CHAPTER 6
Ratios, Rates, and Proportions

6-1 Ratios and Rates

A **ratio** is a comparison of two quantities by division.

The ratio of a to b can be written in three different ways: a to b, $a:b$, and $\frac{a}{b}$.

If two quantities are in the ratio of a to b, then the two numbers can be expressed as $\boldsymbol{ax}$ and $\boldsymbol{bx}$, in which x is a positive integer.

A **rate** is a ratio of two measurements having different units of measure. For example, a price of \$2.59 per gallon of gasoline, an income of \$750 in 3 days, and a speed of 60 miles per hour are all rates.

A **unit rate** is a rate that has a denominator of 1. Some examples of unit rates are defined as follows.

$$\textbf{Unit Price} = \frac{\text{Price of Package}}{\text{Number of Units in the Package}}$$

$$\textbf{Gas Mileage} = \frac{\text{Number of Miles Traveled}}{\text{Number of Gallons of Gas Used}}$$

$$\textbf{Speed (Miles per Hour)} = \frac{\text{Number of Miles Traveled}}{\text{Number of Hours}}$$

$$\textbf{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Example 1 □ Express each ratio as a unit rate.

a. 1360 grams of coffee cost \$17.68. What is the unit price of the coffee?

b. A car travels 322 miles on 11.5 gallons of gas. What is the car's gas mileage?

c. A driver traveled $485\frac{1}{3}$ miles in $8\frac{2}{3}$ hours. What is his speed?

d. A volume of $46\ \text{cm}^3$ of silver has a mass of 483 grams. What is the density of silver?

Solution □ a. $\frac{\$17.68}{1360\ \text{grams}} = \frac{1768\ \text{cents}}{1360\ \text{grams}} = 1.3\ \text{cents / gram}$

b. $\frac{322\ \text{mi}}{11.5\ \text{gal}} = 28\ \text{miles / gallon}$.

c. $\frac{485\frac{1}{3}\ \text{mi}}{8\frac{2}{3}\ \text{hr}} = \frac{(485\frac{1}{3}\ \text{mi})\cdot 3}{(8\frac{2}{3}\ \text{hr})\cdot 3} = \frac{1456\ \text{mi}}{26\ \text{hr}} = 56\ \text{mph}$

d. $\text{density} = \frac{\text{mass}}{\text{volume}} = \frac{483\ \text{grams}}{46\ \text{cm}^3} = 10.5\ \text{grams/cm}^3$

Example 2 □ 3 angles of a triangle are in the ratio of $3:5:7$. What is the measure of each angle?

Solution □ The measure of each angle of the triangle can be represented as $3x$, $5x$, and $7x$.

$3x + 5x + 7x = 180$	The angle sum in a triangle is 180.
$15x = 180$	Simplify.
$x = 12$	Simplify.

The measure of the 3 angles are $3x = 3\cdot 12 = 36$, $5x = 5\cdot 12 = 60$, and $7x = 7\cdot 12 = 84$.

Exercises - Ratios and Rates

1

The ratio of $1\frac{3}{4}$ to $2\frac{1}{2}$ is equal to the ratio of 14 to what number?

A) 18

B) 20

C) 22

D) 24

2

The sum of two numbers is 14 and the ratio of the two numbers is -3. What is the product of the two numbers?

A) -105

B) -119

C) -133

D) -147

3

If $2(x-y)=3y$, what is the ratio $\frac{x}{y}$?

A) $\frac{2}{5}$

B) $\frac{4}{3}$

C) $\frac{5}{2}$

D) $\frac{8}{3}$

4

The ratio of length to width of a rectangular garden is $6:7$. If the perimeter of the rectangle is 78 meters, what is the area of the garden in square meters?

A) 274

B) 326

C) 352

D) 378

5

A car travels 218.5 miles on 9.5 gallons of gas. What is the car's gas mileage?

