

### 5.1 Use Properties of Angles, Triangles, and the Pythagorean and Theorem

5.1 Exercise Set, page 612 (594): 1, 5, 7, 9, 13, 15, 22

### 5.2 Applications: Sine, Cosine and Tangent Ratios

5.2 Exercise Set, page 640 (622): 1, 5, 7, 11, 15, 16, 19, 26

I will supply supplementary material about converting between decimal degrees and DMS notation.

## 6. Health Option

### 6.1 Measurement; Health Applications

6.1 Exercise Set, page 663 (645): 1, 3, 5, 8, 14, 17, 19,

### 6.2 Ratio, rate, and percent; Health Applications

6.2 Exercise Set, page 680 (662): 1, 6, 10, 11, 18, 20, 21

I will provide supplementary material about computing values in direct, indirect, and inverse variation.

Exam 2		stem & leaf		
66.3	mean			A-2
18.3334	st.dev	9 48		B - 2
6				
68	median	8 25		C - 5
28	min	7 44889		D -4
98	max	6 0279		F -7
20	count	5 077		
		4 89		
		3 7		
		2 8		

Exam 1		stem & leaf		
78	mean	10 0		A-4
13.52969	st.dev	9 357		B - 7
80.5	median	8 0113679		C - 3
55	min	7 135		D -4
100	max	6 2356		F -2
20	count	5 58		

Course Grade      Quiz      Exam 1      Exam 2      Final

If final < E1, E2      20%      20%      20%      40%

final > lower(E1, E2)      20%      20% high      X      60%

$$\sin(90^\circ) = 1$$

( DMS = degree - minute - second )  
 1 degree = 1°

memorize

$$\left\{ \begin{array}{l} 1 \text{ degree} = 1^{\circ} \\ 1 \text{ degree} = 60 \text{ minutes} = 60' \\ 1 \text{ minute} = 1' \\ 1' = 60'' = 60 \text{ seconds} \end{array} \right.$$

DD = decimal degree  
example  $15.4^{\circ}$

convert  $15.4^{\circ}$  to DMS

$$\begin{aligned} 15.4^{\circ} &= 15^{\circ} + 0.4^{\circ} \\ &= 15^{\circ} + 0.4(60') \\ &= 15^{\circ} + 24' \end{aligned}$$

$$\boxed{15.4^{\circ} = 15^{\circ} 24'}$$

convert  $70^{\circ} 30' 20''$  to DD

$$\begin{aligned} &= 70^{\circ} + 30' + 20'' \\ &= 70^{\circ} + 30\left(\frac{1}{60}\right)^{\circ} + 20\left(\frac{1}{60}\right)\left(\frac{1}{60}\right)^{\circ} \\ &= 70^{\circ} + .5^{\circ} + \left(\frac{1}{3}\right)\left(\frac{1}{60}\right)^{\circ} \\ &= 70^{\circ} + .5^{\circ} + \frac{1}{180}^{\circ} \end{aligned}$$

$$1/180 = 0.0056$$

$$\begin{array}{r} 70.00^{\circ} \\ .5^{\circ} \\ .0056^{\circ} \\ \hline \end{array}$$

$$\boxed{70.5556^{\circ}}$$

$$\begin{aligned} 60' &= 1^{\circ} \\ \frac{60'}{60} &= \frac{1^{\circ}}{60} \\ 1' &= \left(\frac{1}{60}\right)^{\circ} \end{aligned}$$

$$\frac{1'}{60} = \frac{60''}{60}$$

$$1'' = \left(\frac{1}{60}\right)'$$

$$= \left(\frac{1}{60}\right)\left(\frac{1}{60}\right)^{\circ}$$

$$70.5556^{\circ}$$

$$= \left(\frac{1}{60}\right) \left(\frac{1}{60}\right)^{\circ}$$

Gemini

convert 70°30'20" to DD

Analysis ▾

Based on the image, the request is to **convert 70°30'20" to Decimal Degrees (DD)**.

The conversion results in 70.50555...°.

