11-16-11

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8.5 Capacity; Medical Applications

OBJECTIVES

a Convert from one unit of capacity to another.

b Solve applied problems concerning medical dosages.

a Convert from one unit of capacity to another.

American units of capacity are ounces, cups, pints, quarts, and gallons. These units are related as follows.

American Units of Capacity

1 gallon (gal) = 4 quarts (qt)

1 pt = 2 cups = 16 ounces (oz)

1 qt = 2 pints (pt)

1 cup = 8 oz

EXAMPLE A Complete: 7 gal = ____ oz.

Solution First, we multiply by 1 using 4 qt on the top and 1 gal on the bottom:

$$7\ \text{gal} = 7\ \text{gal} \cdot \frac{4\ \text{qt}}{1\ \text{gal}}$$

$$= 7 \cdot 4\ \text{qt}$$

$$= 28\ \text{qt}$$

EXAMPLE A Complete: 7 gal = ____ oz.

Next, we convert 28 qt to ounces by multiplying by 32 oz/1qt:

$$7\ \text{gal} = 28\ \text{qt}$$

$$= 28\ \text{qt} \cdot \frac{32\ \text{oz}}{1\ \text{qt}}$$

$$= 28 \cdot 32\ \text{oz}$$

$$= 896\ \text{oz}.$$

EXAMPLE B Complete: 32 qt = ____ gal.

Solution

In this case, we multiply by 1 using 1 gal in the numerator, since we are converting to gallons, and 4 qt in the denominator, since we are converting from quarts.

$$32\ \text{qt} = 32\ \text{qt} \cdot \frac{1\ \text{gal}}{4\ \text{qt}}$$

$$= \frac{32}{4} \cdot \text{gal}$$

$$= 8\ \text{gal}$$

a Convert from one unit of capacity to another.

A common unit for drug dosage is the milliliter (mL) or cubic centimeter (cm3). The notation "cc" is also used for cubic centimeters, especially in medicine. A milliliter and a cubic centimeter are the same size. Each is about the size of a sugar cube.

1 cm³ 5 mL 3 cm³

1 mL = 1 cm³ = 1 cc

Metric Units of Capacity

1 liter (L) = 1000 cubic centimeters (1000 cm³)

The script letter *l* is also used for "liter."

1 L = 1000 mL = 1000 cm³;

0.001 L = 1 mL = 1 cm³.

EXAMPLE C Complete: 6.2 L = ____ mL.

Solution

$$6.2\ \text{L} = 6.2 \times 1\ \text{L}$$

$$= 6.2 \cdot 1000\ \text{mL}$$

$$= 6200\ \text{mL}$$

1000 L	100 L	10 L	1 L	0.1 L	0.01 L	0.001 L
1 kL	1 hL	1 daL	1 L	1 dL	1 cL	1 mL

EXAMPLE D Complete: 340 mL = ____ L.

Solution

$$340\ \text{mL} = 340 \times 1\ \text{mL}$$
$$= 340 \times 0.001\ \text{L}$$
$$= 0.34\ \text{L}$$

1000 L	100 L	10 L	1 L	0.1 L	0.01 L	0.001 L
1 kL	1 hL	1 daL	1 L	1 dL	1 cL	1 mL

3 places to the left

Measurements play a critical role in health care. Doctors, nurses, aides, technicians, and others all need to use the proper units and perform proper calculations to assure the best possible care of patients.

EXAMPLE E Amount of Saline Solution Administered

A physician orders 3.4 L of a 0.9% saline solution to be administered intravenously over a 24-hr period. How many milliliters were ordered?

Solution

We convert 3.4 L to milliliters:

$$3.4\ \text{L} = 3.4 \cdot 1\ \text{L}$$
$$= 3.4 \cdot 1000\ \text{mL} \quad \text{Substituting}$$
$$= 3400\ \text{mL}$$

The physician ordered 3400 mL of saline.

EXAMPLE F Amount of Theophylline in Prescription

A prescription calls for 4 oz of theophylline, a drug commonly used for children with asthma. For how many milliliters is the prescription?

Solution We convert as follows:

$$4\ \text{oz} = 4 \cdot 1\ \text{oz}$$
$$= 4 \cdot 29.57\ \text{mL} \quad \text{Substituting}$$
$$= 118.28\ \text{mL}.$$

The prescription calls for 118.28 mL of theophylline.

8.6 Time and Temperature

OBJECTIVES

a Convert from one unit of time to another.

b Convert between Celsius and Fahrenheit temperatures using the formulas $F = 9/5 \cdot C + 32$ and $C = 5/9 \cdot (F - 32)$.

Units of Time

1 day = 24 hours (hr) 1 year (yr) = 365 ¼ days

1 hr = 60 minutes (min) 1 week (wk) = 7 days

1 min = 60 seconds (sec)

EXAMPLE A Complete: 2 hr = ____ sec.