6

At a grocery store, 20 fl oz of brand *A* vitamin water is sold for \$0.95. What is the unit price of the vitamin water per ounce, to the nearest cents?

7

The density of aluminum is 2.7 grams per cm^3. How many grams does 12 cm^3 of aluminum weigh?

6-2 Proportions

A **proportion** is an equation stating that two ratios are equal.

The proportions $\frac{a}{b}=\frac{c}{d}$ is read "a is to b as c is to d." The numbers a and d are called the **extremes** of the proportion. The numbers b and c are called the **means** of the proportion.

In a proportion, the product of the extremes is equal to the product of the means.

If $\frac{a}{b}=\frac{c}{d}$, then $ad=bc$. The products ad and bc are called the **cross products** of the proportion $\frac{a}{b}=\frac{c}{d}$.

Example 1 □ Determine whether each pair of ratios forms a proportion.

a. $\frac{0.4}{1.5}, \frac{1.6}{6}$ b. $\frac{12}{25}, \frac{7}{15}$

Solution □ a. $\frac{0.4}{1.5}\stackrel{?}{=}\frac{1.6}{6}$ Write a proportion.

$0.4\times 6\stackrel{?}{=}1.5\times 1.6$ Find the cross products.

$2.4=2.4$ Simplify.

The cross products are equal, so the ratios form a proportion.

b. $\frac{12}{25}\stackrel{?}{=}\frac{7}{15}$ Write a proportion.

$12\times 15\stackrel{?}{=}25\times 7$ Find the cross products.

$180\neq 175$ Simplify.

The cross products are not equal, so the ratios do not form a proportion.

Example 2 □ Solve the proportion $\frac{3}{7}=\frac{6}{x-4}$.

Solution □ $\frac{3}{7}=\frac{6}{x-4}$

$3(x-4)=7(6)$ Find the cross products.

$3x-12=42$ Distributive Property

$3x=54$ Add 12 to each side.

$x=18$ Divide each side by 3.

Example 3 □ Carter's SUV requires 8 gallons of gasoline to travel 148 miles. How much gasoline, to the nearest gallon, will he need for a 500 mile trip?

Solution □ a. Let $g=$ the number of gallons of gas needed for a 500 mile trip.

$\begin{matrix}\text{miles} & \rightarrow & \frac{148}{8} & = & \frac{500}{g} & \leftarrow & \text{miles}\\ \text{gallons} & \rightarrow & & & & \leftarrow & \text{gallons}\end{matrix}$ Write a proportion.

$148g=8\times 500$ Find the cross products.

$g=\frac{8\times 500}{148}\approx 27.03$ Divide each side by 148.

Carter's needs 27 gallons of gas for a 500 mile trip.

Exercises - Proportions

1

On a map, 1 inch represents 5 miles. If a certain state is represented on a map by a rectangle 10 inches by 7.2 inches, what is the area of the state in square miles?

A) 360 mi^2

B) 720 mi^2

C) $1,080 \text{ mi}^2$

D) $1,800 \text{ mi}^2$

2

Together there are 754 students and teachers in the meeting. If the ratio of students to teachers is $27:2$, how many teachers are there?

A) 46

B) 52

C) 58

D) 64

3

Concrete is made by mixing cement, sand, and gravel in the ratio 5 : 9 : 13. How much cement is needed to make 324 ft^3 of concrete?

A) 54 ft^3

B) 60 ft^3

C) 84 ft^3

D) 108 ft^3

4

If Andy drove 84 miles in 1 hour 45 minutes, how many miles can he drive in 5 hours?

5

A collection of quarters, dimes, and nickels is worth \$5.00. If the ratio of quarters to dimes to nickels is $2:4:7$, how many quarters are there?

6

If $\frac{5x}{3} = \frac{x+14}{2}$, what is the value of x?

7

A trail mix contains raisin, peanut, and chocolate. The ratio of raisin to peanut is $2:3$ and the ratio of peanut to chocolate is $5:8$. What is the ratio of raisin to chocolate?

