

***LHF STUDY GUIDE***  
**PASS THE HiSET<sup>®</sup> MATH TEST!**

# **PROPORTION WORD PROBLEMS**

<b>Ratios.....</b>	<b>1</b>
<b>Proportions.....</b>	<b>3</b>
<b>Basic Proportion Word Problems.....</b>	<b>5</b>
<b>Map and Scale Diagram Word Problems.....</b>	<b>8</b>
<b>Time Word Problems.....</b>	<b>11</b>
<b>Word Problems with Expression Answers.....</b>	<b>14</b>
<b>Multi-step and Tricky Word Problems.....</b>	<b>18</b>
<b>Proportion Word Problems Test.....</b>	<b>22</b>
<b>Answer Key.....</b>	<b>27</b>

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dgruve642@gmail.com

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## Reducing Improper Fraction Ratios

If you use the abc key to reduce an improper fraction ratio (top number is bigger than bottom number), you will get a mixed number, not a ratio in fraction form.

For example, if you reduce the ratio  $\frac{25}{10}$  by entering 25 abc 10 =  
you will get  $2\frac{1}{2}$  which is a mixed number, not a ratio in fraction form.

So, if you want a ratio in fraction form, reduce an improper fraction ratio by hand by dividing the same number into the top and bottom of the fraction.

Reduce  $\frac{25}{10}$  by dividing 5 into both the top and bottom numbers to get  $\frac{5}{2}$ .

**OR** - Use this little trick: Flip the top and bottom number of an improper fraction ratio, reduce on the calculator, and then flip your answer.

For example, to reduce the ratio  $\frac{25}{10}$ , flip the fraction and reduce  $\frac{10}{25}$  on the calculator, then flip your result.

Enter 10 abc 25 = and get  $\frac{2}{5}$ . Flip the result to get  $\frac{5}{2}$ .

*Remember* – do this only if the top number is bigger than the bottom number in a fraction ratio you need to reduce.

**Example 3:** Darla has 10 pennies, 6 nickels, and 4 dimes.

1. The ratio of pennies to nickels is: 10 to 6 or 10:6 or  $\frac{10}{6}$   
which reduces to: 5 to 3 or 5:3 or  $\frac{5}{3}$

*(Reduce the improper fraction ratio  $\frac{10}{6}$  by hand,  
or reduce  $\frac{6}{10}$  on the calculator and flip the result.)*

2. The ratio of coins to dimes is: 20 to 4 or 20:4 or  $\frac{20}{4}$   
which reduces to: 5 to 1 or 5:1 or  $\frac{5}{1}$

3. The ratio of coins to nickels is: 20 to 6 or 20:6 or  $\frac{20}{6}$   
which reduces to: 10 to 3 or 10:3 or  $\frac{10}{3}$

*(Reduce the improper fraction ratio  $\frac{20}{6}$  by hand,  
or reduce  $\frac{6}{20}$  on the calculator and flip the result.)*

**Practice One** – Write your ratios in fraction form. *Answers – p. 27*

1. A 24-piece box of candy has 6 chocolates, 5 caramels, 10 jellies, and 3 mints.
  - a) What is the ratio of chocolates to caramels?
  - b) What is the ratio of caramels to chocolates?
  - c) What is the ratio of jellies to mints?
  - d) What is the ratio of mints to total number of candies?
  - e) What is the ratio of total number of candies to chocolates?
  - f) What is the ratio of total number of candies to jellies?
  
2. Sammy played 12 games of chess and won 7 of them.
  - a) What is the ratio of games won to games played?
  - b) What is the ratio of games played to games won?
  - c) What is the ratio of games won to games lost?
  - d) What is the ratio of games lost to games to games played?

## **Proportions**

A proportion shows two ratios that are equal to each other.

For example,  $\frac{2}{5} = \frac{4}{10}$  is a proportion because both fractions are equal.