### 📐 Conversion Steps

To convert from **Degrees-Minutes-Seconds (DMS)** to **Decimal Degrees (DD)**, you use the following formula:

$$\text{DD} = \text{Degrees} + \left(\frac{\text{Minutes}}{60}\right) + \left(\frac{\text{Seconds}}{3600}\right)$$

## 1. Identify the Components

From the given value 70°30'20":

- **Degrees:** 70
- **Minutes:** 30
- **Seconds:** 20

## 2. Apply the Formula

Substitute the values into the formula:

$$\text{DD} = 70 + \left(\frac{30}{60}\right) + \left(\frac{20}{3600}\right)$$

### 3. Calculate the Decimal Equivalents

- **Minutes to Decimal:**  $\frac{30}{60} = 0.5$
- **Seconds to Decimal:**  $\frac{20}{3600} \approx 0.005555...$

### 4. Sum the Components

$$DD = 70 + 0.5 + 0.005555...$$

$$DD = 70.505555...$$

### ✓ Final Answer

The value  $70^{\circ}30'20''$  converted to Decimal Degrees is  $70.5056^{\circ}$  (rounded to four decimal places).

Would you like to **convert another coordinate value** from DMS to DD, or perform the **reverse conversion** from DD to DMS?

6.1

### Copilot Search

The **Mars Climate Orbiter** was lost in 1999 due to a **measurement mismatch** between the metric system used by NASA and the US customary units used by its contractor, Lockheed Martin. This error occurred during a critical phase of the mission when the orbiter was to be launched into orbit. The orbiter was designed to measure atmospheric conditions, but the navigation team at NASA used metric units while the contractor used English units, leading to a significant navigation error that caused the spacecraft to approach Mars too closely, ultimately resulting in its destruction in the atmosphere. [↪ Wikipedia](#) [+4](#)

What was the cost of the Orbiter?

The Mars Climate Orbiter cost approximately **\$125 million** to build and launch. This included development, construction, and mission operations. Unfortunately, the entire investment was lost due to a unit conversion error between metric and imperial systems.

memoir J

Imperial System of Measurement

memorize J

### Imperial System of Measurement

<p>Length</p> <p>✓ 1 foot (ft.) = 12 inches (in.)</p> <p>1 yard (yd.) = 3 feet (ft.)</p> <p>1 mile (mi.) = 5,280 feet (ft.)</p>	<p>Volume</p> <p>3 teaspoons (t) = 1 tablespoon (T)</p> <p>16 tablespoons (T) = 1 cup (C)</p> <p>1 cup (C) = 8 fluid ounces (fl. oz.)</p> <p>1 pint (pt.) = 2 cups (C)</p> <p>1 quart (qt.) = 2 pints (pt.)</p> <p>1 gallon (gal) = 4 quarts (qt.)</p>
<p>Weight</p> <p>1 pound (lb.) = 16 ounces (oz.)</p> <p>1 ton = 2000 pounds (lb.)</p>	<p>Time</p> <p>✓ 1 minute (min) = 60 seconds (sec)</p> <p>✓ 1 hour (hr) = 60 minutes (min)</p> <p>✓ 1 day = 24 hours (hr)</p> <p>✓ 1 week (wk) = 7 days</p> <p>✓ 1 year (yr) = 365 days</p>

Memorize

#### Identity Property of Multiplication

For any real number  $a$ :

$$a \cdot 1 = a$$

$$1 \cdot a = a$$

1 is the **multiplicative identity**.

Convert 66 inches to feet

$$66 \text{ inches} \cdot \frac{1 \text{ foot}}{12 \text{ inches}} \quad \text{or} \quad \cancel{66 \text{ inches} \cdot \frac{12 \text{ inches}}{1 \text{ foot}}}$$

The first form works since  $\cancel{66 \text{ inches}} \cdot \frac{1 \text{ foot}}{\cancel{12 \text{ inches}}}$ .