6-3 Ratios, Rates, and Proportions Word Problems

You can use conversion factors to convert a unit of measure from one system to another. Sometimes you may need to use two or more conversion factors.

Example 1 □ A model car is scaled so that 1 inch of the model equals 6 feet of the actual car. If the model is $1\frac{2}{3}$ inch long, how long is the actual car?

Solution □ Let x = the length of actual car.

$$\begin{array}{l}\text{model} \rightarrow \dfrac{1 \text{ in}}{6 \text{ ft}} = \dfrac{1\frac{2}{3} \text{ in}}{x \text{ ft}} \leftarrow \text{model} \\ \text{actual} \rightarrow \qquad\qquad \leftarrow \text{actual}\end{array}$$

Set up a proportion.

$$x = 6 \times 1\frac{2}{3} = 10$$

Cross product

The length of the actual car is 10 feet.

Example 2 □ A car is traveling at a constant rate of 54 miles per hour. How many kilometers will the car travel in 5 minutes? (1 mile = 1.6 kilometers)

Solution □ $54 \text{ miles} = 54 \text{ mi} \times \dfrac{1.6 \text{ km}}{1 \text{ mi}} = 86.4 \text{ km}$

$$\frac{54 \text{ mi}}{1 \text{ hr}} = \frac{86.4 \text{ km}}{60 \text{ min}}$$

54 miles = 86.4 km and 1 hour = 60 min

$$\frac{86.4 \text{ km}}{60 \text{ min}} = \frac{x \text{ km}}{5 \text{ min}}$$

Set up a proportion.

$$86.4 \times 5 = 60x$$

Cross Products

$$x = \frac{86.4 \times 5}{60}$$

Divide.

$$= 7.2 \text{ km}$$

Example 3 □ The ratio of males to females in an office is $6 : 7$. If there are 42 males in the office, what is the total number of people in the office?

Solution □ Let f = the number of females in the office.

$$\begin{array}{l}\text{male} \rightarrow \dfrac{6}{7} = \dfrac{42}{f} \\ \text{female} \rightarrow\end{array}$$

The ratio of males to females is 6 to 7.

$$6f = 7 \cdot 42 = 294$$

Cross products

$$f = \frac{294}{6} = 49$$

Divide.

The total number of people in the office is $42 + 49$, or 91.

Exercises - Ratios, Rates, and Proportions Word Problems

1

If 20 machines produce 1,240 printers in a day, how many more machines are needed to produce 1,984 printers in a day?

A) 12

B) 20

C) 24

D) 32

2

If $\frac{3}{4}$ quart of lemonade concentrate is mixed with $6\frac{2}{3}$ quarts of water to make lemonade for 40 people, how many quarts of lemonade concentrate are needed to make the lemonade for 24 people?

A) $\frac{3}{10}$

B) $\frac{7}{20}$

C) $\frac{2}{5}$

D) $\frac{9}{20}$

3

A machine produced 735 tapes in $5\frac{1}{4}$ hours. What fraction of the 735 tapes was produced in one hour?

A) $\frac{1}{7}$

B) $\frac{4}{21}$

C) $\frac{5}{21}$

D) $\frac{2}{7}$

4

A 32-acre field yields 768 bushels of corn each year. How many more acres are needed to yield 960 bushels of corn each year?

A) 6

B) 8

C) 10

D) 12

5

The length of a rectangle is 8 inches longer than the width. If the ratio of the length to perimeter is $5:16$, what is the area of the rectangle?

A) 160 in^2

B) 180 in^2

C) 240 in^2

D) 280 in^2

6

If 12 grams of coffee costs x dollars and each gram makes y cups of coffee, what is the cost of one cup of coffee in terms of x and y?