**You can test** that they are equal by reducing both fractions. You will get the same result for both.

$$\frac{2}{5} \text{ reduces to } \frac{2}{5} \quad \text{and} \quad \frac{4}{10} \text{ reduces to } \frac{2}{5}$$

**You can also test** that they are equal by simplifying both fractions with division.

Think of the fraction bar as a division sign.

$$2 \div 5 = 0.4 \quad \text{and} \quad 4 \div 10 = 0.4$$

**Another test** to prove the fractions are equal is to multiply cross products. This means that if you multiply the diagonals, you will get the same product both times.

$$2 \times 10 = 20 \quad \text{and} \quad 5 \times 4 = 20$$

To multiply diagonals means to multiply the top of one fraction in a proportion times the bottom of the other fraction.

The word “product” means the answer of a multiplication problem.

## Cross Multiplication

Notice that a proportion has four parts. There are two tops, called numerators, and two bottoms, called denominators. In a proportion where three of the parts are known, cross multiplication can be used to solve for the missing part.

This is done by multiplying the two diagonal numbers and dividing by the remaining number. The answer will be the missing part.

**Examples** –  $x$  stands for the missing part, also called the unknown.

$$1. \quad \frac{x}{12} = \frac{3}{4} \quad x = 12 \times 3 \div 4 = \mathbf{9} \quad \text{or} \quad x = 3 \times 12 \div 4 = \mathbf{9} \quad \frac{9}{12} = \frac{3}{4}$$

$$2. \quad \frac{4}{7} = \frac{x}{63} \quad x = 4 \times 63 \div 7 = \mathbf{36} \quad \text{or} \quad x = 63 \times 4 \div 7 = \mathbf{36} \quad \frac{4}{7} = \frac{36}{63}$$

$$3. \quad \frac{15}{x} = \frac{75}{45} \quad x = 15 \times 45 \div 75 = \mathbf{9} \quad \text{or} \quad x = 45 \times 15 \div 75 = \mathbf{9} \quad \frac{15}{9} = \frac{75}{45}$$

$$4. \quad \frac{24}{80} = \frac{3}{x} \quad x = 3 \times 80 \div 24 = \mathbf{10} \quad \text{or} \quad x = 80 \times 3 \div 24 = \mathbf{10} \quad \frac{24}{80} = \frac{3}{10}$$

Test that the completed proportions are correct.

In example 1, the completed proportion is  $\frac{9}{12} = \frac{3}{4}$ .

Reduce both fractions. Both reduce to  $\frac{3}{4}$ .

Or, divide to simplify.  $9 \div 12 = 0.75$  and  $3 \div 4 = 0.75$

Or, multiply cross products.  $12 \times 3 = 36$  and  $9 \times 4 = 36$

Test the completed proportions in examples 2, 3, and 4 above.

**Practice Two** – Solve for  $x$  using cross multiplication. *Answers – p. 27*

$$1. \quad \frac{x}{5} = \frac{24}{30} \qquad 2. \quad \frac{9}{12} = \frac{3}{x}$$

$$3. \quad \frac{5}{8} = \frac{x}{88} \qquad 4. \quad \frac{4}{x} = \frac{36}{63}$$

$$5. \quad \frac{10}{x} = \frac{25}{100} \qquad 6. \quad \frac{x}{9} = \frac{75}{45}$$

$$7. \quad \frac{9}{3} = \frac{12}{x} \qquad 8. \quad \frac{24}{80} = \frac{x}{10}$$

## Proportion Word Problems

Proportion word problems are solved by setting up a proportion where three of the parts are known based on information in the word problem, and then using cross multiplication to solve for the missing fourth part.

### Basic Proportion Word Problems

**Example 1:** Lena spends 15 hours practicing her violin over a period of 12 days. At the same rate, how many hours does she practice in 45 days?

- A. 18            B. 57            C. 56.25            D. 36            E. 45.5

**Step 1** – Determine the two related values and make a ratio out of the words. You will often find the two related values in the sentence that asks the question. In this problem, hours of practice and number of days are the two related values.

$$\frac{\text{hours of practice}}{\text{days}}$$

**Step 2** – Write a ratio using the relationship given in the problem. The problem tells you that 15 hours of practice goes with 12 days, so these two numbers will form the first ratio. Make sure they are in the same order as the word ratio, with hours on top and days on bottom. It doesn't matter which value is on top of the ratio and which value is on the bottom of the ratio, but you must keep the same order throughout the problem.

