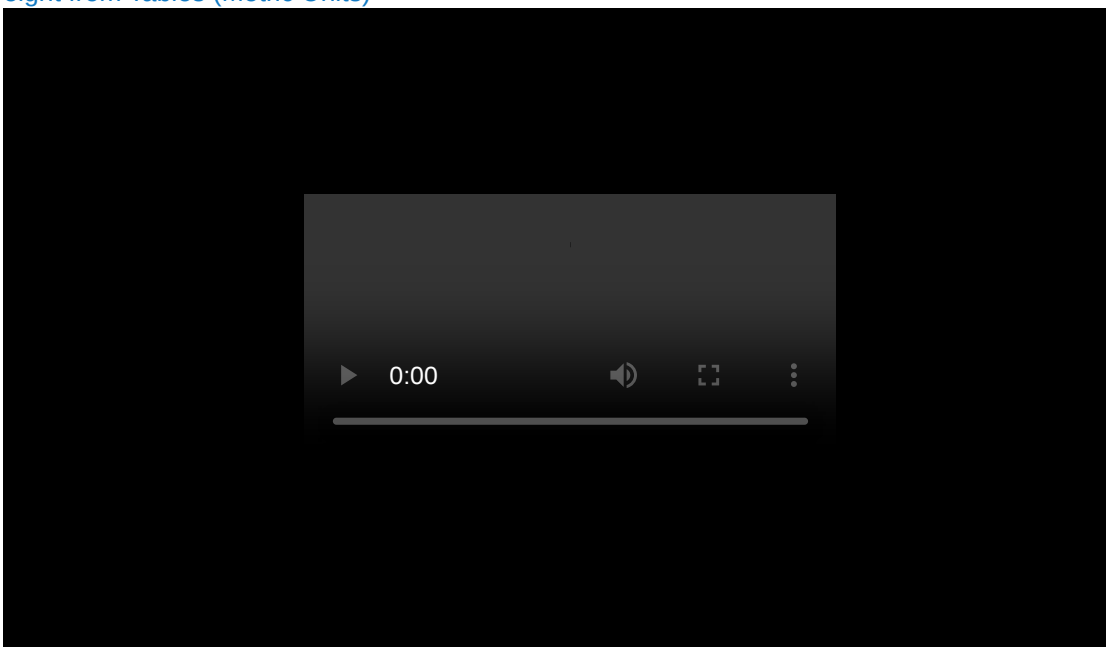
6.4.2.2: Subtract Weights in Grams Applications

Compare the heaviest and lightest items by subtracting the lightest item from the heaviest.

Subtracting Weights (Metric Units)



Finding the Different Weight from Tables (Metric Units)



Practice Resource

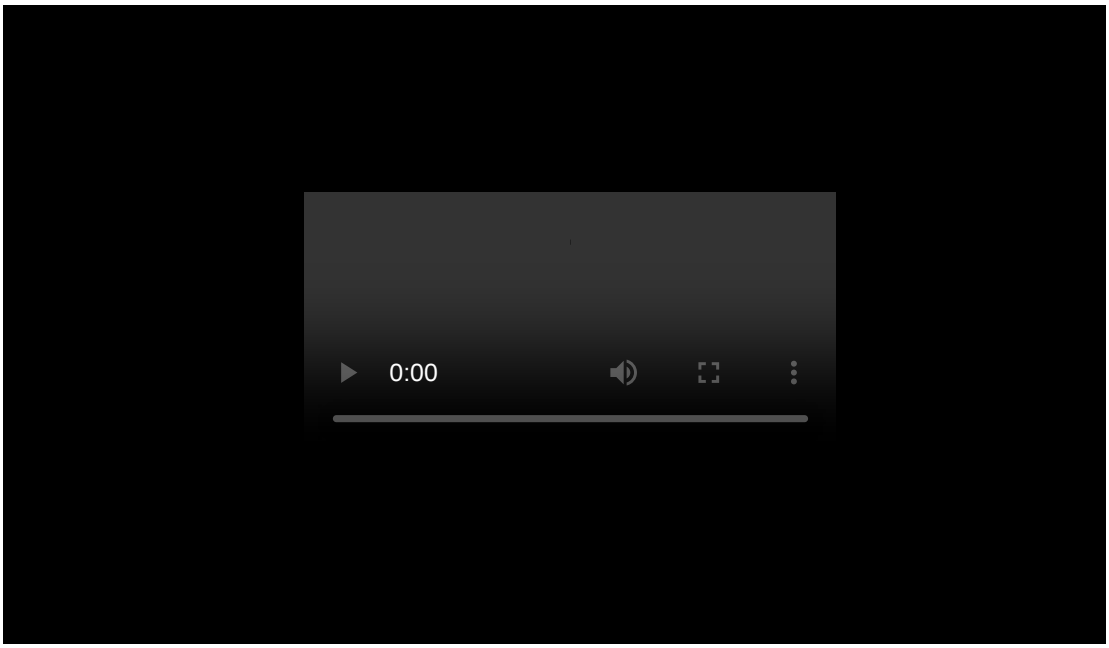
Subtract Weights in Grams Applications Practice

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6.4.2.3: Subtract Weights in Kilograms

Find the difference of the weight in kilograms

Subtraction in Kilograms



Practice Resource

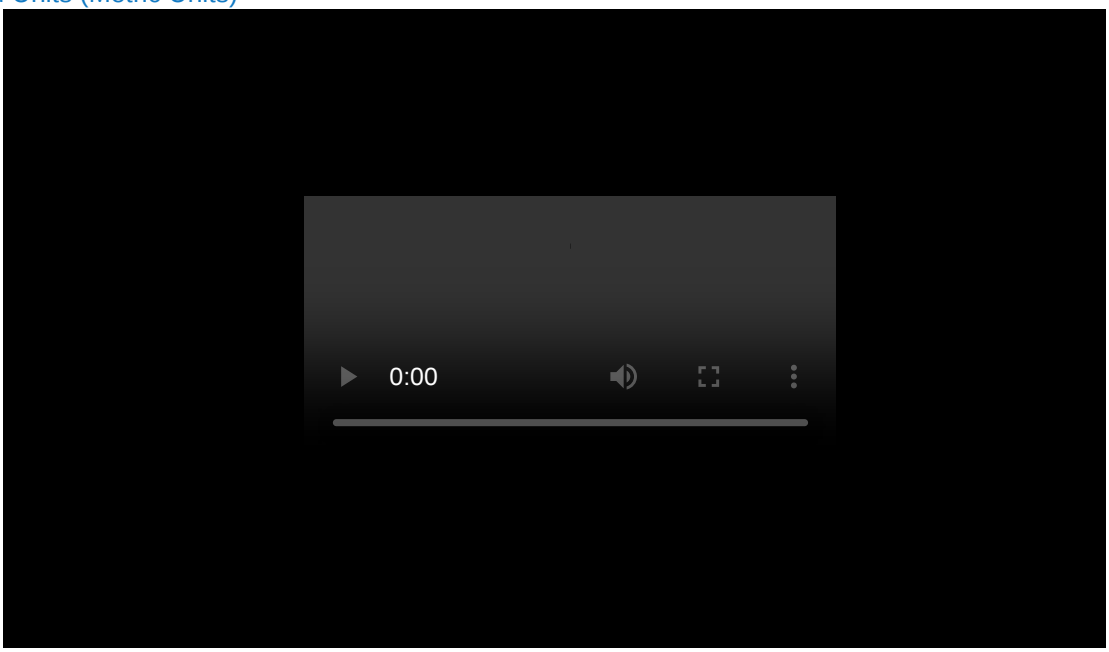
Subtract Weights in Kilograms Practice

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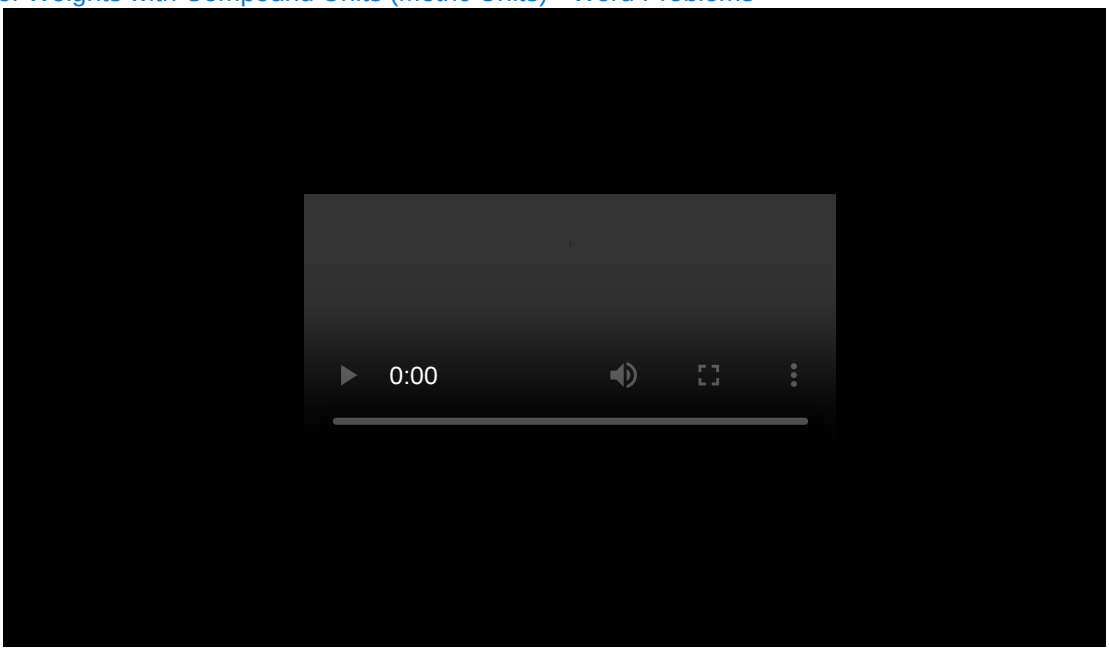
6.4.2.4: Subtract Compound Units

Subtract weights that include both grams and kilograms by subtracting each unit separately to get the difference of each unit.

Subtracting Compound Units (Metric Units)



Multi-step Subtraction of Weights with Compound Units (Metric Units) - Word Problems



Practice Resource

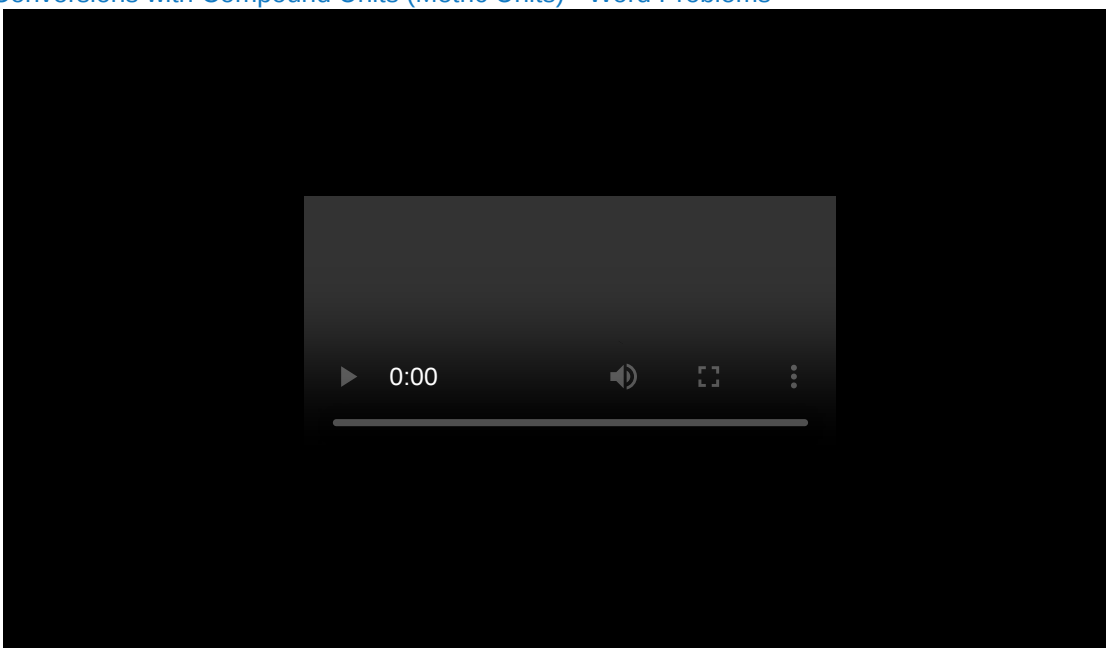
Subtract Compound Units Practice

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6.4.2.5: Subtract and Convert Using Compound Units Applications

Subtract the total weight from a given weight to find the weight of the other part.