A) $\frac{12y}{x}$

B) $\frac{y}{12x}$

C) $\frac{12x}{y}$

D) $\frac{x}{12y}$

Chapter 6 Practice Test

1

The density of an object is equal to the mass of the object divided by the volume of the object. What is the mass, in grams, of an object with a volume of $0.01\ \text{m}^3$ and a density of 4.54 grams per cubic centimeters? ($1\ \text{m} = 100\ \text{cm}$)

A) 454

B) 4,540

C) 45,400

D) 454,000

2

Jason and Donny painted a house and received $1,200. To complete the painting job Jason painted 4 hours 25 minutes and Donny spent 2 hours and 15 minutes. If they split the $1,200 in proportion to the amount of time each spent painting, how much did Donny receive?

A) $405.00

B) $443.00

C) $472.00

D) $492.00

3

The tennis balls in a bag are either white or yellow. If the ratio of white balls to yellow balls is $\frac{3}{10}$, which of the following could not be the number of balls in the bag?

A) 26

B) 39

C) 42

D) 52

4

A car is traveling at a constant rate of x miles per hour. How many miles will the car travel in y minutes?

A) $60xy$

B) $\frac{60x}{y}$

C) $\frac{xy}{60}$

D) $\frac{y}{60x}$

5

A tree is 8 feet tall and grows 8 inches each year. In how many years will the tree reach a height of 30 feet?

A) 27

B) 33

C) 45

D) 52

6

Aaron reads x pages of a science fiction book in m minutes. If he continues reading at this rate, what will be the number of pages he reads in $20\ m$ seconds?

A) $\frac{1}{3}x$

B) $\frac{1}{2}x$

C) $\frac{2}{3}x$

D) $2x$

7

If $\frac{x}{y}=1$, what is the value of $x-y-1$?

A) -1

B) 0

C) 1

D) The value cannot be determined from the information given.

8

In a certain room the ratio of males to females is 4 to 5. After 8 males enter the room, the ratio of males to females is 6 to 5. What is the total number of people in the room before the additional males enter the room?

A) 27

B) 36

C) 45

D) 54

9

A person is born every 5 seconds and a person dies every 12 seconds. How many seconds does it take for the population to grow by one person?

A) 7 sec

B) $8\frac{4}{7}$ sec

C) 10.5 sec

D) $10\frac{5}{7}$ sec

10

Steve is going to paint a wall that measures 9 feet by 12 feet. If one gallon of paint is needed for each s square foot of wall and each gallon costs g dollars, in terms of s and g how much does it cost to paint the entire wall?

A) $\frac{108}{gs}$

B) $\frac{gs}{108}$

C) $\frac{108s}{g}$

D) $\frac{108g}{s}$

11

If 2 inches are equivalent to 5 centimeters, how many square centimeters are in one square inch?

12

A large painting has a length of 18 inches and a width of 12 inches. If each dimension is reduced by x inches to make the ratio of length to width 5 to 3, what is the value of x?

Answer Key

Section 6-1

1. B 2. D 3. C 4. D 5. 23
6. 5 7. 32.4

Section 6-2

1. D 2. B 3. B 4. 240 5. 8
6. 6 7. $\frac{5}{12}$

Section 6-3

1. A 2. D 3. B 4. B 5. C
6. D

Chapter 6 Practice Test

1. C 2. A 3. C 4. C 5. B
6. A 7. A 8. B 9. B 10. D
11. $\frac{25}{4}$ or 6.25 12. 3

Answers and Explanations

Section 6-1

1. B

$\frac{1\frac{3}{4}}{2\frac{1}{2}} = \frac{14}{x}$ The ratio of $1\frac{3}{4}$ to $2\frac{1}{2}$ is equal to the ratio of 14 to x.

$1\frac{3}{4} \cdot x = 14 \cdot 2\frac{1}{2}$ Cross Products

$\frac{7}{4}x = 14 \cdot \frac{5}{2}$ Simplify.

$\frac{7}{4}x = 35$ Simplify.