The inches divide out and leave only feet. The second form does not have any units that will divide out and so will not help us.

$$\frac{(66 \cancel{\text{in}})(1 \text{ ft})}{12 \cancel{\text{in}}} = \left(\frac{66}{12}\right) \text{ ft} = 5.5 \text{ ft}$$

$$12 \overline{) 66.0} \begin{array}{r} 5.5 \\ \underline{60} \phantom{0} \\ 60 \phantom{0} \\ \underline{60} \phantom{0} \\ 0 \end{array}$$

$$\begin{array}{r}
 12 \overline{) 66.0} \\
 \underline{60} \phantom{0} \\
 60 \phantom{0} \\
 \underline{60} \\
 0
 \end{array}$$

Memorize ✓

### Metric System of Measurement

Length	Mass	Capacity (volume)
1 kilometre (km) = 1,000 m ✓	1 kilogram (kg) = 1,000 g ✓	1 kilolitre (kL) = 1,000 L ✓
1 hectometre (hm) = 100 m	1 hectogram (hg) = 100 g	1 hectolitre (hL) = 100 L
1 dekametre (dam) = 10 m	1 dekagram (dag) = 10 g	1 dekalitre (daL) = 10 L
1 metre (m) = 1 m ✓	1 gram (g) = 1 g ✓	1 litre (L) = 1 L ✓
1 decimetre (dm) = 0.1 m	1 decigram (dg) = 0.1 g	1 decilitre (dL) = 0.1 L
1 centimetre (cm) = 0.01 m ✓	1 centigram (cg) = 0.01 g ✓	1 centilitre (cL) = 0.01 L ✓
1 millimetre (mm) = 0.001 m ✓	1 milligram (mg) = 0.001 g ✓	1 millilitre (mL) = 0.001 L ✓
	1 microgram (mcg) = 0.000001 g	
1 metre = 100 centimetres ✓	1 gram = 100 centigrams ✓	1 litre = 100 centilitre s ✓
1 metre = 1,000 millimetres ✓	1 gram = 1,000 milligrams ✓	1 litre = 1,000 millilitre s ✓

kilo = 1000  
 Memorize centi =  $\frac{1}{100}$   
 milli =  $\frac{1}{1000}$

In physics weight depends on gravity, but mass is intrinsic to an object.

### EXAMPLE 5

Eleanor's newborn baby weighed 3,200 grams. How many kilograms did the baby weigh?

#### Solution

We will convert grams into kilograms.

	3,200 <b>grams</b>
Multiply the measurement to be converted by 1.	3,200 <b>grams</b> • 1
Write 1 as a function relating kilograms and grams.	3,200 <b>grams</b> • $\frac{1 \text{ kg}}{1,000 \text{ grams}}$
Simplify.	3,200 <b>grams</b> • $\frac{1 \text{ kg}}{1,000 \text{ grams}}$
Multiply.	$\frac{3,200 \text{ kilograms}}{1,000}$
Divide.	3.2 kilograms The baby weighed 3.2 kilograms.

$$1 \text{ kg} = 1000 \text{ g}$$

$$\Rightarrow \frac{1 \text{ kg}}{1000 \text{ g}} = 1$$

supplied

### Conversion Factors Between Imperial and Metric Systems

Length	Mass	Capacity
1 in. = 2.54 cm $\Rightarrow \frac{2.54 \text{ cm}}{1 \text{ in}} = 1$	1 lb. = 0.45 kg	1 qt. = 0.95 L
1 ft. = 0.305 m	1 oz. = 28 g	1 fl. oz. = 30 mL
1 yd. = 0.914 m	1 kg = 2.2 lb.	1 L = 1.06 qt.
1 mi. = 1.61 km		
1 m = 3.28 ft.		

Convert 7.4 inches to centimeters. Round answer to nearest tenth.