Solution

1 hr is equal to 60 min

2 hr = ____ sec.

$$= 2 \cdot 60 \cdot 1\ \text{min}$$
$$= 2 \cdot 60 \cdot 60\ \text{sec}$$
$$= 7200\ \text{sec}$$

EXAMPLE B Complete: 10,080 min = ____ days.

Solution

$$10{,}080\ \text{min} = 10{,}080\ \text{min} \cdot \frac{1\ \text{hr}}{60\ \text{min}} \cdot \frac{1\ \text{day}}{24\ \text{hr}}$$
$$= \frac{10{,}080}{60 \cdot 24}\ \text{days}$$

There are two temperature scales: Fahrenheit, which is used most often in the United States, and Celsius, which is used internationally and in science.

= 7200 sec

EXAMPLE B Complete: 10,080 min = ____ days.

Solution

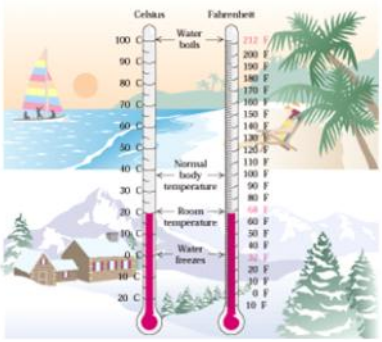
$$10{,}080 \text{ min} = 10{,}080 \text{ min} \cdot \frac{1 \text{ hr}}{60 \text{ min}} \cdot \frac{1 \text{ day}}{24 \text{ hr}}$$

$$= \frac{10{,}080}{60 \cdot 24} \text{ days}$$

$$= 7 \text{ days}$$

There are two temperature scales: Fahrenheit, which is used most often in the United States, and Celsius, which is used internationally and in science.

b Convert between Celsius and Fahrenheit temperatures using the formulas $F = 9/5 \cdot C + 32$ and $C = 5/9 \cdot (F - 32)$.



By laying a straightedge horizontally between the scales, we can approximate conversions between Celsius and Fahrenheit.

EXAMPLE C Use a straightedge to approximate each of the following conversions.

EXAMPLE C Approximate the Conversions

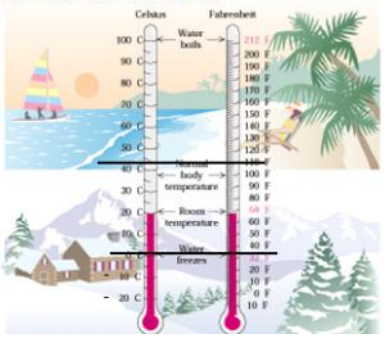
Solution

90°F (warm day)

≈ 32°C

−10°C (cold day)

≈ 14°F



Celsius to Fahrenheit

$$F = \frac{9}{5} \cdot C + 32 \quad \text{or} \quad F = 1.8 \cdot C + 32$$

(Multiply the Celsius temperature by 9/5, or 1.8, and add 32.)

EXAMPLE D Convert 42°C to Fahrenheit.

Solution

$$F = 1.8 \cdot C + 32$$

$$= 1.8 \cdot 42 + 32$$

$$= 75.6 + 32$$

$$= 107.6^{\circ}$$

42°C = 107.6°F

Fahrenheit to Celsius

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

Subtract 32 from the Fahrenheit temperature and multiply by 5/9.)

EXAMPLE E Convert 87°F to Celsius.

Solution

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

$$= \frac{5}{9} \cdot (87 - 32)$$

$$= \frac{5}{9} \cdot 55$$

EXAMPLE E Convert 87°F to Celsius.

Solution

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

$$= \frac{5}{9}\cdot(87-32)$$

$$= \frac{5}{9}\cdot 55$$

$$= 30.6^\circ$$

87°F = 31°C

8.7 Converting Units of Area

OBJECTIVES

a Convert from one American unit of area to another.

b Convert from one metric unit of area to another.

American Units

It is often necessary to convert units of area. First we will convert from one American unit of area to another.

EXAMPLE A Complete 1 yd^2 = _____ ft^2.

Solution.

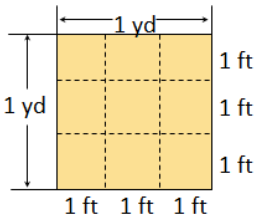
Recall that 1 yd = 3 ft and make a sketch.

Note that 1 yd^2 = 9 ft^2.

1 yd^2 = 1 (3 ft)^2

= 3 ft · 3 ft

= 9 ft^2



EXAMPLE B Complete: 3 ft^2 = ____ $in.^2$.

Solution

3 ft^2 = 3 · (12 in.)^2

= 3 · 12 in. · 12 in.

= 432 $in.^2$

American Units of Area

1 square yard (yd^2) = 9 square feet (ft^2)

1 square foot (ft^2) = 144 square inches ($in.^2$)

1 square mile (mi^2) = 640 acres

1 acre = 43,560 ft^2

EXAMPLE C Complete 45 ft^2 = ____ yd^2.