$\frac{4}{7} \cdot \frac{7}{4}x = \frac{4}{7} \cdot 35$ Multiply each side by $\frac{4}{7}$.

$x = 20$ Simplify.

2. D

Let x and y be the two numbers.

$x + y = 14$ The sum of two numbers is 14.

. $\frac{x}{y} = -3$. The ratio of the two numbers is -3.

$\frac{x}{y} = -3 \Rightarrow x = -3y$

$x + y = 14$ First equation

$(-3y) + y = 14$ Substitute $-3y$ for x.

$-2y = 14$ Simplify.

$y = -7$

Substitute $y = -7$ in the first equation.

$x + (-7) = 14 \Rightarrow x = 21$

Therefore the product of the two numbers is $x \cdot y = 21 \cdot (-7) = -147$.

3. C

$2(x - y) = 3y$

$2x - 2y = 3y$ Distributive property

$2x = 5y$ Add $2y$ to each side.

$\frac{2x}{2} = \frac{5y}{2}$ Divide each side by 2.

$x = \frac{5}{2}y$ Simplify.

$\frac{x}{y} = \frac{\frac{5}{2}y}{y}$ Divide each side by y.

$\frac{x}{y} = \frac{5}{2}$ Simplify.

4. D

Let $6x =$ the length and $7x =$ the width of the rectangle.

$P = 2\ell + 2w$ Perimeter of a rectangle.

$78 = 2(6x) + 2(7x)$ $P = 78$, $\ell = 6x$, and $w = 7x$

$78 = 26x$ Simplify.

$3 = x$ Divide each side by 26.

Therefore, the length of the rectangle is $6 \cdot 3$ or 18, and the width of the rectangle is $7 \cdot 3$ or 21. The area of the rectangle is $18 \cdot 21$ or 378.

5. 23

$$\text{Gas Mileage} = \frac{\text{Number of Miles Traveled}}{\text{Number of Gallons of Gas Used}}$$

$$= \frac{218.5}{9.5} = 23$$

The car's gas mileage is 23 miles per gallon.

6. 5

$$\text{Unit Price} = \frac{\text{Price of Package}}{\text{Number of Units in the Package}}$$

$$= \frac{0.95}{20} = 0.0475$$

The unit price of the vitamin water to the nearest cent is 5.

7. 32.4

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$
$$\frac{2.7 \text{ grams}}{1 \text{ cm}^3} = \frac{x \text{ grams}}{12 \text{ cm}^3}$$
$$x = 2.7 \times 12 = 32.4 \text{ grams}$$

Section 6-2

1. D

Set up a proportion.

$$\frac{1 \text{ inch}}{5 \text{ miles}} = \frac{10 \text{ inches}}{x \text{ miles}} \Rightarrow x = 50 \text{ miles}$$
$$\frac{1 \text{ inch}}{5 \text{ miles}} = \frac{7.2 \text{ inches}}{y \text{ miles}} \Rightarrow y = 7.2 \times 5 = 36 \text{ miles}$$

The area of the state is 50×36, or $1{,}800 \text{ mi}^2$.

2. B

Let the number of students $= 27x$ and let the number of teachers $= 2x$. Then, there will be $27x + 2x$, or $29x$ students and teachers who are in the meeting. Now set up a proportion.

$$\frac{\text{total in the meeting}}{\text{number of teachers}} = \frac{29x}{2x} \Rightarrow$$
$$\frac{754}{\text{number of teachers}} = \frac{29\cancel{x}}{2\cancel{x}} \Rightarrow$$
$$\text{number of teachers} = \frac{754 \times 2}{29} = 52$$

3. B

Let $5x$ = the volume of cement, $9x$ = the volume of sand, and $13x$ = the volume of gravel. Thus the total volume of concrete is $5x + 9x + 13x$, or $27x$, which is equal to 324 ft^3.