$$(7.4 \text{ in})(1) = (7.4 \text{ in}) \left( \frac{2.54 \text{ cm}}{1 \text{ in}} \right) \approx 18.8 \text{ cm}$$

$$7.4 \times 2.54 = 18.796$$

Supplied

#### Temperature Conversion

To convert from Fahrenheit temperature, F, to Celsius temperature, C, use the formula

$$C = \frac{5}{9}(F - 32).$$

To convert from Celsius temperature, C, to Fahrenheit temperature, F, use the formula

$$F = \frac{9}{5}C + 32.$$

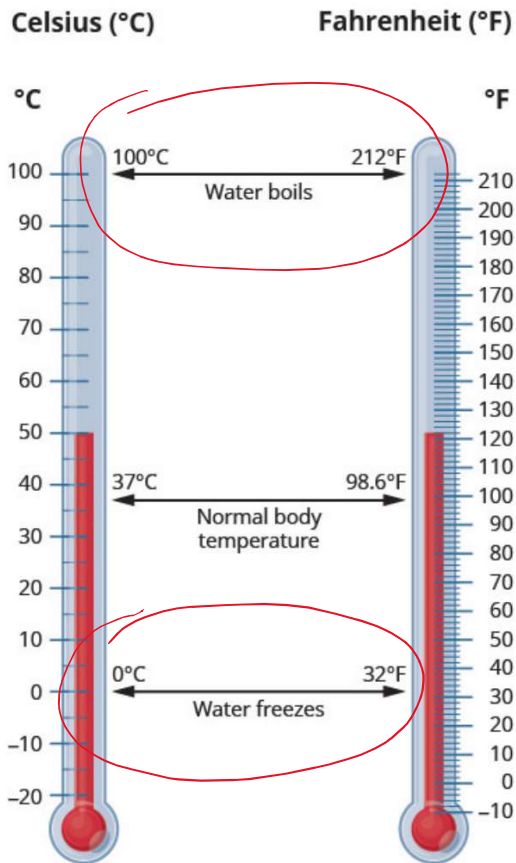
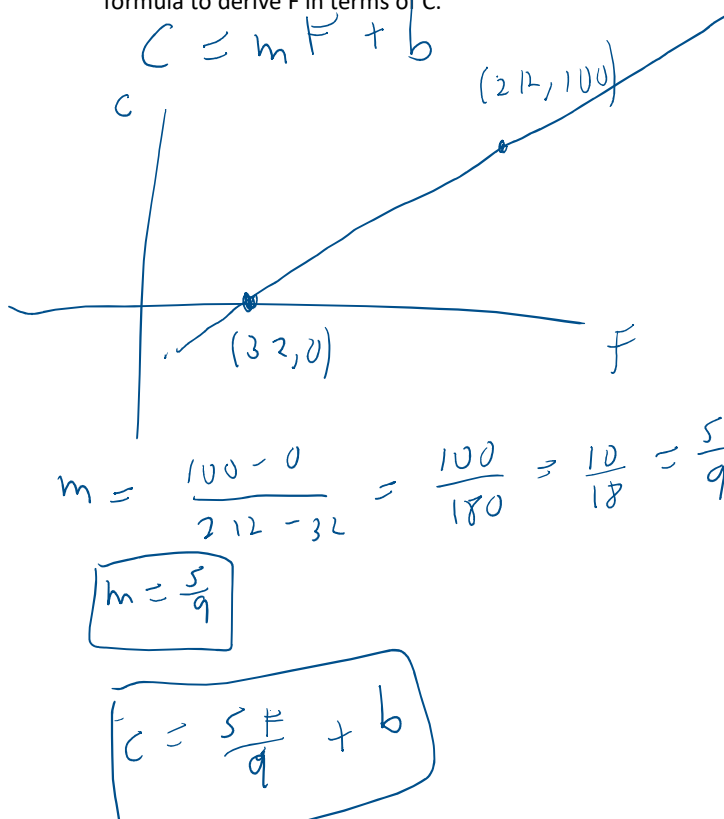


Figure.5

#### Quiz 4

Assume that C is a linear function of F.