One-step Subtraction Conversions with Compound Units (Metric Units) - Word Problems



Practice Resource

Subtract and Convert Using Compound Units Applications Practice

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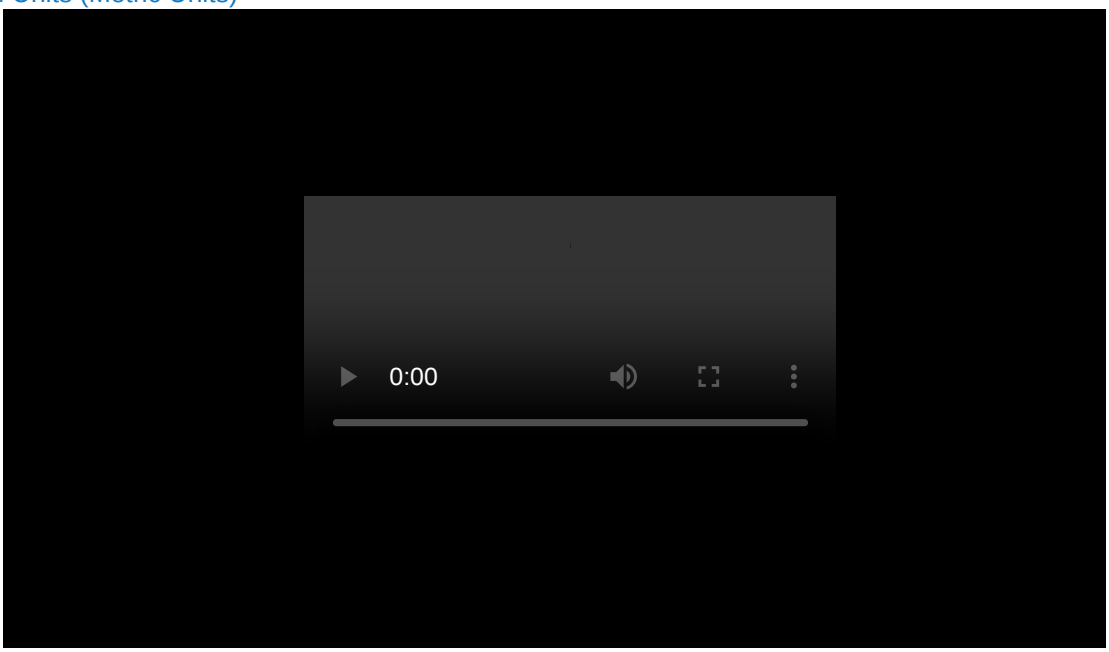
6.4.3: Add and Subtract Metric Weight

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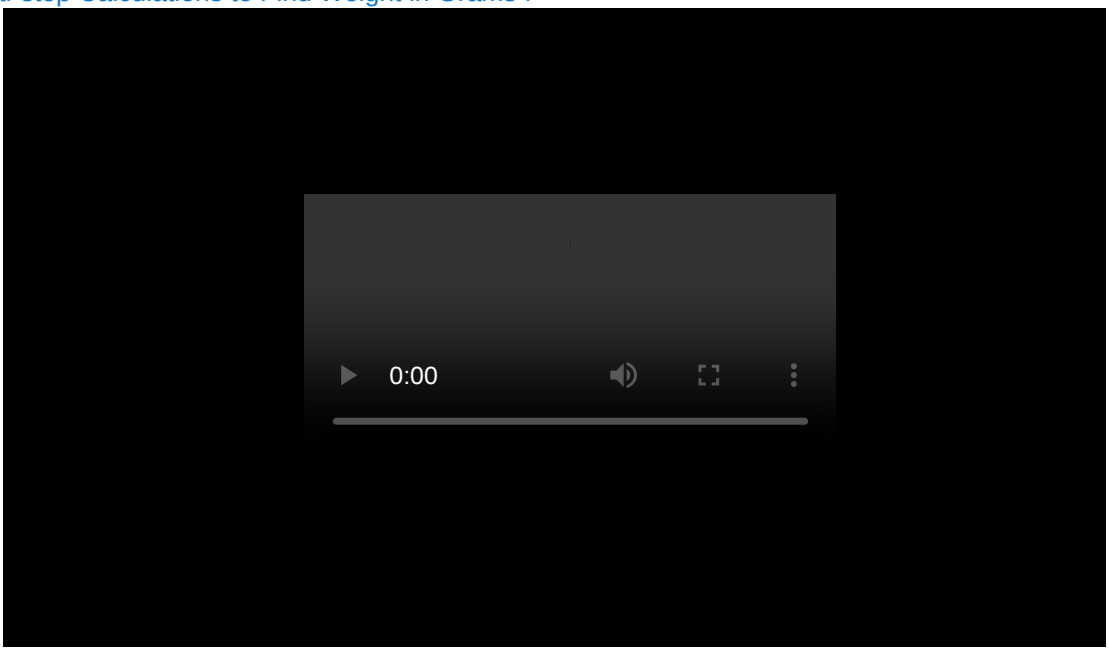
6.4.3.1: Add, Subtract and Compare Mass in Grams Multi-Step Applications

Add and subtract weights of items to determine how much greater/lesser from each other they are and determine how to make them equal.

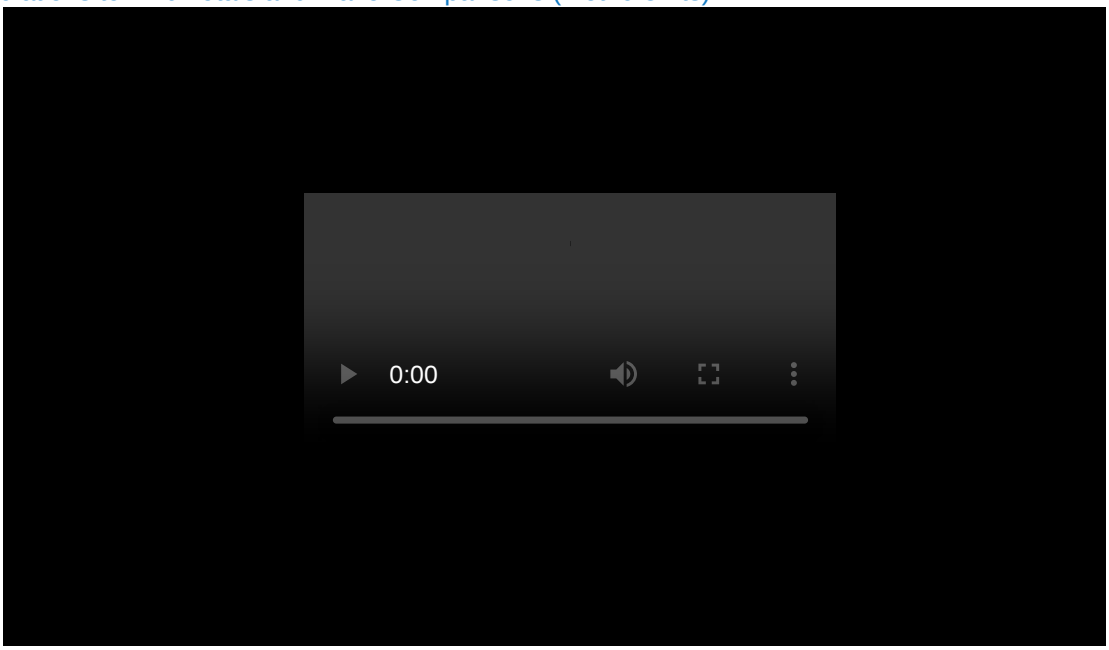
Subtracting Compound Units (Metric Units)



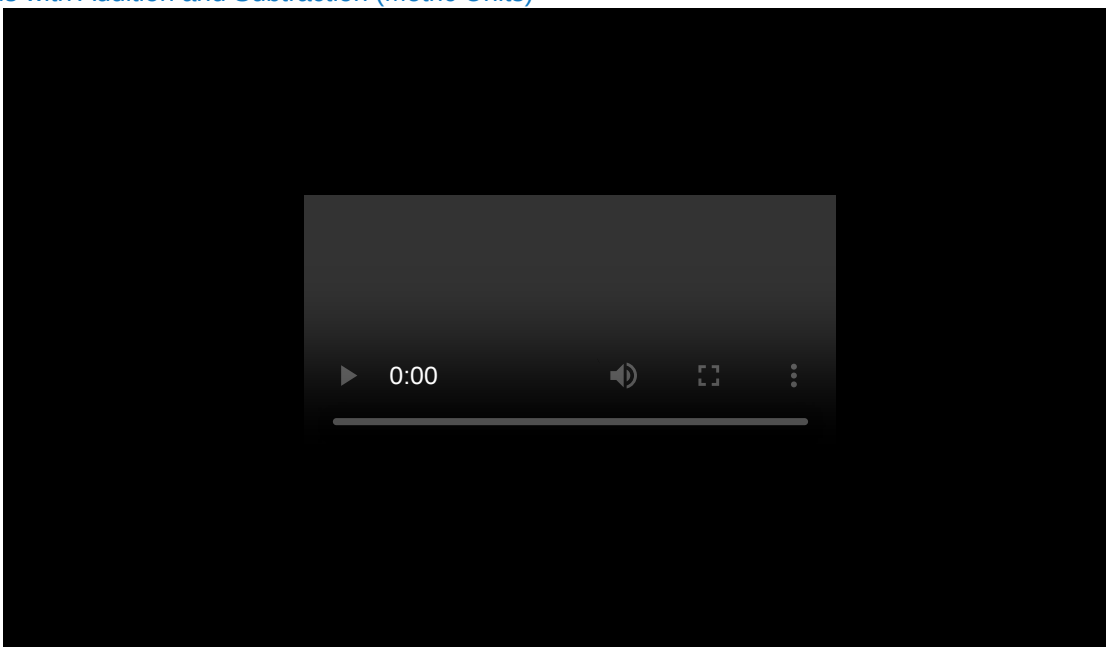
Using A Scale and Multi-step Calculations to Find Weight in Grams I



Using Scales and Calculations to Find Totals and Make Comparisons (Metric Units)



Totals and Comparisons with Addition and Subtraction (Metric Units)



Practice Resource

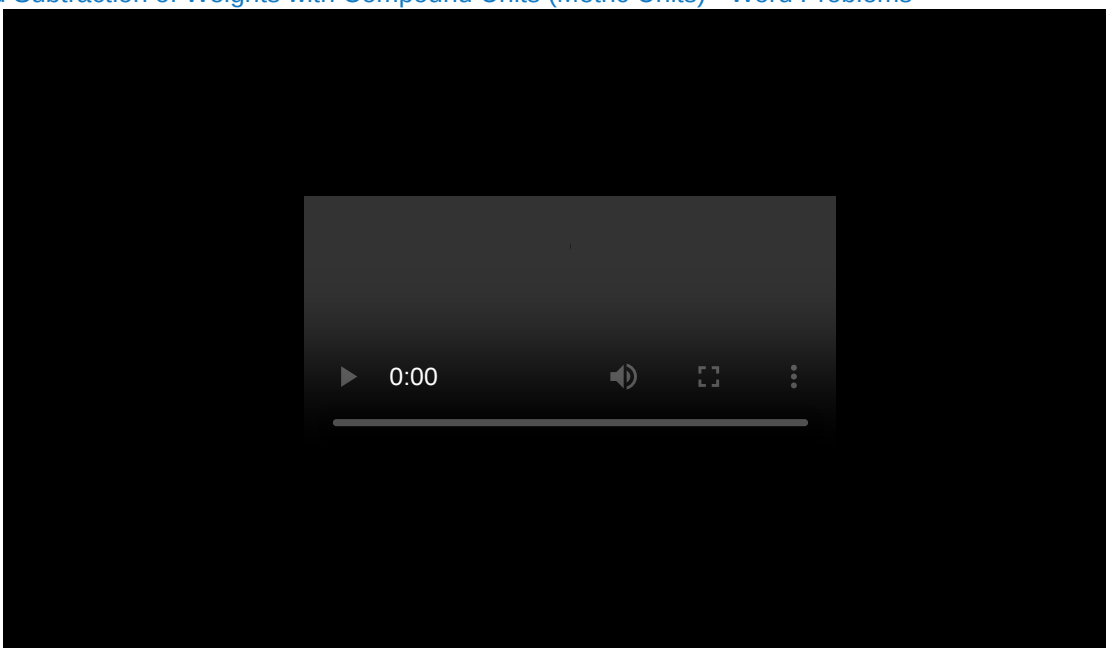
Add Subtract and Compare Mass in Grams Multi-Step Applications Practice

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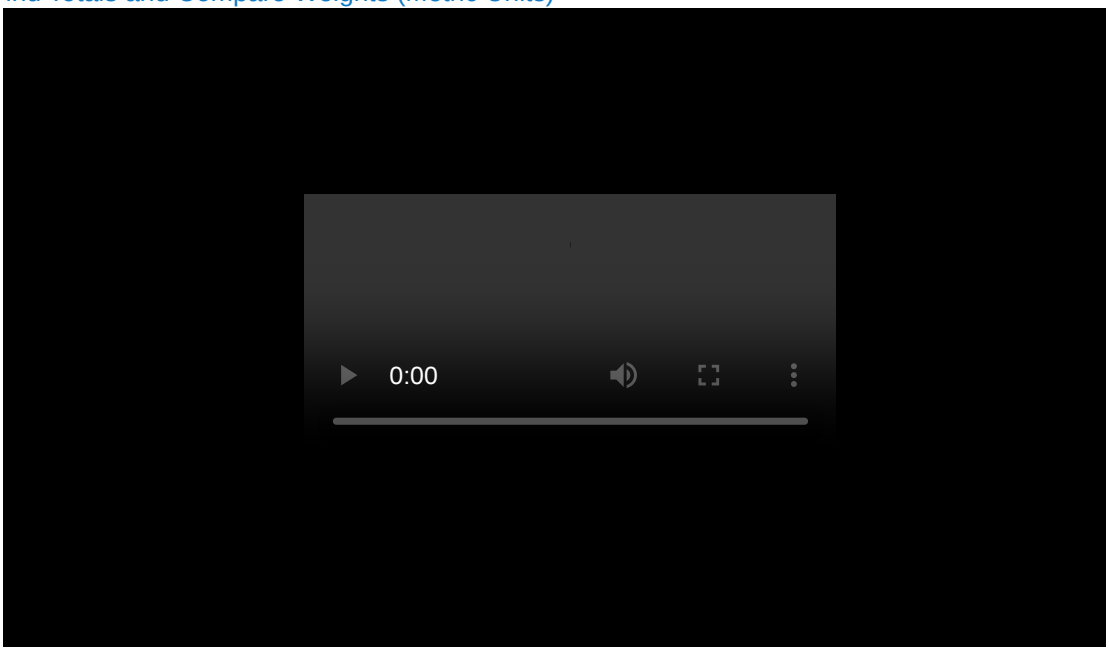
6.4.3.2: Add and Subtract and Convert Compound Units

Use addition and subtraction to find totals of weights that include both grams and kilograms. Do the operations for kilograms then for grams.