$$\frac{\text{hours of practice}}{\text{days}} \quad \frac{15}{12}$$

**Step 3** – Write a second ratio using  $x$  for the unknown, and information from the problem for the other part of the ratio. The question asks how many hours of practice go with 45 days, so, hours of practice is the unknown  $x$  that you need to figure out, and it goes with 45 days.  $x$  goes on top with hours. 45 goes on the bottom with days.

$$\frac{\text{hours of practice}}{\text{days}} \quad \frac{15}{12} = \frac{x}{45}$$

**Step 4** – Solve for  $x$  using cross multiplication.      $15 \times 45 \div 12 = x = 56.25$   
**Answer: C. 56.25 hours of practice**

**Important** – When forming the first ratio, be sure to choose the two values that the problem tells you are related. In this problem, 15 hours of practice is related to 12 days. 15 hours of practice is not related to 45, the other days number.

**Example 2:** Joanne is catering a large wedding. She knows from experience that she needs 90 appetizers to serve 35 people. If the wedding will have 225 guests, how many appetizers should she prepare?

- A. 3,150      B. 579      C. 87.5      D. 3,375      E. 759

**Step 1** – The word ratio is:  $\frac{\text{guests}}{\text{appetizers}}$

**Step 2** – The relationship given in the problem is 90 appetizers for 35 people so these two numbers make up the first ratio. 90 goes on the bottom with the word appetizers and 35 goes on the top with the word guests. (Guests and people mean the same thing in this problem.)

$$\frac{\text{guests}}{\text{appetizers}} = \frac{35}{90}$$

**Step 3** – For the second ratio, the number of appetizers is the unknown value,  $x$ , and it goes with 225 guests. These two related values make up the second ratio. 225 goes on top with guests, and  $x$  goes on the bottom with appetizers.

$$\frac{\text{guests}}{\text{appetizers}} = \frac{225}{x}$$

**Step 4** – Solve with cross multiplication.  $90 \times 225 \div 35 = x = 578.57$

**Answer: B. 579 appetizers**

**Important** – When forming the first ratio, be sure to choose the two values that the problem tells you are related. In this problem, 90 appetizers is related to 35 people. 90 appetizers is not related to 225, the other people number.

**Example 3:** The cost of carpeting is directly proportional to the size of the area being carpeted. If it costs \$16 to carpet 3 square yards, how much will it cost to carpet 525 square yards?

- A. \$98.44      B. \$175      C. \$8,400      D. \$32.81      E. \$2,800

This is another way of wording a proportion problem, and it is solved the same way as the first two examples. The two related values are cost in \$ and size in square yards. The first ratio shows the given relationship of \$16 for 3 square yards. The second ratio shows the unknown cost that goes with 525 square yards.

$$\frac{\text{cost in \$}}{\text{size in square yards}} = \frac{16}{3} = \frac{x}{525} \quad 525 \times \$16 \div 3 = x = \$2,800 \quad \text{Answer: E. \$2,800}$$

**Important** – When forming the first ratio, be sure to choose the two values that the problem tells you are related. In this problem, \$16 is related to 3 square yards. \$16 is not related to 525, the other square yards number.

**Practice Three**    *Answers – p. 28*

*It is important to write your word ratio before forming your number ratios. This will help you keep the numbers in both ratios in the same order.*

1. Remco has canned tomato sauce on sale for 5 cans for \$2. How much would it cost to buy 35 cans of sauce?  
A. \$20            B. \$9                    C. \$14                    D. \$87.50            E. \$45
  
2. A warehouse currently stores 5,200 manufactured units using 65% of its storage capacity. How many units can it store when using 100% of its storage capacity?  
A. 3,380            B. 8,000                    C. 338,000            D. 800                    E. 80,000
  
3. A case of candy containing 300 pieces is on sale for \$5.99. How much will 24,000 pieces of candy cost?  
A. \$47.92            B. \$1,797.00            C. \$4,006.67            D. \$400.67            E. \$479.20
  
4. The weight of a shipment of granola bars is directly proportional to the number of packages in the shipment. If 8 packages of granola bars weigh 5 pounds, what is the weight in pounds of a shipment of 300 packages?  
A. 480            B. 187.5                    C. 1,500                    D. 2,400                    E. 1,875
  