Solution

To convert from "ft^2" to "yd^2" we write 1 with yd on top and ft^2 on the bottom.

$$45\ ft^2 = 45\ \cancel{ft^2}\cdot\frac{1\ yd^2}{9\ \cancel{ft^2}}$$

$$= \frac{45}{9}\ yd^2$$

$$= 5\ yd^2$$

EXAMPLE D Complete 8 mi^2 = ____ acres.

Solution

When converting from larger to smaller units, it is usually easiest to use substitution.

8 mi^2 = 8 · 640 acres Substituting 640 acres for 1 mi^2

= 5120 acres

EXAMPLE E Complete: $2\ km^2 = \_\_\_\_\_\ m^2$.

Solution

$2\ km^2 = 2 \cdot (1000\ m)^2$

$= 2 \cdot 1000\ m \cdot 1000\ m$

$= 2{,}000{,}000\ m^2$

EXAMPLE F Complete: $2\ km^2 = \_\_\_\_\_\ m^2$.

1000 m	100 m	10 m	1 m	0.1 m	0.01 m	0.001 m
1 km	1 hm	1 dam	1 m	1 dm	1 cm	1 mm

3 moves to the right

Decimal moves 2(3), or 6 places to the right.

2.0 2,000000. $2\ km^2 = 2{,}000{,}000\ m^2$

EXAMPLE F Complete: $2\ km^2 = \_\_\_\_\_\ m^2$.

Solution

Note that 102 = 100, 1002 = 10,000, and 0.12 = 0.01. We will use the table as before and multiply the number of moves by 2 to determine the number of moves of the decimal point.

EXAMPLE G Complete: $4.23\ km^2 = \_\_\_\_\ m^2$.

Solution

We shift the decimal point six places to the right.

4.23 4.230000. $4.23\ km^2 = 4{,}230{,}000\ m^2$

9.1 Perimeter

OBJECTIVES

a Find the perimeter of a polygon.

b Solve applied problems involving perimeter.

Perimeter of a Polygon

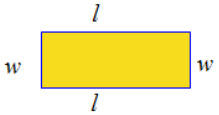
A **polygon** is a closed geometric figure with three or more sides. The **perimeter** of a **polygon** is the distance around it, or the sum of the lengths of its sides.

Perimeter of a Rectangle

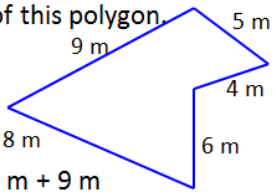
A **rectangle** is a polygon with four sides and four 90 degree angles.

The **perimeter of a rectangle** is twice the sum of the length and the width, or 2 times the length plus 2 times the width.

$P = 2l + 2w$, or $P = 2 \cdot (l + w)$.



EXAMPLE A Find the perimeter of this polygon.



Solution

Add the lengths of all sides.

Perimeter = 5 m + 4 m + 6 m + 8 m + 9 m

= (5 + 4 + 6 + 8 + 9) m

= 32 m

EXAMPLE B Find the perimeter of a barn door that is 10 ft by 12 ft.

Solution

$P = 2l + 2w$

$= 2 \cdot 12\ ft + 2 \cdot 10\ ft$

$= (2 \cdot 12)\ ft + (2 \cdot 10)\ ft$

$= 24\ ft + 20\ ft$

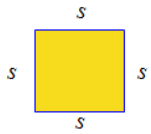
$= 44\ ft$

Perimeter of a Square

A **square** is a rectangle in which all sides have the same length.

The **perimeter of a square** is four times the length of a side.

$P = 4s$



EXAMPLE C Find the perimeter of a square garden with sides of length 15 feet.

Solution

$P = 4s$

$= 4 \cdot 15$ ft

$= 60$ ft

EXAMPLE D Cost of Fencing

A farmer wishes to fence in a pasture for his sheep. The pasture is 75 feet by 120 feet. How many feet of fence will be needed? If fencing sells for $3.95 per feet, what will the fencing cost?

1. Familiarize. We make a drawing and let P = the perimeter.

EXAMPLE D Cost of Fencing

2. Translate. The perimeter of the garden is given by $P = 2 \cdot (l + w)$.

$P = 2 \cdot (120 \text{ ft} + 75 \text{ ft})$.

3. Solve. We calculate the perimeter as follows:

$P = 2 \cdot (120 \text{ ft} + 75 \text{ ft}) = 2 \cdot (195 \text{ ft}) = 390$ ft

Then we multiply by $3.95 to find the cost of the fencing:

Cost = $3.95 · Perimeter = $3.95 · 390 = $1540.50

EXAMPLE D Cost of Fencing

4. Check.

$P = 75 \text{ ft} + 75 \text{ ft} + 120 \text{ ft} + 120 \text{ ft}$

$= 390$ ft

Estimate: $4.00 (400) = $1600

5. State.

The 390 feet of fencing that is needed will cost $1540.50.