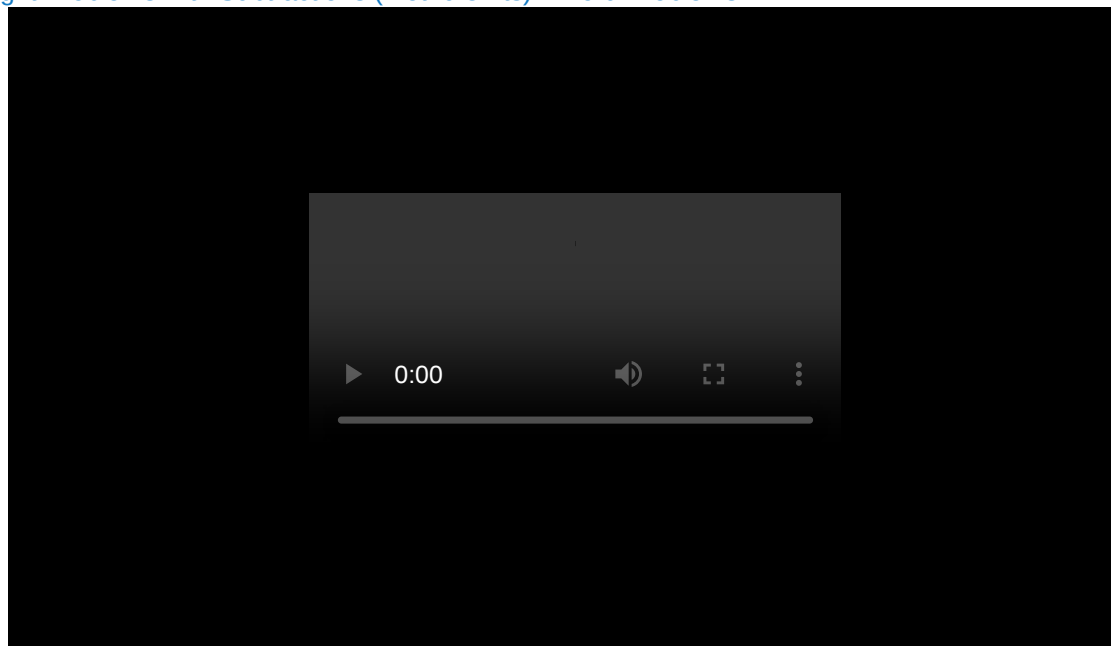
Multi-Step Addition and Subtraction of Weights with Compound Units (Metric Units) - Word Problems



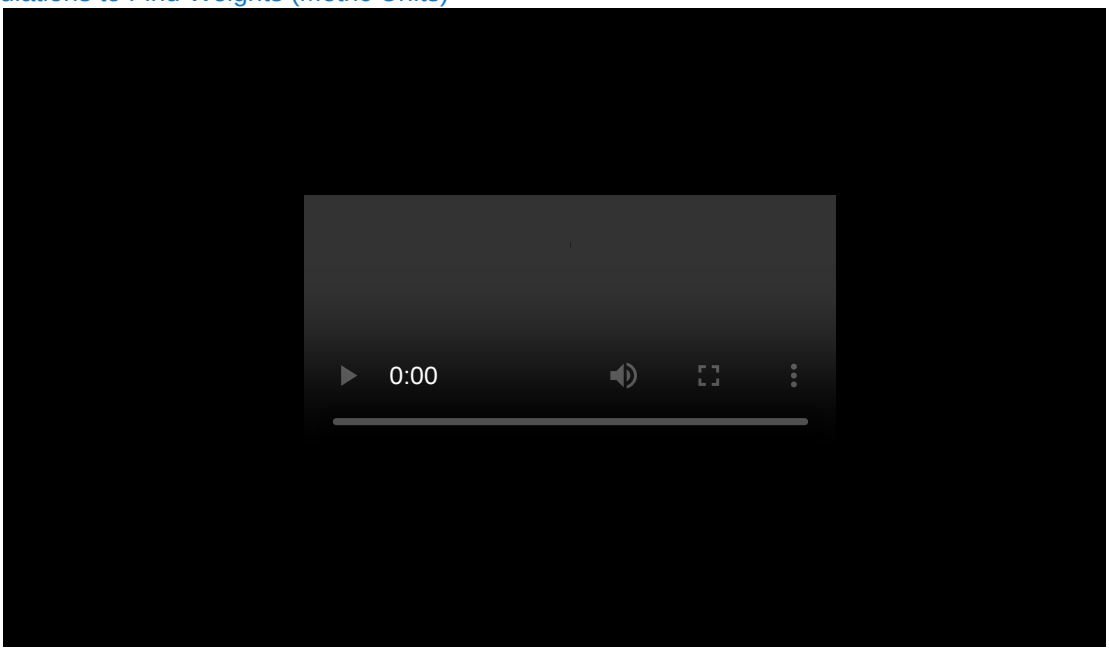
Using Calculations to Find Totals and Compare Weights (Metric Units)



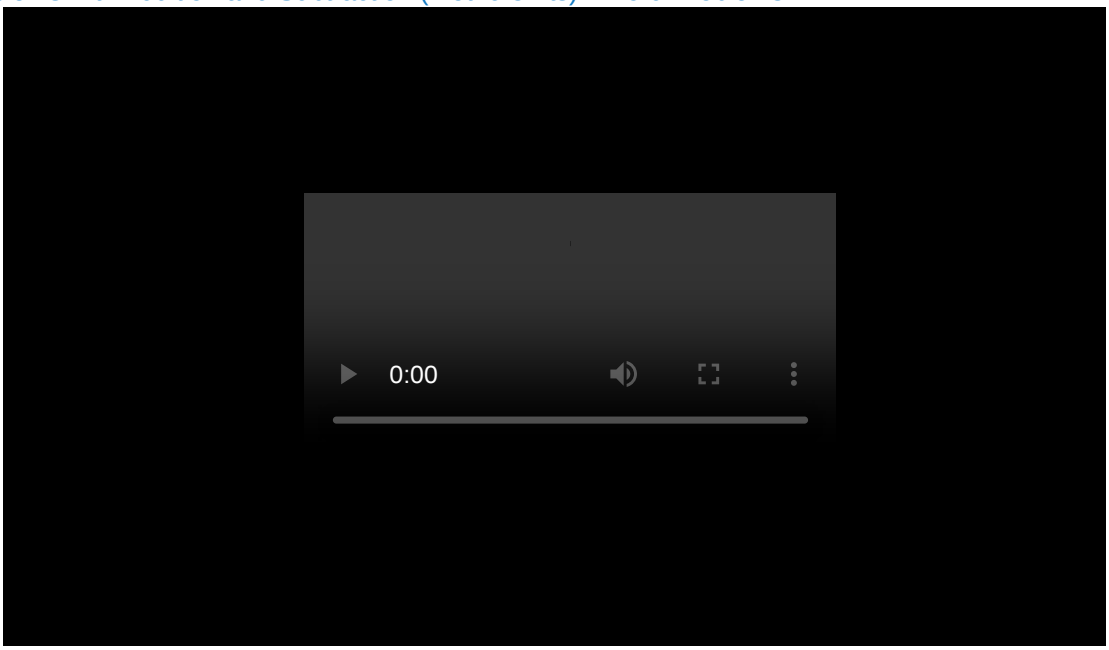
Solving Multi-step Weight Problems with Subtractions (Metric Units) - Word Problems



Using Scales and Calculations to Find Weights (Metric Units)



Solving Multi-step Problems with Addition and Subtraction (Metric Units) - Word Problems



Practice Resource

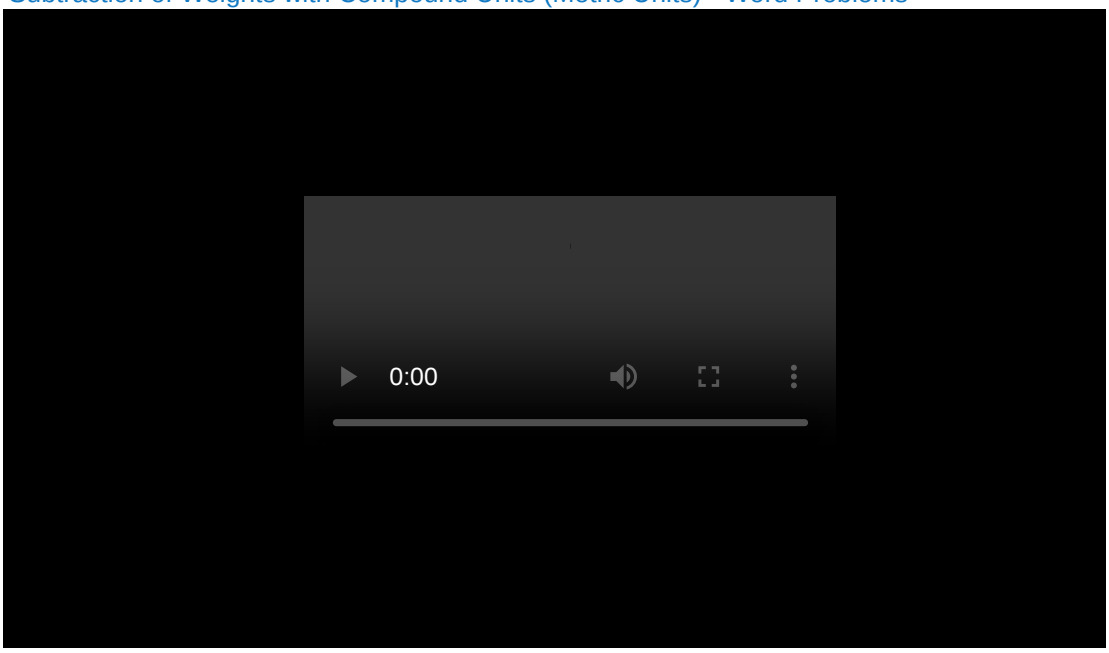
Add and Subtract and Convert Compound Units Practice

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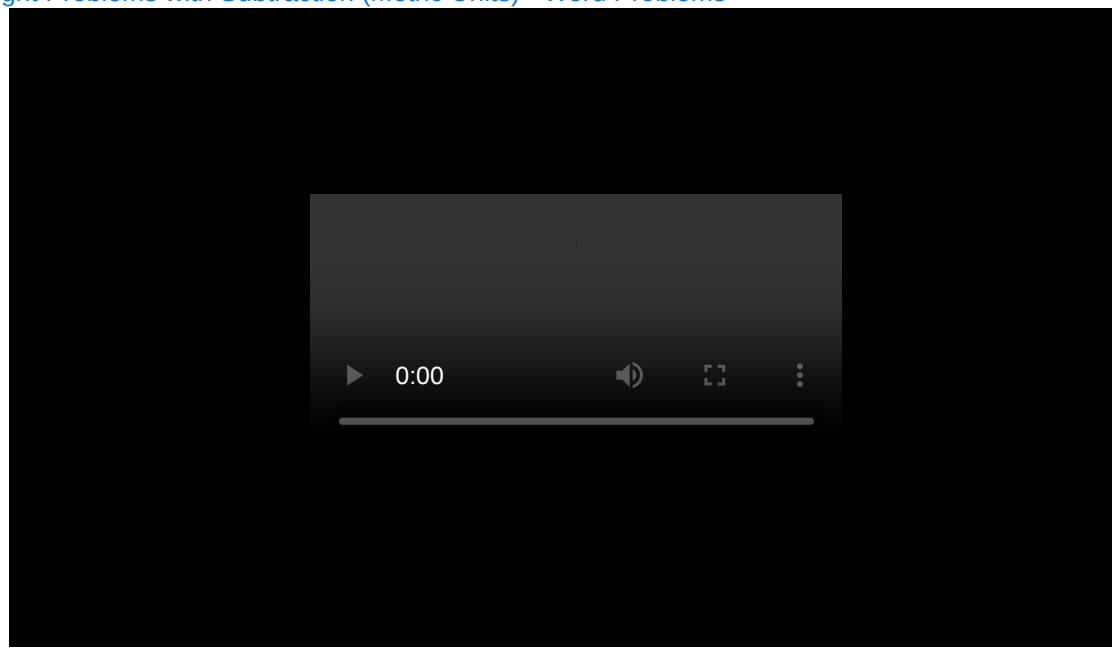
6.4.3.3: Add, Subtract and Compare Grams and Kilograms Multi-Step Applications

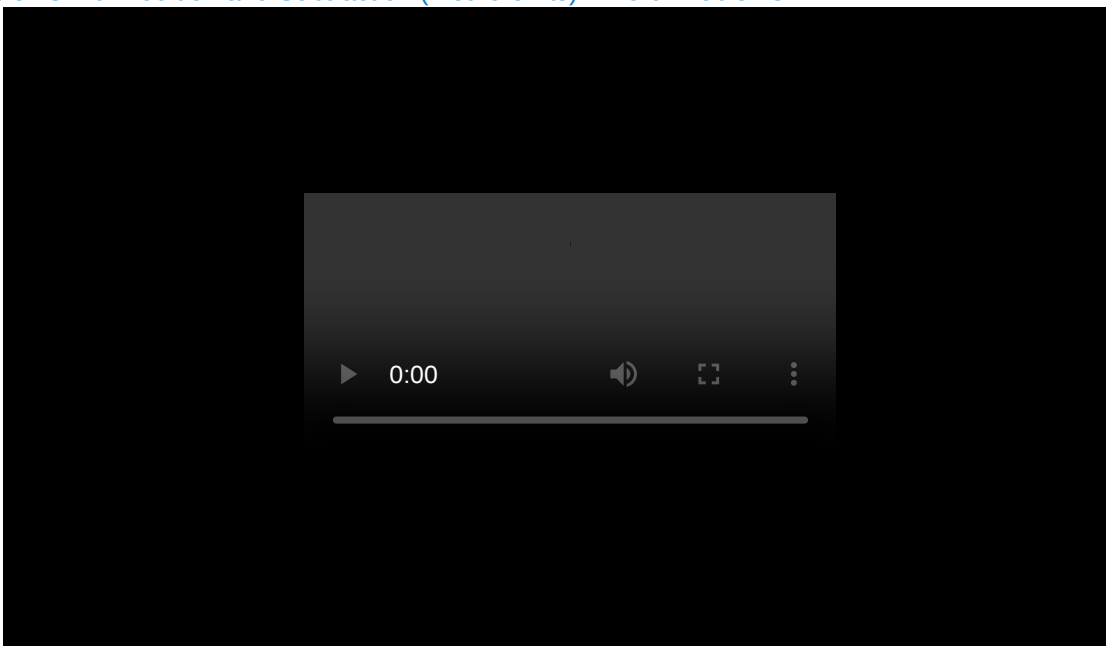
Use addition and subtraction to solve multi-step word problems that involves weights that are greater or lesser.

Multi-step Addition and Subtraction of Weights with Compound Units (Metric Units) - Word Problems



Solving Multi-step Weight Problems with Subtraction (Metric Units) - Word Problems





Practice Resource

Add Subtract and Compare Grams and Kilograms Multi-Step Applications Practice

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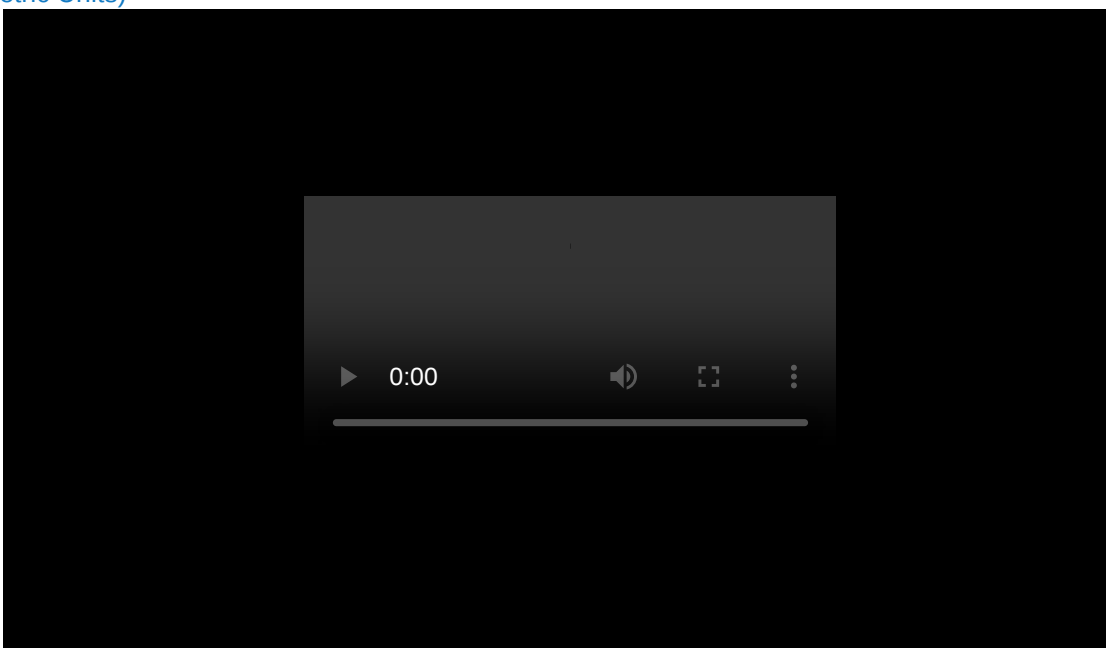
6.4.4: Multiply and Divide Metric Weight

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6.4.4.1: Multiply to Find the Weight in Grams or Kilograms

Find weights of objects by comparing a weight that is given by the weight that is needed to be found and then multiplying.