$27x = 324 \Rightarrow x = 12$
Therefore, the amount of cement is $5x = 5 \cdot 12 = 60$.

4. 240

$$1 \text{ hour } 45 \text{ minutes} = 1\frac{3}{4} \text{ hours}$$

Set up a proportion.

$$\frac{84 \text{ miles}}{1\frac{3}{4} \text{ hours}} = \frac{x \text{ miles}}{5 \text{ hours}}$$
$$1\frac{3}{4}x = 84 \cdot 5 \qquad \text{Cross Products}$$
$$\frac{7}{4}x = 420 \qquad \text{Simplify.}$$
$$\frac{4}{7} \cdot \frac{7}{4}x = \frac{4}{7} \cdot 420 \qquad \text{Multiply each side by } \frac{4}{7}.$$
$$x = 240$$

He can drive 240 miles in 5 hours.

5. 8

Let $2x$ = the number of quarters, $4x$ = the number of dimes, and $7x$ = the number of nickels.
Then the total amount in terms of x,
$2x(0.25) + 4x(0.1) + 7x(0.05)$, is equal to \$5.00.
$$2x(0.25) + 4x(0.1) + 7x(0.05) = 5.00$$
$$0.5x + 0.4x + 0.35x = 5$$
$$1.25x = 5$$
$$x = 4$$

There are $2x = 2 \cdot 4$, or 8 quarters.

6. 6

$$\frac{5x}{3} = \frac{x+14}{2}$$
$$2(5x) = 3(x+14) \qquad \text{Cross Products}$$
$$10x = 3x + 42$$
$$7x = 42$$
$$x = 6$$

7. $\frac{5}{12}$

Let r = the amount of raisin, p = the amount of peanut, and c = the amount of chocolate. Then

$\frac{r}{p} = \frac{2}{3}$ The ratio of raisin to peanut is $2:3$.
$3r = 2p$ Cross Products
$p = \frac{3}{2}r$ Solve for p.
$\frac{p}{c} = \frac{5}{8}$ The ratio of peanut to chocolate is $5:8$.
$8p = 5c$ Cross Products
$p = \frac{5}{8}c$ Solve for p.

Equate the two equations solved for p.

$$\frac{3}{2}r = \frac{5}{8}c \Rightarrow \frac{2}{3} \cdot \frac{3}{2}r = \frac{2}{3} \cdot \frac{5}{8}c$$
$$\Rightarrow r = \frac{5}{12}c \Rightarrow \frac{r}{c} = \frac{5}{12}$$

Section 6-3

1. A

Set up a proportion.

$$\frac{20}{1240} = \frac{x}{1984} \quad \begin{array}{l} \leftarrow \text{ number of machines} \\ \leftarrow \text{ number of printers} \end{array}$$

$1240x = 20 \cdot 1984$ Cross Products

$x = \dfrac{20 \cdot 1984}{1240} = 32$

Altogether we need 32 machines, therefore we need $32 - 20$, or 12, more machines.

2 D

Let $x =$ the number of quarts of lemonade concentrate needed for 24 people.

In this question "$6\frac{2}{3}$ quarts of water" was unnecessary information.

$$\frac{\frac{3}{4}}{40} = \frac{x}{24} \quad \begin{array}{l} \leftarrow \text{ quarts} \\ \leftarrow \text{ people} \end{array}$$

$40x = 24 \cdot \dfrac{3}{4}$ Cross products

$x = 24 \cdot \dfrac{3}{4} \cdot \dfrac{1}{40} = \dfrac{9}{20}$

3. B

The number of tapes produced in one hour is equal to $735 \div 5\frac{1}{4}$, or 140.

The fraction of 735 tapes produced in one hour is $\frac{140}{735}$, or $\frac{4}{21}$.