5. To make Powerzone cleaning solution, the directions say to use  $\frac{1}{2}$  cup of Powerzone powder for 20 ounces of water. How many cups of powder will be used with 70 ounces of water?  
A.  $1\frac{3}{4}$             B.  $1\frac{1}{4}$                     C. 25                    D. 10                    E.  $1\frac{1}{2}$
  
6. A factory that manufactures a patented metal alloy produces 327 liters of liquid waste for every 2 million kilograms of the alloy that are made. How many liters of liquid waste are produced when 6.5 million kilograms of alloy are made?  
A. 2,125.5            B. 100.62                    C. 654                    D. 1,062.75            E. 2,779.50



## Proportion Word Problems Using Maps and Scale Diagrams

**Example 1:** Smithville and Tarrytown are  $4\frac{1}{2}$  inches apart on a map where the scale reads 5 miles =  $\frac{1}{2}$  inch. How many miles apart are the two towns?

- A. 45            B. 22.5            C. 25            D. 2.5            E. 54

Scale problems like this compare the real distance between two points with the much smaller distance between the two points that is shown on a map or diagram. In most cases, the two related values in a scale problem will be the two scale measurements.

**Step 1** – In this problem, the two related values are inches on the map and miles of real distance, so this is the word ratio.

**Step 2** –  $\frac{1}{2}$  inch on the map = 5 miles in real distance, so this is the first ratio of the proportion.

**Step 3** –  $4\frac{1}{2}$  inches on the map goes with the unknown, which is the real distance between the two towns, so  $4\frac{1}{2}$  and  $x$  make up the second ratio of the proportion.

$$\frac{\text{miles of real distance}}{\text{inches on the map}} = \frac{5}{\frac{1}{2}} = \frac{x}{4\frac{1}{2}} \qquad 5 \times 4\frac{1}{2} \div \frac{1}{2} = x = 45$$

**Answer: A. 45 miles apart**

**Important** – When forming the first ratio, be sure to choose the two values that the problem tells you are related. In this problem, 5 miles is related to  $\frac{1}{2}$  inch. 5 miles is not related to  $4\frac{1}{2}$ , the other inches number.

**Tip** – It is usually easier to enter the fractions  $\frac{1}{4}$ ,  $\frac{1}{2}$ , and  $\frac{3}{4}$  as decimals than it is to enter them as fractions using the abc key. So,  $\frac{1}{2}$  can be entered as 0.5 and  $4\frac{1}{2}$  can be entered as 4.5 .

**Example 2:** Dean Contracting Co. has created a blueprint for a grocery store they have been hired to build. The store will be 270 feet long and 180 feet wide, and each inch on the blueprint equals 6 feet of actual distance. What are the length and width of the store on the blueprint?

- A. 1620 inches x 1080 inches                      B. 22.5 inches x 15 inches  
C. 450 inches x 300 inches                      D. 45 inches x 30 inches  
E. 270 inches x 180 inches

Notice that you will have to do two proportions, one to figure out the length, and one to figure out the width. Another signal that two calculations are needed is that the answer choices all have two measurements.

The two related values in this problem are the two scale measurements, inches and feet. The relationship that is given is “each inch on the blueprint equals 6 feet of actual distance.” You have to recognize that “each inch” means 1 inch, so use the number 1 in your proportions even though the number 1 is not stated.

**LENGTH:** The unknown in the length calculation is the number of inches on the blueprint that will represent 270 feet of actual length of the grocery store.

$$\frac{\text{actual feet}}{\text{inches on blueprint}} \quad \frac{6}{1} = \frac{270}{x} \quad 270 \times 1 \div 6 = x = 45 \quad \text{Length} = \mathbf{45 \text{ inches}}$$

**WIDTH:** The unknown in the width calculation is the number of inches on the blueprint that will represent 180 feet of actual width of the grocery store.

$$\frac{\text{actual feet}}{\text{inches on blueprint}} \quad \frac{6}{1} = \frac{180}{x} \quad 180 \times 1 \div 6 = x = 30 \quad \text{Width} = \mathbf{30 \text{ inches}}$$

**Answer: D. 45 inches x 30 inches**

**Note** – You may have recognized this problem as a pair of division problems:

Length is  $270 \div 6 = 45$  inches.                      Width is  $180 \div 6 = 30$  inches.