Multiplying Weights (Metric Units)



Practice Resource

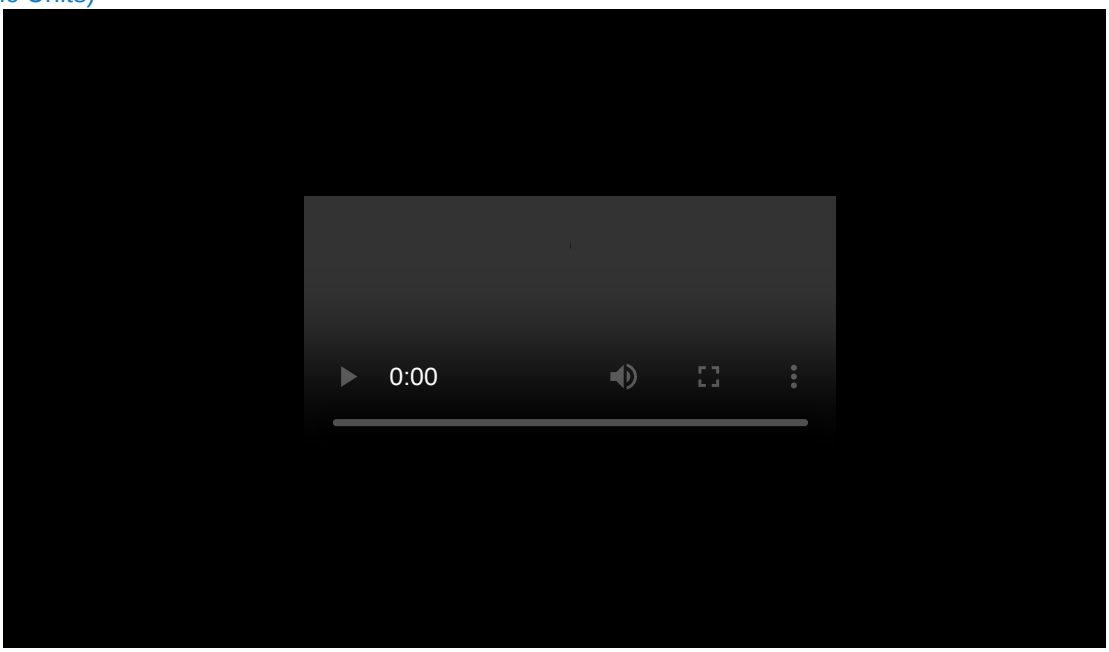
Multiply to find the Weight in Grams or Kilograms Practice

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6.4.4.2: Divide to Find the Weight in Grams or Kilograms

Find weights of objects by comparing and then dividing.

Dividing Weights (Metric Units)



Practice Resource

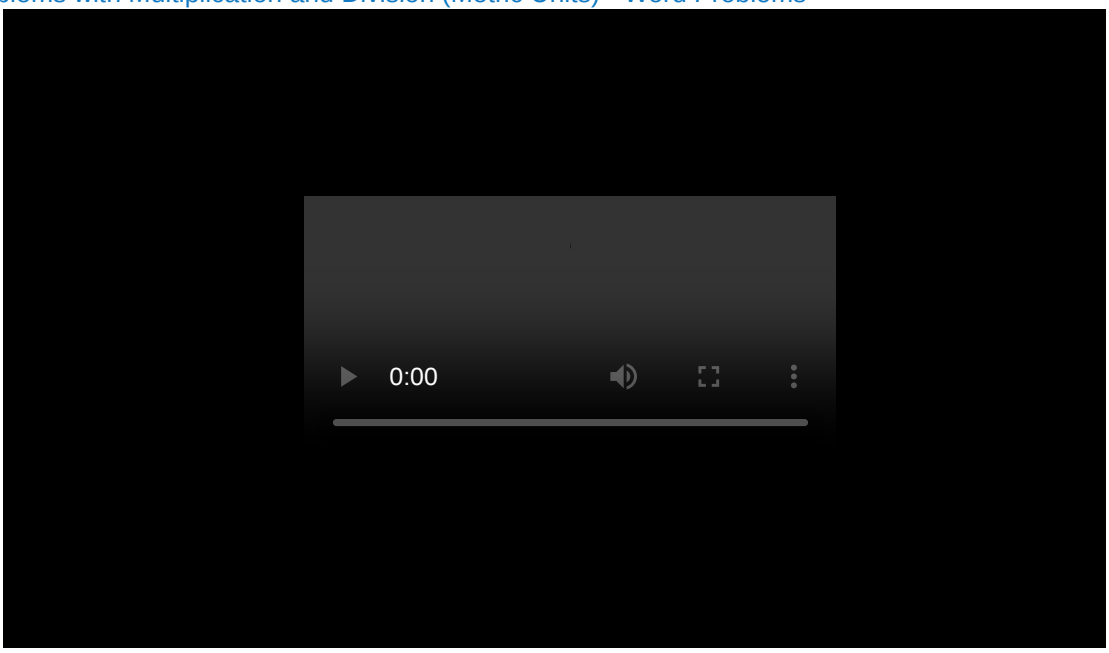
Divide to find the Weight in Grams or Kilograms Practice

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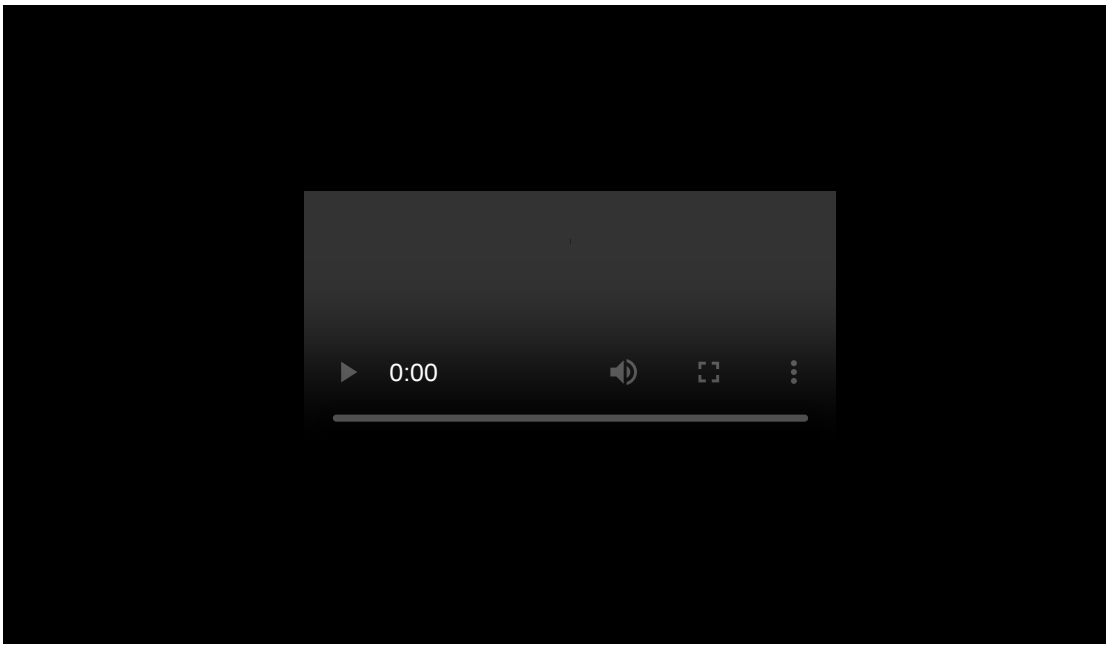
6.4.4.3: Multiply and Divide to Find the Weight in Grams or Kilograms Applications

Use multiplication or division to find out how to balance the scale. Find weight of objects with given information then find out how to make both sides equal.

Solving Multi-Step Problems with Multiplication and Division (Metric Units) - Word Problems



Multi-step, Single-unit Picture Problems



Exercise 6.4.4.3.1

Multiply and Divide to Find the Weight in Grams or Kilograms Applications Practice

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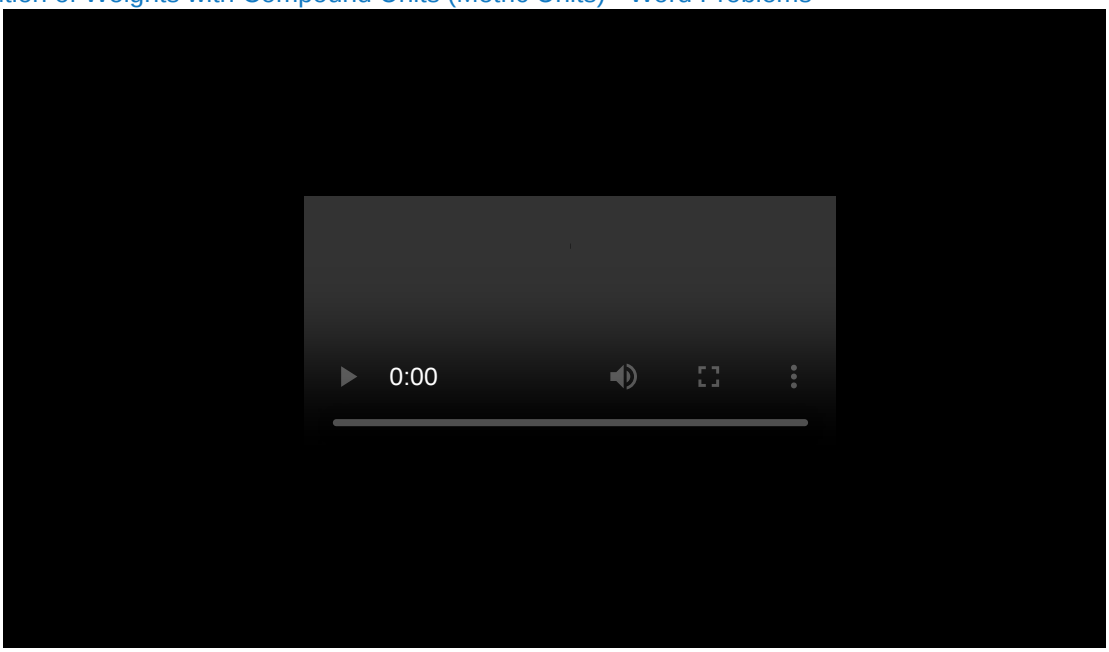
6.4.5: Mixed Operations to find Metric Weight

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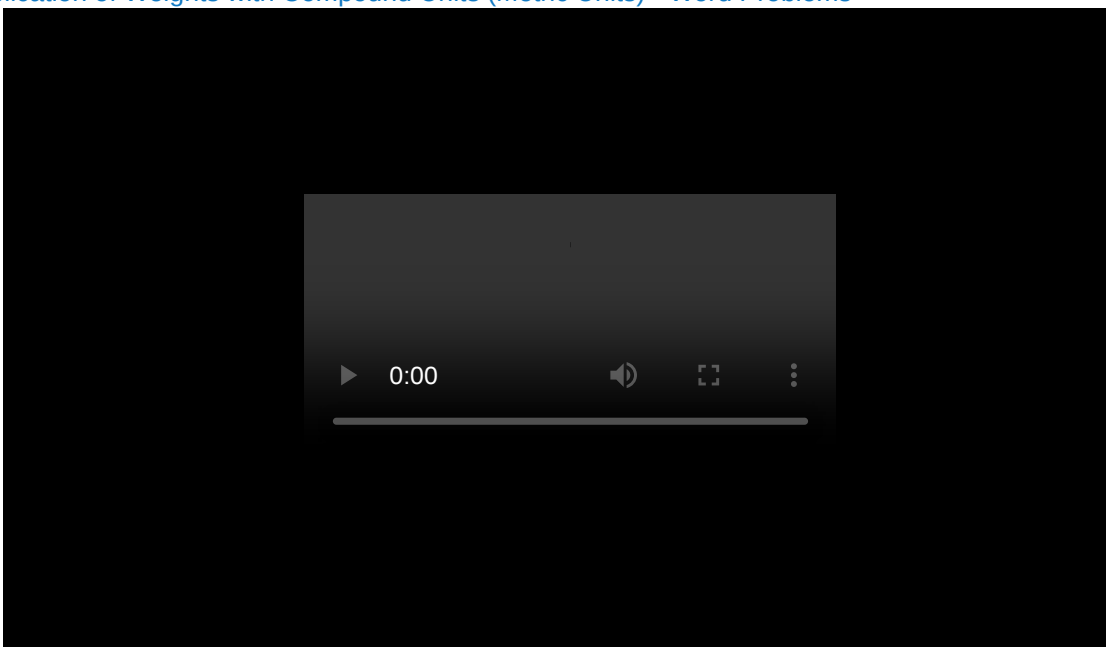
6.4.5.1: Use the Four Operations to Find Weight in Grams and/or Kilograms Applications

Use one of the four basic operations to solve word problems that include kilograms or grams.