4. B

Set up a proportion.

$$\frac{32}{768} = \frac{x}{960} \quad \begin{array}{l} \leftarrow \text{ number of acres} \\ \leftarrow \text{ number of bushels} \end{array}$$

$768x = 32 \cdot 960$ Cross products

$x = \dfrac{32 \cdot 960}{768} = 40$

Altogether we need 40 acres, therefore we need $40 - 32$, or 8, more acres.

5. C

Let $x =$ the width of the rectangle,
then $x + 8 =$ the length of the rectangle.

$P = 2\ell + 2w$ Perimeter of a rectangle.

$P = 2(x+8) + 2(x)$ $\ell = x + 8$, and $w = x$

$P = 4x + 16$ Simplify.

$\dfrac{\text{length}}{\text{perimeter}} = \dfrac{x+8}{4x+16} = \dfrac{5}{16}$

$16(x+8) = 5(4x+16)$ Cross Products

$16x + 128 = 20x + 80$

$48 = 4x$

$12 = x$

The length of the rectangle is $12 + 8$, or 20 and the width of the rectangle is 12.
The area of the rectangle is $20 \cdot 12$, or 240.

6. D

If 12 grams of coffee cost x dollars, the cost of each gram of coffee is $\frac{x}{12}$ dollars. Let one cup of coffee cost d dollars, and set up a proportion to find the cost of one cup of coffee.

$$\frac{\frac{x}{12}}{y} = \frac{d}{1} \quad \begin{array}{l} \leftarrow \text{ cost in dollars} \\ \leftarrow \text{ number of cups} \end{array}$$

$y \cdot d = \dfrac{x}{12}$ Cross Products

$d = \dfrac{x}{12y}$

Chapter 6 Practice Test

1. C

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

$1 \text{ m}^3 = (100 \text{ cm})^3 = 1{,}000{,}000 \text{ cm}^3$

$0.01 \text{ m}^3 = 0.01 \times 1{,}000{,}000 \text{ cm}^3 = 10{,}000 \text{ cm}^3$

$\text{Density} = \dfrac{\text{Mass}}{\text{Volume}}$

$4.54 \text{ grams/cm}^3 = \dfrac{\text{Mass}}{0.01 \text{ m}^3} = \dfrac{\text{Mass}}{10{,}000 \text{ cm}^3}$

$\text{Mass} = 4.54 \dfrac{\text{grams}}{\text{cm}^3} \cdot 10{,}000 \text{ cm}^3$

$= 45{,}400 \text{ grams}$

2. A

$\text{Total time} = \text{Jason's time} + \text{Donny's time}$

$= 4 \text{ hour } 25 \text{ min} + 2 \text{ hour } 15 \text{ min}$

$= 4\frac{5}{12} \text{ hour} + 2\frac{1}{4} \text{ hour} = 6\frac{2}{3} \text{ hour}$

The amount Donny received

$$= 1,200 \times \frac{2\frac{1}{4} \text{ hour}}{6\frac{2}{3} \text{ hour}} = 1,200 \cdot \frac{\frac{9}{4}}{\frac{20}{3}} = 1,200 \cdot \frac{9}{4} \cdot \frac{3}{20}$$

$$= 405$$

3. C

If the ratio of white balls to yellow balls is $\frac{3}{10}$, $3n$ represents the number of white balls and $10n$ represents the number of yellow balls (n is a positive integer).
Since the total number of balls in the bag is $3n + 10n$, or $13n$, and n is a positive integer, the number of balls will be a multiple of 13.

Choice C is correct, because 42 is not a multiple of 13.

4. C

Let $m =$ the number of miles traveled in y minutes. Substitute 60 minutes for 1 hour and set up a proportion.

$$\frac{x}{60} = \frac{m}{y} \quad \begin{matrix} \leftarrow \text{ number of miles} \\ \leftarrow \text{number of minutes} \end{matrix}$$

$60m = xy$ Cross Products

$$m = \frac{xy}{60}$$

5. B

Let $x =$ the number of years it will take the tree to reach a height of 30 feet.