If you see that just from reading the problem, great. It is a faster way to solve the problem. If you don't see that right off, and are not sure how to solve the problem, set up two proportions as just shown.

Sometimes when the number relationships are simple, you can solve proportion word problems by just multiplying or dividing without setting up the proportion. If you can see this when reading a problem, that is fine and will save some time. When in doubt, take the time to set up the proportion.

**Practice Four**    *Answers – p. 29*

**1.** The distance between Leo’s house and his daughter’s college is 325 kilometers (km), and on a map that shows both locations, 3 centimeters (cm) equals 25 kilometers (km). On the map, how many centimeters apart are Leo’s house and the college?

- A. 13                      B. 39                      C. 100                      D. 75                      E. 117

**2.** The distance on a local map between Rob’s house and his job is 5 inches. If 2 inches represents 3 miles on the map, how many miles is Rob’s house from his job?

- A. 7.5                      B. 75                      C. 3.3                      D. 15                      E. 10

**3.** Kayla is painting a large wall mural and will plan out the design and colors on a grid. The mural will be 40 feet long and 15 feet wide. 5 feet on the mural is equivalent to 3 units on the grid. What are the dimensions of the mural on the grid?

- A. 24 units by 9 units                      B. 67 units by 25 units                      C. 13 units by 8 units  
D. 120 units by 45 units                      E. 120 units by 75 units

**4.** A new hotel ballroom will measure 60 meters long and 42 meters wide, and a scale model will be built to use in mapping out different floor plan arrangements. Each centimeter (cm) on the scale model is equal to 2 meters (m) of actual distance. What will the length and width of the ballroom be on the scale model?

- A. 120 cm by 84 cm                      B. 60 cm by 42 cm                      C. 58 cm by 40 cm  
D. 30 cm by 30 cm                      E. 30 cm by 21 cm

**5.** A detailed diagram of an airplane is drawn to scale, with each inch on the diagram equivalent to 5 feet of length on the airplane. If the wingspan is 25 inches long on the diagram, how many feet long is the actual wingspan of the airplane?

- A. 5                      B. 30                      C. 125                      D. 152                      E. 20

## Proportion Word Problems Using Time

Memorize these time conversions if you don't already know them.

$$60 \text{ minutes} = 1 \text{ hour}$$

$$45 \text{ minutes} = \frac{3}{4} \text{ hour or } 0.75 \text{ hour}$$

$$30 \text{ minutes} = \frac{1}{2} \text{ hour or } 0.50 \text{ hour}$$

$$15 \text{ minutes} = \frac{1}{4} \text{ hour or } 0.25 \text{ hour}$$

**Example 1:** Sandy can process 16 invoices every 30 minutes. How many invoices can she process in 4 hours and 45 minutes?

- A. 152      B. 71      C. 76      D. 480      E. 142

The two related values are invoices and time. 16 invoices goes with 30 minutes, so this will make up the first ratio. The unknown,  $x$ , is the number of invoices that goes with 4 hours and 45 minutes, so this will be the second ratio.

Before forming the proportion, you must convert both of the times given to be in the same unit, either minutes or hours.

### To Use Minutes:

The first time, 30 minutes, is already in minutes, so no conversion is needed.

Use 30 minutes.

The second time, 4 hours and 45 minutes, must be converted to minutes.

Multiply 4 hours times 60 minutes per hour = 240 minutes, then add the 45 minutes for a total of 285 minutes.

$$\frac{\text{minutes}}{\text{invoices}} \quad \frac{30}{16} = \frac{285}{x}$$

$$16 \times 285 \div 30 = x = 152 \quad \text{Answer: A. 152 invoices}$$

### To Use Hours:

30 minutes, is the same as  $\frac{1}{2}$  hour, also written as 0.5 hour. Use 0.5 hours.