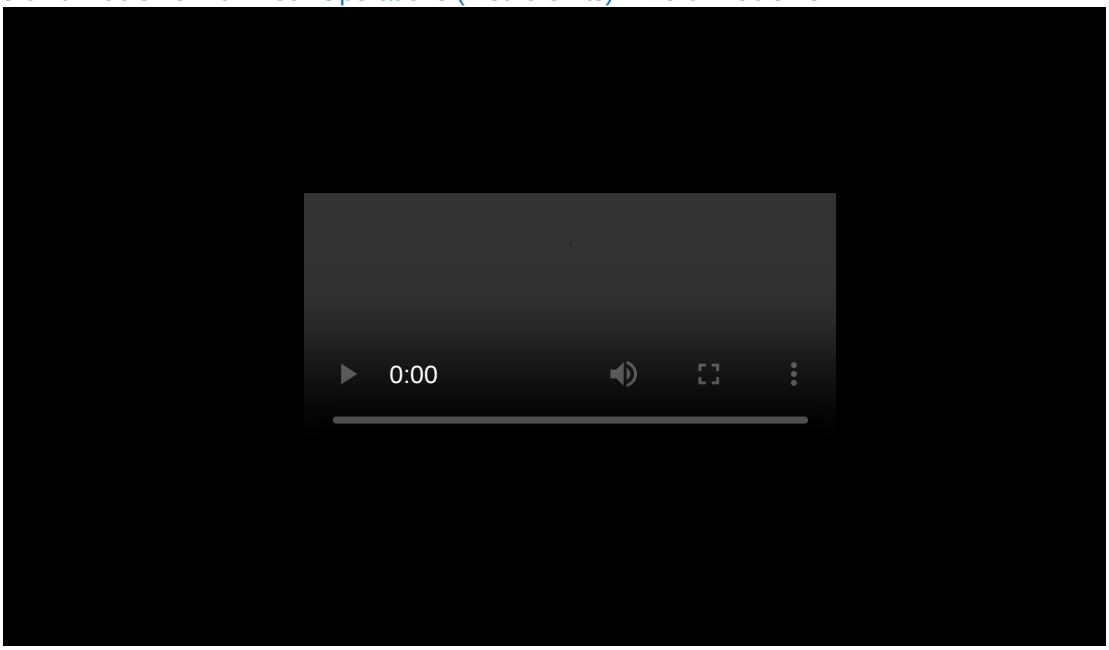
Multiplication then Addition of Weights with Compound Units (Metric Units) - Word Problems



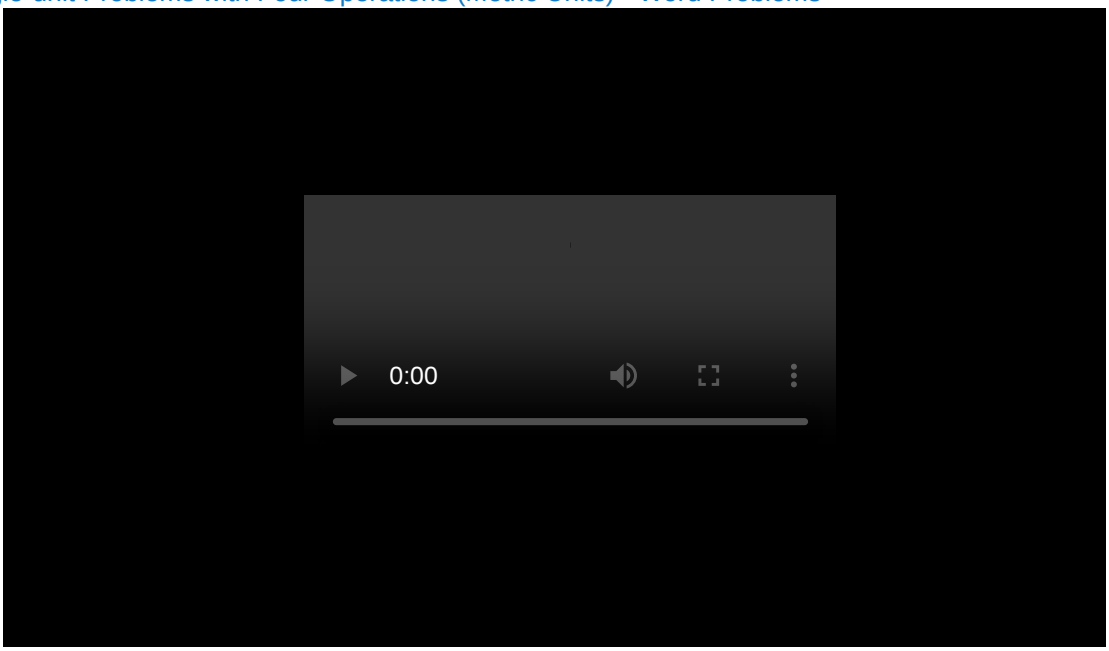
Subtraction then Multiplication of Weights with Compound Units (Metric Units) - Word Problems



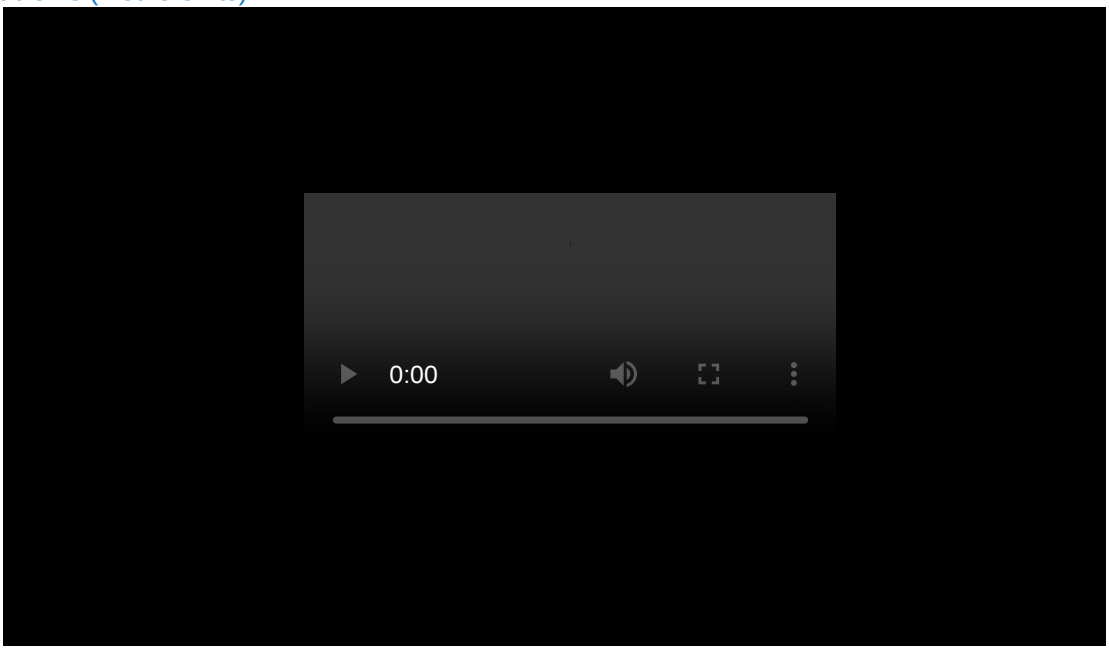
Solving Two-step Single-unit Problems with Four Operations (Metric Units) - Word Problems



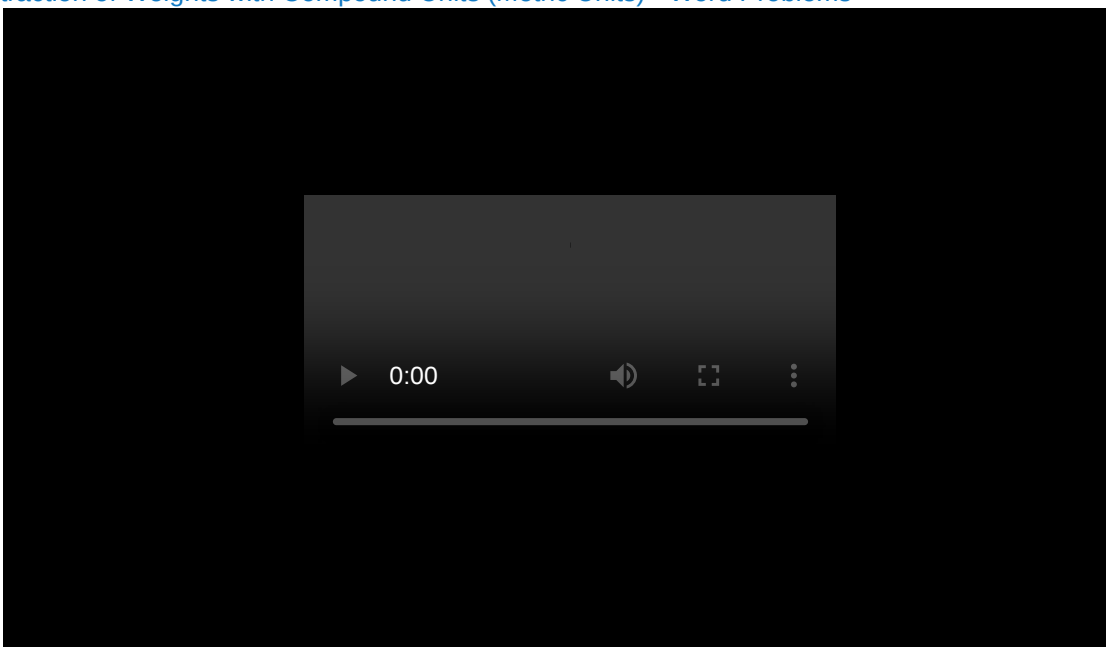
Solving Multi-step Single-unit Problems with Four Operations (Metric Units) - Word Problems



Overview of Weight Problems (Metric Units)



Multiplication then Subtraction of Weights with Compound Units (Metric Units) - Word Problems



Practice Resource

Use the Four Operations to find Weight in Grams and/or Kilograms Applications Practice

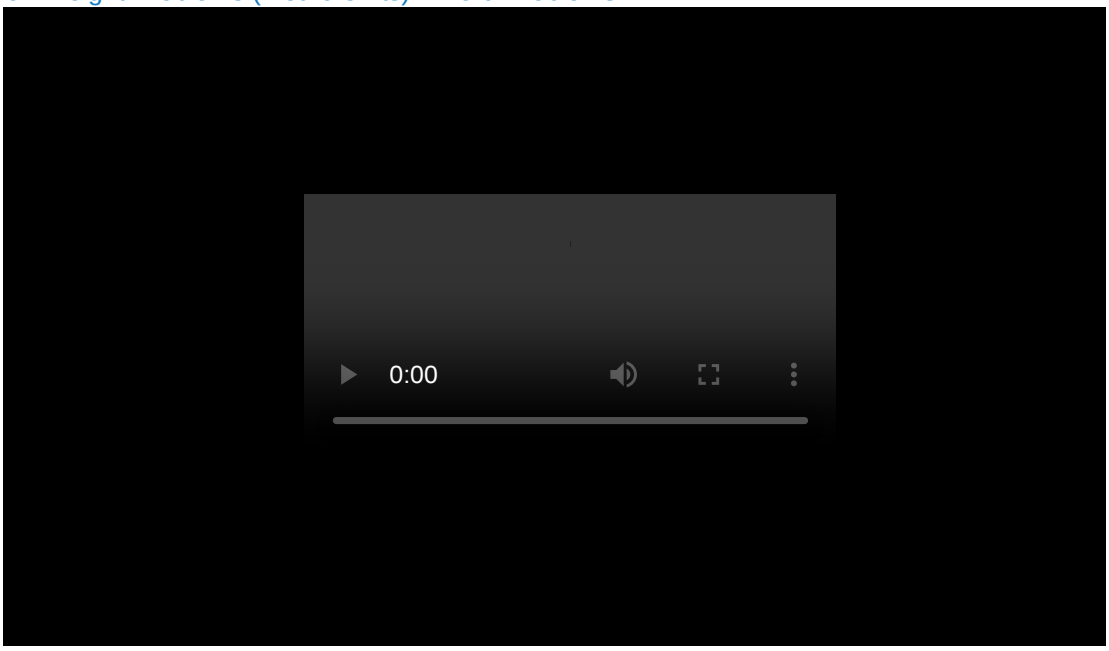
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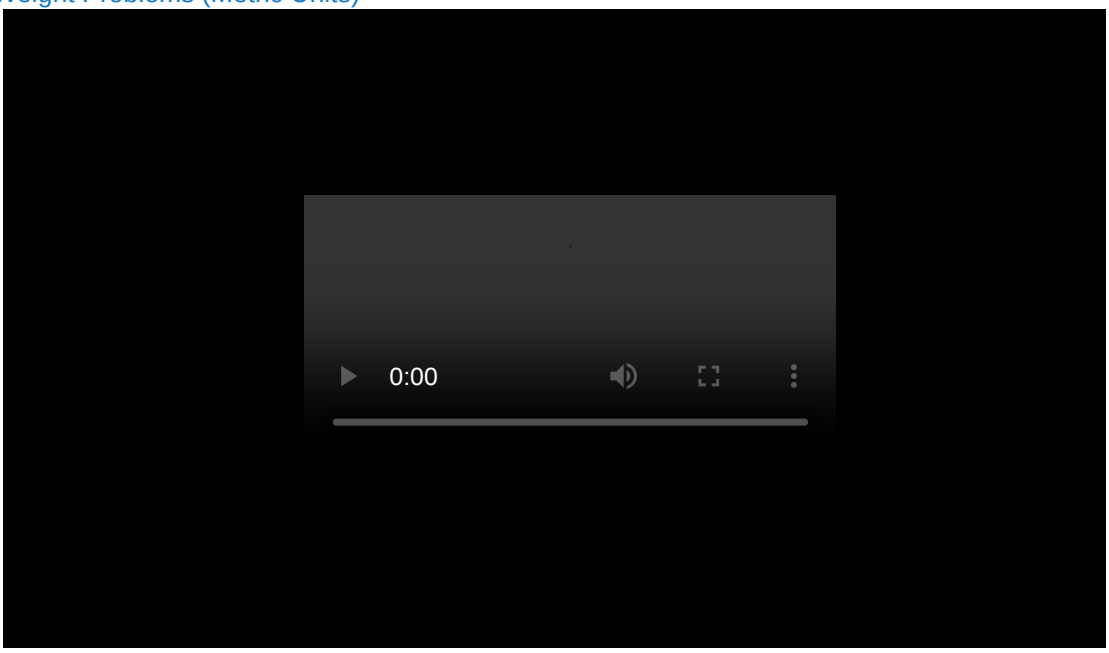
6.4.5.2: Higher Order Four-Operations to Find Weight in Grams or Kilograms Applications

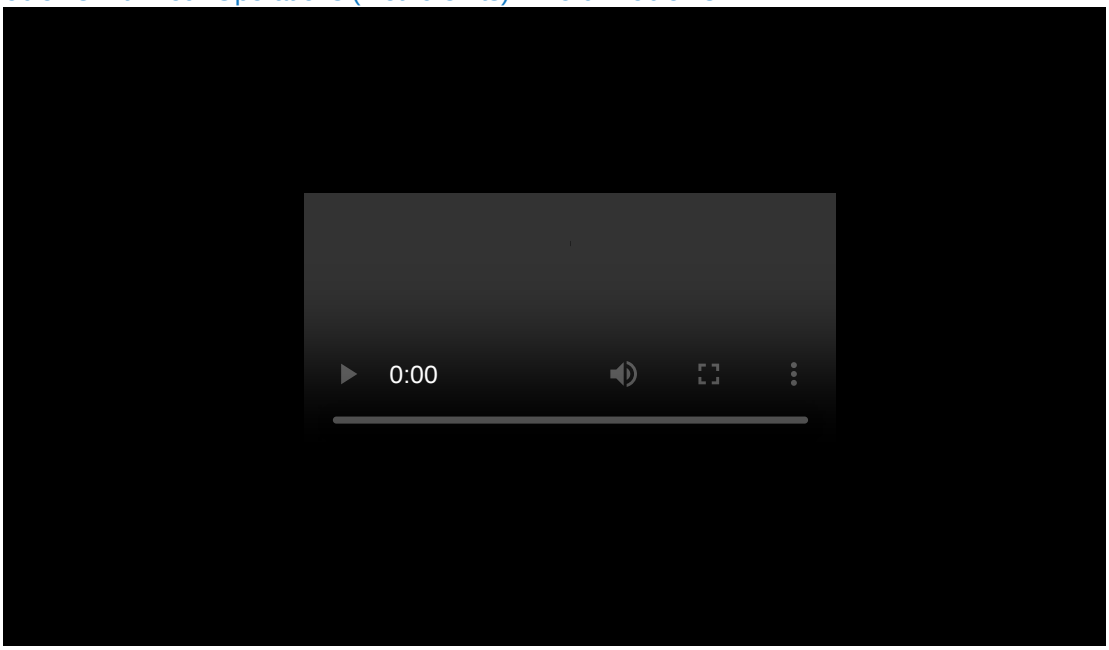
Use four basic operations to solve multi-step word problems that could involve both kilograms and grams. To solve these problems, you need to compare weights and find which operation to use.