Also, 8 inches $= \frac{8}{12}$ feet.

$8 + \frac{8}{12}x = 30$ The tree is 8 feet tall and will grow $\frac{8}{12}x$ feet in x years.

$\frac{8}{12}x = 22$

$x = 22 \cdot \frac{12}{8} = 33$

6. A

m minutes $= 60m$ seconds
Let $p =$ the number of pages he reads in $20m$ seconds.
Set up a proportion.

$$\frac{x}{60m} = \frac{p}{20m} \quad \begin{matrix} \leftarrow \text{ number of pages} \\ \leftarrow \text{number of seconds} \end{matrix}$$

$60m \cdot p = 20m \cdot x$ Cross Products

$$p = \frac{20m \cdot x}{60m} = \frac{1}{3}x$$

7. A

$\frac{x}{y} = 1$

$y \cdot \frac{x}{y} = y \cdot 1$	Multiply each side by y.
$x = y$	Simplify.
$x - y = y - y$	Subtract y from each side.
$x - y = 0$	Simplify.
$x - y - 1 = 0 - 1$	Subtract 1 from each side.
$x - y - 1 = -1$	Simplify.

8. B

Let $m =$ the number of males in the room and let $f =$ the number of females in the room.

$\frac{m}{f} = \frac{4}{5}$	The ratio of males to females is 4 to 5.
$5m = 4f$	Cross Products
$\frac{m+8}{f} = \frac{6}{5}$	After 8 males enter the room, the ratio of males to females is 6 to 5.
$5(m+8) = 6f$	Cross Products
$5m + 40 = 6f$	Simplify.
$4f + 40 = 6f$	Substitute $4f$ for $5m$.
$40 = 2f$	Subtract $2f$ from each side.
$20 = f$	Divide each side by 2.

Substituting 20 for f in the equation $5m = 4f$ gives $5m = 4 \cdot 20$. Solving for m yields $m = 16$.

The total number of people in the room before the additional males enter the room is $m + f = 16 + 20 = 36$.

9. B

If a person is born every 5 seconds, 12 people are born per minute. If a person dies every 12 seconds, 5 people die per minute. Every minute the population grows by $12 - 5$, or 7, people.

Therefore, it takes $\frac{60}{7}$ seconds, or $8\frac{4}{7}$ seconds, for the population to grow by one person.

10. D

Total area of the wall $= 9 \times 12 = 108 \text{ ft}^2$.
Let it take p gallons of paint to paint 108 ft^2.

Set up a proportion.

$$\frac{1}{s} = \frac{p}{108} \quad \begin{matrix} \leftarrow \text{ number of gallons} \\ \leftarrow \text{number of square feet} \end{matrix}$$

$sp = 108$	Cross Products
$p = \frac{108}{s}$	

It takes $\frac{108}{s}$ gallons of paint to paint 108 ft^2.
Since each gallon costs g dollars, the total cost will be $\frac{108}{s} \cdot g$ dollars.

11. $\frac{25}{4}$ or 6.25

$2 \text{ in} = 5 \text{ cm}$	
$1 \text{ in} = \frac{5}{2} \text{ cm}$	Divide each side by 2.
$(1 \text{ in})^2 = (\frac{5}{2} \text{ cm})^2$	Square both sides.
$1 \text{ in}^2 = \frac{25}{4} \text{ cm}^2$	Simplify.

There are $\frac{25}{4}$ square centimeters in 1 square inch.

12. 3

The reduced length of the painting is $18 - x$ and the reduced width of the painting is $12 - x$.

$\frac{18-x}{12-x} = \frac{5}{3}$	The new ratio is 5 to 3.
$3(18-x) = 5(12-x)$	Cross Products
$54 - 3x = 60 - 5x$	Distributive Property
$54 + 2x = 60$	Add $5x$ to each side.
$2x = 6$	Subtract 54 from each side.
$x = 3$	Divide each side by 2.