Derive the formula for C in terms of F. Use this formula to derive F in terms of C.





$$c = \frac{5F}{9} + b$$

$$0 = \frac{(5)(32)}{9} + b$$

$$b = -\left(\frac{5}{9}\right)(32)$$

$$c = \frac{5F}{9} - \left(\frac{5}{9}\right)(32) \rightarrow c = \frac{5F}{9} - \frac{160}{9}$$

$$c = \frac{5}{9}(F - 32)$$

Solve for F

$$9c = 5(F - 32)$$

$$\frac{9c}{5} = F - 32$$

$$F - 32 = \frac{9c}{5}$$

$$F = \frac{9c}{5} + 32$$

$$c = 0 \Rightarrow F = \frac{9(0)}{5} + 32 = 32 \quad \checkmark$$

$$c = 100 \Rightarrow F = \frac{9(100)}{5} + 32 = (9)(20) + 32 \\ = 180 + 32 \\ = 212 \quad \checkmark$$

## 6.2

### Memorize

Definition: a ratio is the comparison of two numbers or quantities by division

Notation: The ratio of a to b =  $\frac{a}{b} = a:b$

#### EXAMPLE 2

Hector's total cholesterol is 249 mg/dl and his HDL cholesterol is 39 mg/dl. a) Find the ratio of his total

cholesterol to his HDL cholesterol. b) Assuming that a ratio less than 5 to 1 is considered good, what would

cholesterol to his HDL cholesterol. b) Assuming that a ratio less than 5 to 1 is considered good, what would you suggest to Hector?

**Solution**

a) First, write the words that express the ratio. We want to know the ratio of Hector's total cholesterol to his HDL cholesterol.

Write as a fraction.	$\frac{\text{total cholesterol}}{\text{HDL cholesterol}}$
Substitute the values.	$\frac{249}{39}$
Simplify.	$\frac{83}{13}$

b) Is Hector's cholesterol ratio ok? If we divide 83 by 13 we obtain approximately 6.4, so  $\frac{83}{13} \approx \frac{6.4}{1}$ . Hector's cholesterol ratio is high! Hector should either lower his total cholesterol or raise his HDL cholesterol.

Handwritten calculation showing the simplification of the ratio:

$$\frac{249 \text{ mg}}{39 \text{ mg}} = \frac{83}{13}$$

The units "mg" are crossed out, and the numbers are simplified by dividing both numerator and denominator by 3.

**Memorize**

**Unit Rate**

A unit rate is a rate with denominator of 1 unit.

**EXAMPLE 4**

Marta had 74 heartbeats in 8 minutes. What is Marta's heartbeat rate?

**Solution**

Start with a rate of heartbeats to minutes. Then divide.	74 heartbeats in 8 minutes
Write as a rate.	$\frac{74}{8 \text{ minutes}}$
Divide the numerator by the denominator.	No $\frac{2}{1 \text{ minute}}$ $\frac{37 \text{ beats}}{4 \text{ min}}$
Rewrite as a rate.	$\frac{2}{1 \text{ minute}}$

Marta's heartbeat rate is 2 per minute.

Handwritten calculation showing the simplification of the rate:

$$\frac{37 \text{ beat}}{4 \text{ min}} \approx \frac{36 \text{ beat}}{4 \text{ min}} = \frac{9 \text{ beats}}{1 \text{ min}}$$

The result is labeled "unit rate" with an arrow pointing to the denominator.

**Memorize**

**Percent**

## Percent

A percent is a ratio whose denominator is 100.

memorize  $\% = \frac{1}{100} = 0.01$

$$100\% = 1$$

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convert  $\frac{25}{100}$  to a percent

$$\frac{25}{100} = 25\left(\frac{1}{100}\right) = 25(\%) = 25\%$$

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convert 36% to a fraction or a decimal

$$36\% = 36\left(\frac{1}{100}\right) = \frac{36}{100} = \frac{18}{50} = \boxed{\frac{9}{25}}$$

$$36\% = 36(0.01) = \boxed{0.36}$$

What is 10 percent of 90?

$$x = (10\%) \cdot 90$$

$$x = (10)\left(\frac{1}{100}\right)(90)$$

$$= \left(\frac{1}{10}\right)(90)$$

$$\boxed{x = 9}$$

9 is 10 percent of 90

12 is what percent of 6?

$$12 = (x\%) \cdot 6$$

$$12 = x\left(\frac{1}{100}\right) \cdot 6$$

$$\frac{12}{6} = \frac{x}{100}$$

$$2 = \frac{x}{100}$$

$$\boxed{x = 200}$$

12 is 200% of 6