Multi-step Four-Operation Weight Problems (Metric Units) - Word Problems



Overview of Complex Weight Problems (Metric Units)





Practice Resource

Higher Order Four-Operations to find Weight in Grams or Kilograms Applications Practice

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6.5.1: Identify Weight in Kilograms and Grams

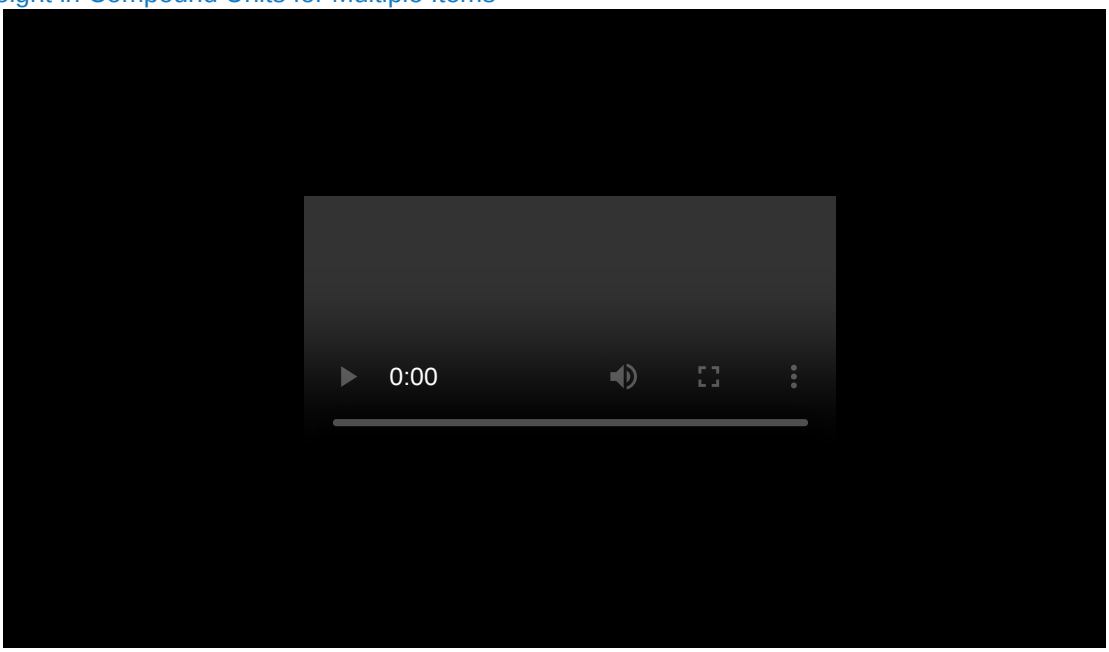
6.5.2: Convert Between Kilograms and Grams

6.5.3: Convert Between Kilograms and Grams and Milligrams

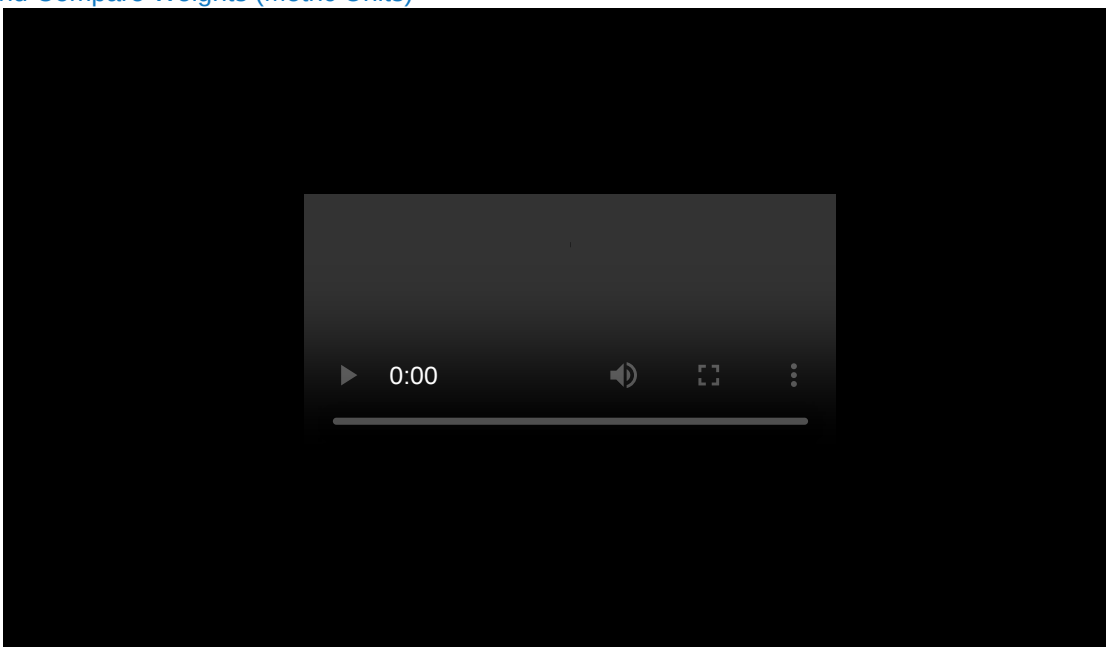
6.5.1: Identify Weight in Kilograms and Grams

Read a scale by finding the values of each of the tick marks then adding the different values to find hte total weight in kilograms or grams.

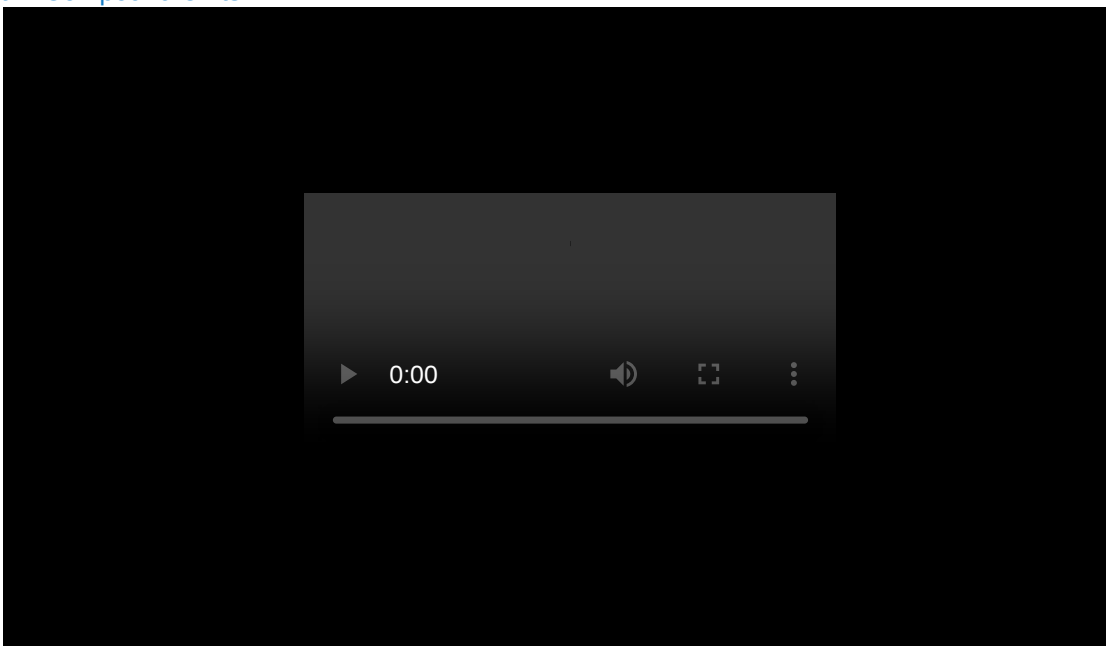
Visually Finding the Weight in Compound Units for Multiple Items



Using Scales to Find and Compare Weights (Metric Units)



Visually Finding Weight in Compound Units



Practice Resource

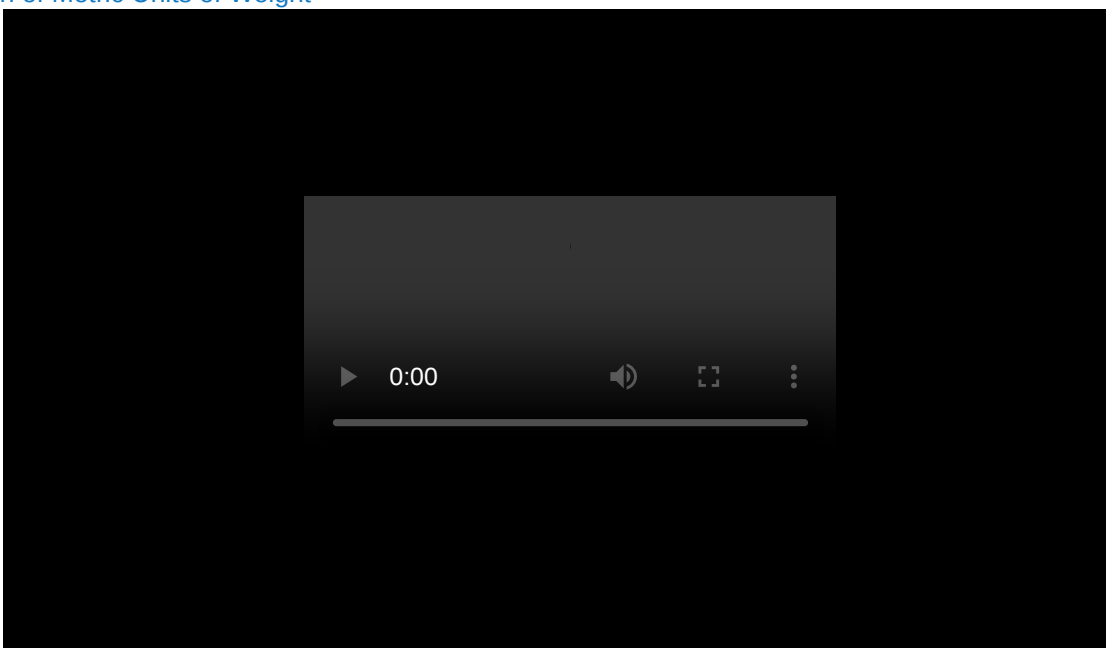
Identify Weight in Kilograms and Grams Practice

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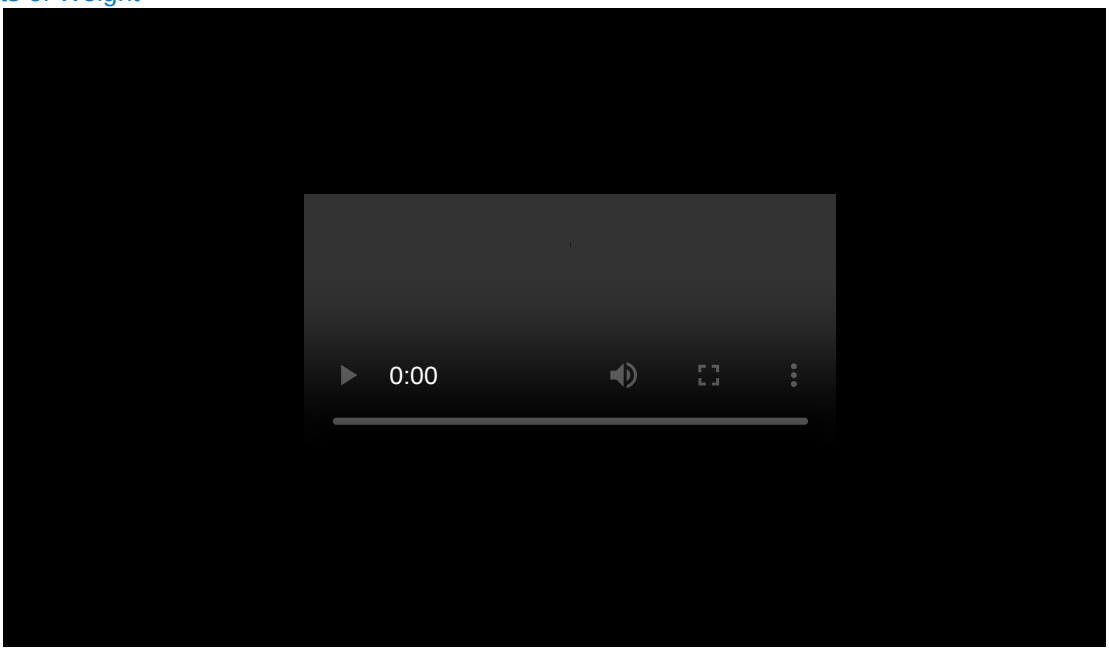
6.5.2: Convert Between Kilograms and Grams

Move the decimal 3 places to the right to convert from grams to kilograms and 3 places to the left for kilograms to grams.

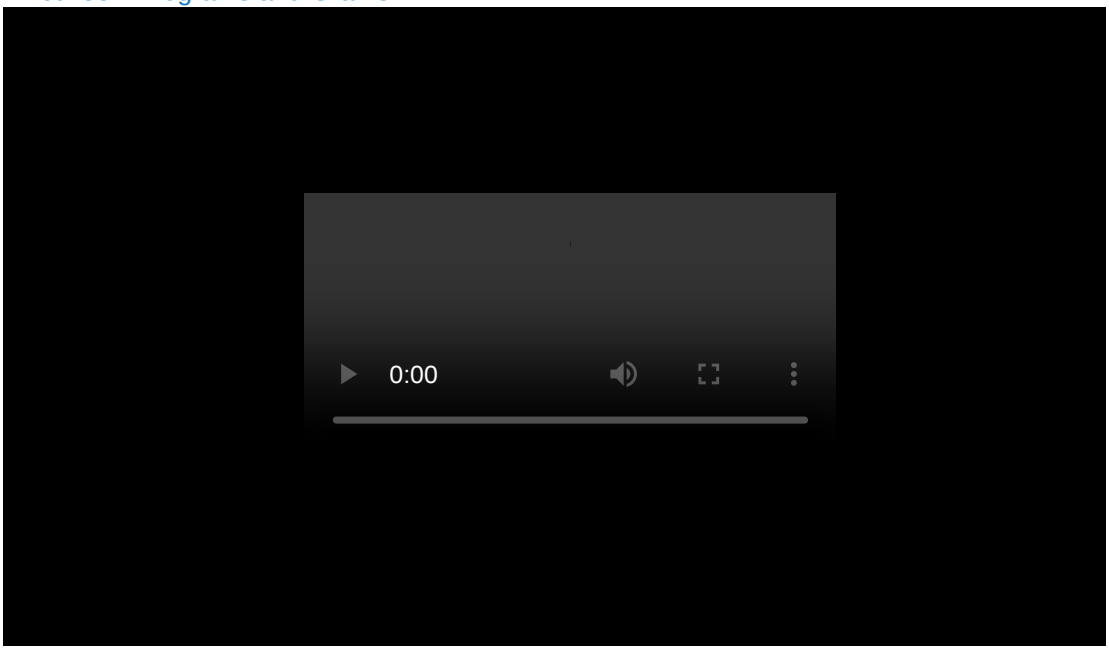
Overview of Conversion of Metric Units of Weight



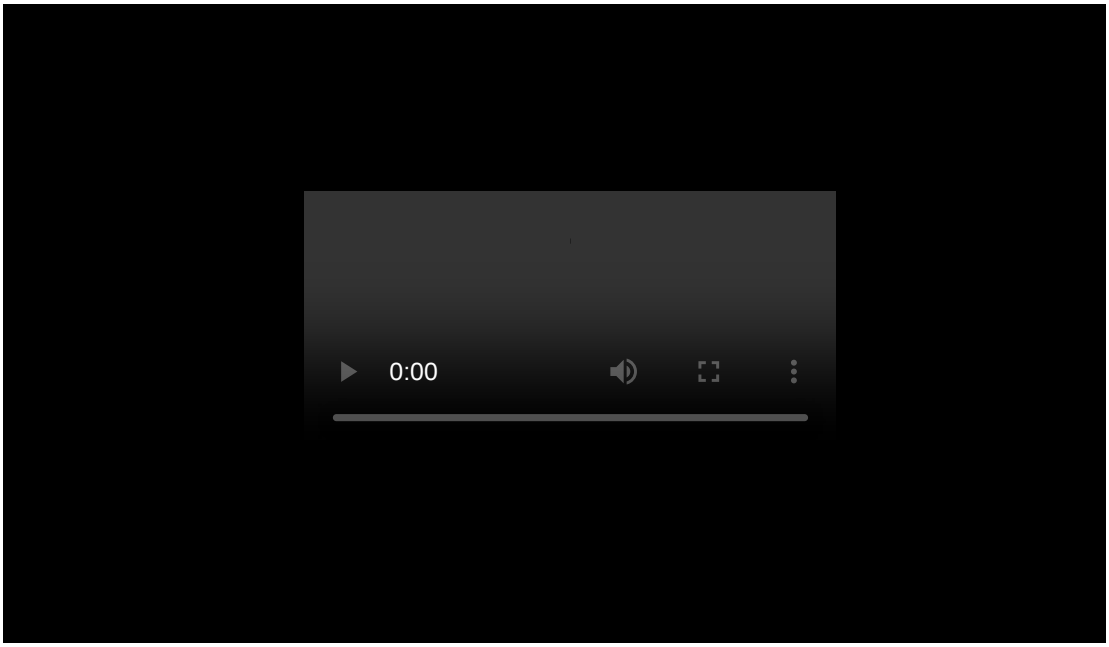
Overview of Metric Units of Weight



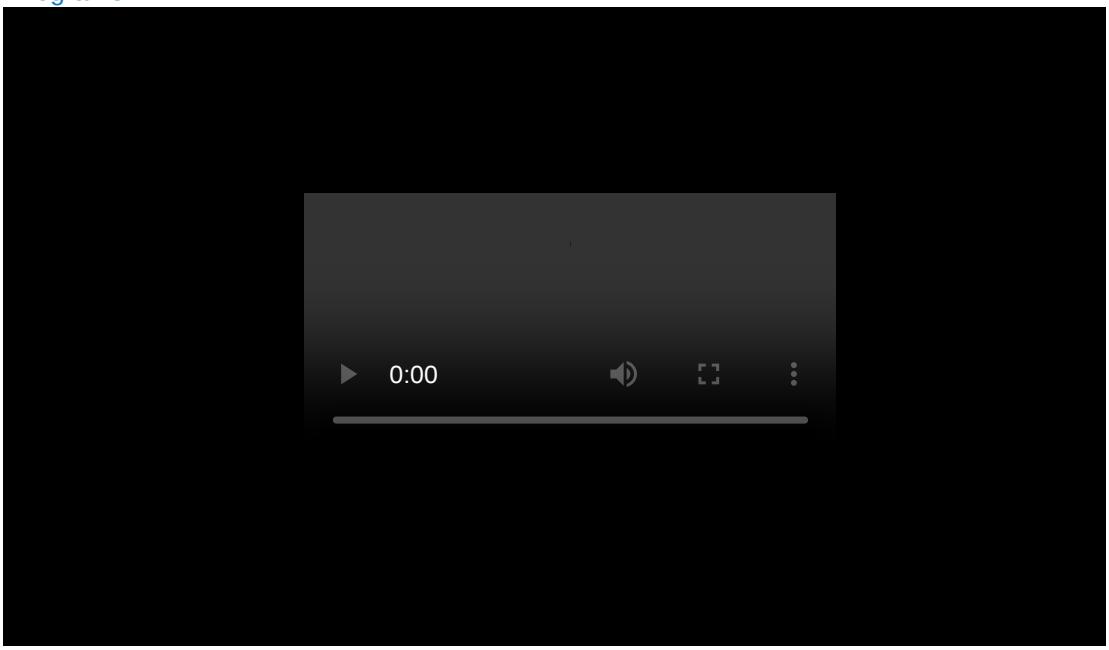
Overview of Conversion Between Kilograms and Grams



Converting Kilograms into Grams



Converting Grams into Kilograms



Problem Resource

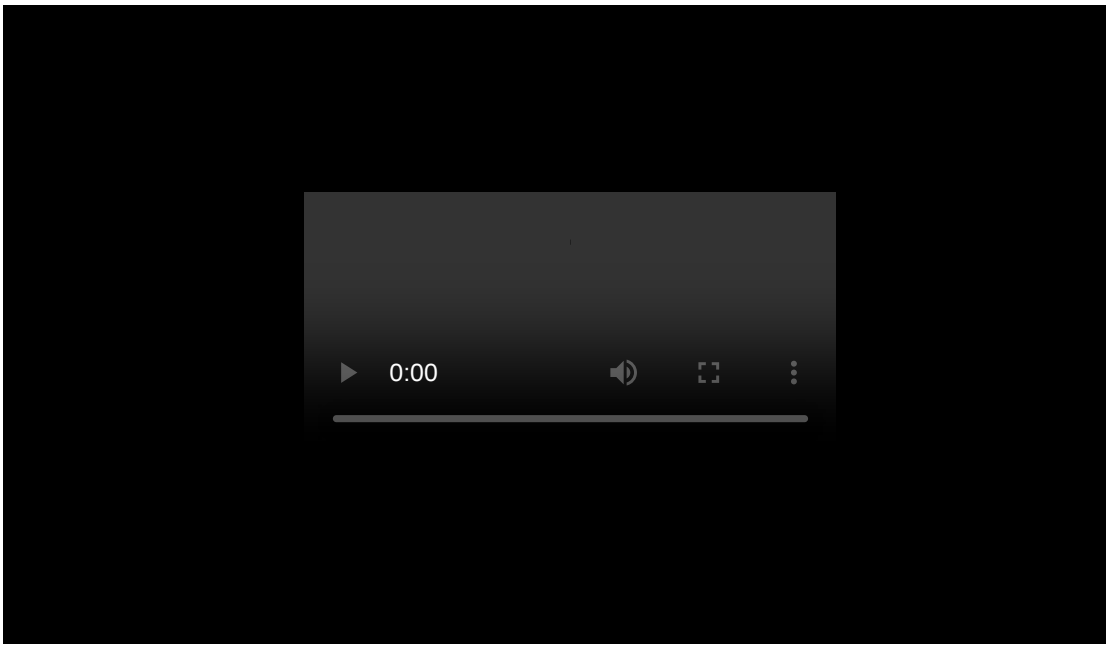
Convert Between Kilograms and Grams Practice

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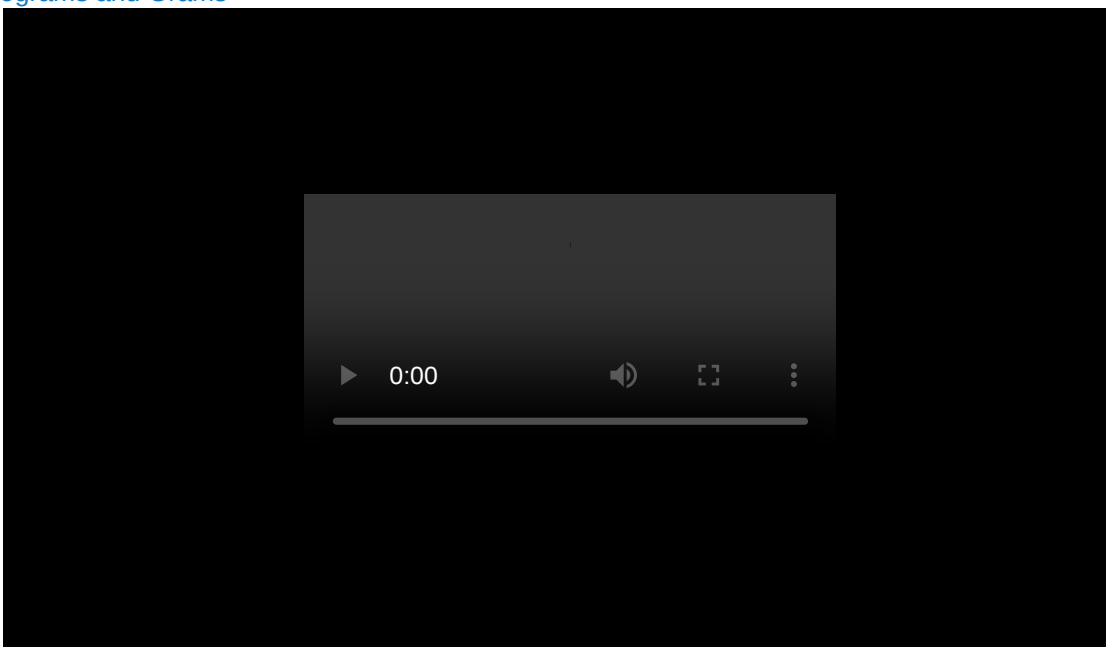
6.5.3: Convert Between Kilograms and Grams and Milligrams

Metric multiplication operations

Convert Kilograms and Grams into Grams



Convert Grams into Kilograms and Grams



Practice Resource

Convert Between Kilograms and Grams and Milligrams Practice

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      - 1.2.2: Convert Between Cents and Dollars - *CK-12 License*
      - 1.2.3: Convert Between Cents and Dollars Applications - *CK-12 License*
    - 1.3: Compare and Arrange Monetary Units - *CK-12 License*
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      - 1.3.2: Identify Equal and Unequal Monetary Values - *CK-12 License*
      - 1.3.3: Order Monetary Values - *CK-12 License*
      - 1.3.4: Identify Greater and Lesser Monetary Amounts - *CK-12 License*
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      - 1.4.1: Add and Subtract Money - *CK-12 License*
      - 1.4.2: Add and Subtract Money Applications - *CK-12 License*
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      - 1.4.5: Convert Dollars and Coins into Dollars Applications - *CK-12 License*
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      - 1.4.7: Use Four Operations in Money Problems - *CK-12 License*
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    - 2.1: Days, Weeks, Months and Years - *CK-12 License*
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      - 2.1.2: AM and PM - *CK-12 License*
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      - 2.1.4: Convert Years into Weeks - *CK-12 License*
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      - 2.1.6: Convert Weeks into Days - *CK-12 License*
      - 2.1.7: Add Compound Units in Years, Months, Weeks and Days - *CK-12 License*
      - 2.1.8: Subtract Compound Units in Years, Months, Weeks and Days - *CK-12 License*
      - 2.1.9: Convert Days and Hours - *CK-12 License*
      - 2.1.10: Add and Subtract Compound Units of Time - *CK-12 License*
      - 2.1.11: Convert Compound Units of Time - *CK-12 License*
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      - 2.2.1: Time to Quarter, Half-Past and Hour - *CK-12 License*
      - 2.2.2: Identify Time in 5-Minute Intervals - *CK-12 License*
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  - 2.3.1: Convert between Analog and Digital - *CK-12 License*
  - 2.3.2: Match the Time - *CK-12 License*
  - 2.3.3: 24 hour Clocks - *CK-12 License*
- 2.4: Operations with Clock Time - *CK-12 License*
  - 2.4.1: Time Patterns - *CK-12 License*
  - 2.4.2: Tell Time Before and After - *CK-12 License*
  - 2.4.3: Determine Elapsed Time - *CK-12 License*
  - 2.4.4: Elapsed Time Applications - *CK-12 License*
  - 2.4.5: Elapsed Time in a Sequence of Events Applications - *CK-12 License*
  - 2.4.6: Difference between Two Time Intervals - *CK-12 License*
  - 2.4.7: Elapsed Time with a 24-Hour Clock - *CK-12 License*
  - 2.4.8: Applications of Four Operations with Time - *CK-12 License*
  - 2.4.9: Four Operations and Fractions in Time Applications - *CK-12 License*
- 2.5: Schedules - *CK-12 License*
  - 2.5.1: Read a Schedule - *CK-12 License*
  - 2.5.2: Use a Timeline - *CK-12 License*

3: Measurement Systems and Unit Conversion - *CK-12 License*

- 3.1: Introduction to Measurement Systems - *CK-12 License*
  - 3.1.1: Introduction to Customary Units of Length - *CK-12 License*
  - 3.1.2: Introduction to Customary Units of Mass and Capacity - *CK-12 License*
  - 3.1.3: Introduction to Metric Units of Length - *CK-12 License*
  - 3.1.4: Introduction to Metric Units of Mass and Capacity - *CK-12 License*
- 3.2: Tools of Measurement - *CK-12 License*
  - 3.2.1: Tools for Measurement of Customary and Metric Lengths - *CK-12 License*
  - 3.2.2: Tools of Metric Measurement of Length - *CK-12 License*
  - 3.2.3: Tools for Measurement of Customary Units of Length, Weight and Capacity - *CK-12 License*
- 3.3: Convert Units of Length, Weight, and Capacity - *CK-12 License*
  - 3.3.1: Conversion between Customary Units of Length, Weight, and Capacity - *CK-12 License*
  - 3.3.2: Multiply or Divide to Convert between Customary Units of Length, Weight, and Capacity - *CK-12 License*
  - 3.3.3: Conversion of Customary Length, Weight, and Capacity Applications - *CK-12 License*
  - 3.3.4: Convert between Metric Units of Length, Weight, and Capacity - *CK-12 License*
  - 3.3.5: Customary and Metric Measurement Conversion - *CK-12 License*
  - 3.3.6: Convert Using Unit Analysis - *CK-12 License*

4: Length - *CK-12 License*

- 4.1: Determine Customary Lengths - *CK-12 License*
  - 4.1.1: Length in Inches - *CK-12 License*
  - 4.1.2: Compare Length in Inches - *CK-12 License*
  - 4.1.3: Estimate by Inches and Feet - *CK-12 License*
  - 4.1.4: Measure and Estimate in Feet and Yards - *CK-12 License*
  - 4.1.5: Differences in Inches, Feet, and Yards - *CK-12 License*
  - 4.1.6: Estimate the Measure in Inches, Feet, and Yards - *CK-12 License*
  - 4.1.7: Distances Greater Than or Less Than a Foot or a Yard - *CK-12 License*
  - 4.1.8: Measurement of Length to a Fraction of an Inch - *CK-12 License*
- 4.2: Convert Customary Lengths - *CK-12 License*
  - 4.2.1: Convert Inches to Feet - *CK-12 License*
  - 4.2.2: Convert Feet to Inches - *CK-12 License*
  - 4.2.3: Convert Inches to Yards - *CK-12 License*
  - 4.2.4: Convert Feet to Yards - *CK-12 License*
  - 4.2.5: Convert Yards to Feet - *CK-12 License*
  - 4.2.6: Convert between Yards and Miles - *CK-12 License*
  - 4.2.7: Convert Miles to Feet - *CK-12 License*
  - 4.2.8: Convert between Inches, Feet and Yards - *CK-12 License*
  - 4.2.9: Mixed Unit Comparison - *CK-12 License*
  - 4.2.10: Conversion Applications - *CK-12 License*
- 4.3: Customary Length Operations - *CK-12 License*
  - 4.3.1: Determine Distance Using Addition - *CK-12 License*
  - 4.3.2: Add Unit Length Applications. - *CK-12 License*
  - 4.3.3: Subtract Unit Lengths - *CK-12 License*
  - 4.3.4: Add and Subtract Unit Lengths - *CK-12 License*

- 4.3.5: Length Comparison Applications - *CK-12 License*
- 4.3.6: Multiply Unit Lengths - *CK-12 License*
- 4.3.7: Divide Unit Lengths - *CK-12 License*

- 4.4: Compound Customary Units of Length - *CK-12 License*
  - 4.4.1: Add and Subtract to Solve Compound Unit Problems - *CK-12 License*
  - 4.4.2: Add and Subtract to Solve Compound Unit Applications - *CK-12 License*
  - 4.4.3: Compare Compound Units - *CK-12 License*
  - 4.4.4: Order Compound Units - Ascending - *CK-12 License*
  - 4.4.5: Order Compound Units- Descending - *CK-12 License*
- 4.5: Metric Units of Length - *CK-12 License*
  - 4.5.1: Meters - *CK-12 License*
  - 4.5.2: Centimeters - *CK-12 License*
  - 4.5.3: Estimate and Compare Meters and Centimeters - *CK-12 License*
  - 4.5.4: Metric Length Comparison in Meters, Centimeters and Millimeters - *CK-12 License*
- 4.6: Convert and Compare Metric Units of Length - *CK-12 License*
  - 4.6.1: Meter, Centimeter Conversions - *CK-12 License*
  - 4.6.2: Meter, Kilometer Conversions - *CK-12 License*
  - 4.6.3: Centimeter, Millimeter Conversions - *CK-12 License*
  - 4.6.4: Meter Millimeter Conversions - *CK-12 License*
  - 4.6.5: Multiple Metric Conversions - *CK-12 License*
  - 4.6.6: Higher Order Metric Conversions - *CK-12 License*
  - 4.6.7: Appropriate Decimal Units for Metric Measurement - *CK-12 License*
- 4.7: Metric Length Operations - *CK-12 License*
  - 4.7.1: Metric Addition - *CK-12 License*
  - 4.7.2: Add Metric Lengths and Distances - *CK-12 License*
  - 4.7.3: Metric Subtraction - *CK-12 License*
  - 4.7.4: Applications of Metric Addition and Subtraction - *CK-12 License*
  - 4.7.5: Metric Multiplication - *CK-12 License*
  - 4.7.6: Metric Division - *CK-12 License*
  - 4.7.7: Metric Multiplication and Division - *CK-12 License*
  - 4.7.8: Multi-Operation and Multi-Step Metric Problems - *CK-12 License*
  - 4.7.9: Multi-Operation and Multi-Step Metric Applications - *CK-12 License*
  - 4.7.10: Compound Metric Units of Length - *CK-12 License*
- 4.8: Scale - *CK-12 License*
  - 4.8.1: Find Scale Dimensions - *CK-12 License*
  - 4.8.2: Find Scale or Actual Dimensions - *CK-12 License*
  - 4.8.3: Find Actual Dimensions - *CK-12 License*
  - 4.8.4: Find the Scale Factor - *CK-12 License*

- 5: Capacity and Volume - *CK-12 License*
  - 5.1: Visually Identify and Compare Measures of Capacity - *CK-12 License*
  - 5.2: Compare Customary Units of Capacity - *CK-12 License*
    - 5.2.1: Compare Cups and Pints - *CK-12 License*
    - 5.2.2: Compare Pints and Quarts - *CK-12 License*
    - 5.2.3: Compare Cups and Quarts - *CK-12 License*
    - 5.2.4: Compare Gallons and Quarts - *CK-12 License*
    - 5.2.5: Compare Cups Pints and Quarts - *CK-12 License*
    - 5.2.6: Compare Pints Quarts and Gallons - *CK-12 License*
    - 5.2.7: Customary Units of Volume Comparisons - *CK-12 License*
  - 5.3: Convert Customary Units of Capacity - *CK-12 License*
    - 5.3.1: Convert between Cups and Pints - *CK-12 License*
    - 5.3.2: Convert between Pints and Quarts - *CK-12 License*
    - 5.3.3: Convert between Quarts and Gallons - *CK-12 License*
    - 5.3.4: Convert between Cups and Quarts - *CK-12 License*
    - 5.3.5: Convert between Pints and Gallons - *CK-12 License*
    - 5.3.6: Convert between Cups and Gallons - *CK-12 License*
    - 5.3.7: Convert between Cups, Pints and Quarts - *CK-12 License*
    - 5.3.8: Convert between Gallons, Pints and Quarts - *CK-12 License*

- 5.3.9: Convert between Cups, Pints, Quarts and Gallons - *CK-12 License*
- 5.4: Compound Customary Units of Capacity - *CK-12 License*
  - 5.4.1: Overview of Customary Unit Compound Conversion - *CK-12 License*
  - 5.4.2: Convert Pints into Compound Units - *CK-12 License*
  - 5.4.3: Convert Quarts into Compound Units - *CK-12 License*
  - 5.4.4: Convert Gallons into Compound Units - *CK-12 License*
  - 5.4.5: Select Correct Conversion Units for Capacity Operations - *CK-12 License*
  - 5.4.6: Compare Compound Customary Units of Capacity - *CK-12 License*
  - 5.4.7: Order Compound Customary Units of Capacity - *CK-12 License*
- 5.5: Customary Capacity Operations - *CK-12 License*
  - 5.5.1: Add Customary Units of Capacity - *CK-12 License*
  - 5.5.2: Add Customary Units of Capacity Applications - *CK-12 License*
  - 5.5.3: Subtract Customary Units of Capacity - *CK-12 License*
  - 5.5.4: Add and Subtract Customary Units of Capacity - *CK-12 License*
  - 5.5.5: Customary Units of Capacity Applications - *CK-12 License*
- 5.6: Metric Capacity in Liters - *CK-12 License*
  - 5.6.1: Compare Capacity in Liters - *CK-12 License*
  - 5.6.2: Higher Order Capacity Conversion of Liters - *CK-12 License*
- 5.7: Metric Capacity Operations using Liters - *CK-12 License*
  - 5.7.1: Find Capacity in Metric Units Using Pictures - *CK-12 License*
  - 5.7.2: Addition and Subtraction of Liters Applications - *CK-12 License*
  - 5.7.3: Multiplication and Division of Liters Applications - *CK-12 License*
  - 5.7.4: Multi-step Metric Capacity Applications - *CK-12 License*
- 5.8: Metric Capacity Operations Using Milliliters - *CK-12 License*
  - 5.8.1: Add Mililiters - *CK-12 License*
  - 5.8.2: The Four Basic Operations Using Milliliters - *CK-12 License*
  - 5.8.3: Higher Order Metric Capacity in Milliliters Applications - *CK-12 License*
- 5.9: Convert Metric Units of Capacity - *CK-12 License*
  - 5.9.1: Best Unit of Measure Liters and Milliliters - *CK-12 License*
  - 5.9.2: Metric Conversion of Liters and Milliliters to find Equivalent Units - *CK-12 License*
  - 5.9.3: Mixed Operations Addition and Subtraction Metric Capacities - *CK-12 License*
  - 5.9.4: Multiply and Divide Then Convert - Mixed Metric Capacities Applications - *CK-12 License*
  - 5.9.5: Multi-Step - Four-Operations Applications - *CK-12 License*
  - 5.9.6: Convert between Kiloliters, Milliliters, and Liters - *CK-12 License*
- 5.10: Compound Metric Units of Capacity - *CK-12 License*
  - 5.10.1: Convert between Liters and Milliliters - *CK-12 License*
  - 5.10.2: Add and Convert to find Liters and Milliliters - *CK-12 License*
  - 5.10.3: Add Subtract and Convert to find Liters and Milliliters - *CK-12 License*
  - 5.10.4: Addition and Subtraction Multi-Step Compound Unit Applications - *CK-12 License*
  - 5.10.5: Multiply and Convert to find Liters and Milliliters Applications - *CK-12 License*
  - 5.10.6: Divide and Convert to find Liters and Milliliters Applications - *CK-12 License*
  - 5.10.7: Multiply, Divide and Convert to find Liters and Milliliters Applications - *CK-12 License*
  - 5.10.8: Mixed-Operation Multi-Step Compound-Conversion Applications - *CK-12 License*
- 6: Weight and Mass - *CK-12 License*
  - 6.1: Measuring Weight and Mass - *CK-12 License*
    - 6.1.1: Visually Identify Equal Weight - *CK-12 License*
    - 6.1.2: Visually Compare Weight - *CK-12 License*
    - 6.1.3: Identify and Order Lightest and Heaviest - *CK-12 License*
  - 6.2: Convert Customary Units of Weight - *CK-12 License*
    - 6.2.1: Read the Compound Units in Pounds and Ounces - *CK-12 License*

- 6.2.2: Convert Pounds and Ounces into Ounces - *CK-12 License*
- 6.2.3: Convert Ounces into Pounds and Ounces - *CK-12 License*
- 6.2.4: Convert Between Ounces Pounds and Tons - *CK-12 License*
- 6.2.5: Convert then Compare Values of Compound Units - *CK-12 License*

- 6.3: Customary Weight Operations - *CK-12 License*
  - 6.3.1: Add Customary Units of Weight Including Applications - *CK-12 License*
  - 6.3.2: Subtract Customary Units of Weight Including Applications - *CK-12 License*
  - 6.3.3: Add and Subtract Compound Customary Units of Weight Applications - *CK-12 License*
  - 6.3.4: Multiply and Divide Compound Customary Units of Weight Applications - *CK-12 License*
  - 6.3.5: Four-Operation Compound Customary Units of Weight Applications - *CK-12 License*
- 6.4: Metric Weight Operations - *CK-12 License*
  - 6.4.1: Add Metric Weight - *CK-12 License*
    - 6.4.1.1: Add Weights in Grams - *CK-12 License*
    - 6.4.1.2: Add Weights in Kilograms - *CK-12 License*
    - 6.4.1.3: Add Weights in Grams or Kilograms Applications - *CK-12 License*
    - 6.4.1.4: Add Compound Units - *CK-12 License*
  - 6.4.2: Subtract Metric Weight - *CK-12 License*
    - 6.4.2.1: Subtract Weights in Grams - *CK-12 License*
    - 6.4.2.2: Subtract Weights in Grams Applications - *CK-12 License*
    - 6.4.2.3: Subtract Weights in Kilograms - *CK-12 License*
    - 6.4.2.4: Subtract Compound Units - *CK-12 License*
    - 6.4.2.5: Subtract and Convert Using Compound Units Applications - *CK-12 License*
  - 6.4.3: Add and Subtract Metric Weight - *CK-12 License*
    - 6.4.3.1: Add, Subtract and Compare Mass in Grams Multi-Step Applications - *CK-12 License*
    - 6.4.3.2: Add and Subtract and Convert Compound Units - *CK-12 License*
    - 6.4.3.3: Add, Subtract and Compare Grams and Kilograms Multi-Step Applications - *CK-12 License*
  - 6.4.4: Multiply and Divide Metric Weight - *CK-12 License*
    - 6.4.4.1: Multiply to Find the Weight in Grams or Kilograms - *CK-12 License*
    - 6.4.4.2: Divide to Find the Weight in Grams or Kilograms - *CK-12 License*
    - 6.4.4.3: Multiply and Divide to Find the Weight in Grams or Kilograms Applications - *CK-12 License*
  - 6.4.5: Mixed Operations to find Metric Weight - *CK-12 License*
    - 6.4.5.1: Use the Four Operations to Find Weight in Grams and/or Kilograms Applications - *CK-12 License*
    - 6.4.5.2: Higher Order Four-Operations to Find Weight in Grams or Kilograms Applications - *CK-12 License*
- 6.5: Convert Metric Units of Weight - *CK-12 License*
  - 6.5.1: Identify Weight in Kilograms and Grams - *CK-12 License*
  - 6.5.2: Convert Between Kilograms and Grams - *CK-12 License*
  - 6.5.3: Convert Between Kilograms and Grams and Milligrams - *CK-12 License*

- Back Matter - *CK-12 License*
  - Index - *CK-12 License*
  - Glossary - *CK-12 License*
  - Detailed Licensing - *CK-12 License*