45 minutes is the same as  $\frac{3}{4}$  hour, also written as 0.75 hour, so 4 hours and 45 minutes would be written as 4.75 hours.

$$\frac{\text{hours}}{\text{invoices}} \quad \frac{0.5}{16} = \frac{4.75}{x}$$

$$16 \times 4.75 \div 0.5 = x = 152 \quad \text{Answer: A. 152 invoices}$$

Be careful when doing calculations with time.

Common mistakes that could be made doing this problem:

4 hours and 45 minutes is  $4 \frac{3}{4}$  hours, or 4.75 hours. It is **not** 4.45 hours.

30 minutes is  $\frac{1}{2}$  hour, or 0.5 hour. It is **not** 0.3 hour.

Also, make sure that all times are in the same units, either hours or minutes, before doing the calculation.

**Example 2:** Lara has set her company's theft prevention system to scan a certain location 340 times per hour. How many scans of this location are made in 15 minutes?

- A. 23                      B. 58                      C. 88                      D. 34                      E. 85

$$\frac{\text{minutes}}{\text{scans}} \frac{60}{340} = \frac{15}{x} \quad 15 \times 340 \div 60 = x = 85 \quad \text{Answer: E. 85 scans}$$

**OR**

$$\frac{\text{hours}}{\text{scans}} \frac{1}{340} = \frac{0.25}{x} \quad 0.25 \times 340 \div 1 = x = 85 \quad \text{Answer: E. 85 scans}$$

Note that the problem says 340 times per hour. This means 340 times in 1 hour, so use 1 hour, or 60 minutes in your proportion.

**Note** – You may have noticed that there are four 15 minute times periods in 1 hour, so you could divide the 340 scans by 4 to solve this problem.  $340 \div 4 = 85$   
If you see that right off, it is a faster way to solve this problem. If you don't see that, use a proportion, as just shown.

**Example 3:** A restaurant worker can dice 3 bags of onions in 45 minutes. How many hours will it take to dice 9 bags of onions?

- A. 2 hours                      B. 2 hours 15 minutes                      C. 36 hours  
D. 5 hours                      E. 2 hours 25 minutes

$$\frac{\text{hours}}{\text{bags of onions}} \frac{0.75}{3} = \frac{x}{9} \quad 9 \times 0.75 \div 3 = x = 2.25 \text{ hours}$$

**Answer: B. 2 hours 15 minutes**

Note that you have to convert 45 minutes to 0.75 hours at the beginning of the problem, and also convert the .25 part of your answer to 15 minutes at the end of the problem.

Common mistakes that could be made doing this problem:

45 minutes is 0.75 hours. It **is not** 0.45 hours

2.25 hours is 2 hours 15 minutes. It **is not** 2 hours 25 minutes.

You could also do the problem in minutes, and convert to hours at the end.

$$\frac{\text{minutes}}{\text{bags of onions}} \frac{45}{3} = \frac{x}{9} \quad 9 \times 45 \div 3 = x = 135 \text{ minutes}$$

$$135 \text{ minutes} \div 60 \text{ minutes per hour} = 2.25 \text{ hours}$$

**Answer: B. 2 hours 15 minutes**

**Note** – You may have noticed that 9 bags of onions is 3 times bigger than the 3 bags of onions given in the problem, so the desired time will also have to be 3 times bigger than 45 minutes given in the problem.  $3 \times 45 = 135$  minutes, and  $135 \text{ minutes} \div 60 \text{ minutes per hour} = 2.25 \text{ hours} \rightarrow 2 \text{ hours } 15 \text{ minutes}$ .

If you see that right off, it is a faster way to solve this problem. If you don't see that, use a proportion, as just shown.

**Practice Five**    *Answers – p. 31*

**1.** Ebony charges \$11 per hour to babysit 2 children. If Mrs. Parks needs a sitter for 3 hours and 15 minutes for her 2 children, how much will she have to pay Ebony?  
A. \$34.65      B. \$69.30      C. \$35.75      D. \$71.50      E. \$37.55

**2.** Celine can make 36 party favors per hour. How many party favors can she make in 45 minutes?  
A. 16              B. 1,620              C. 81              D. 27              E. 72

**3.** It takes a team of 8 workers 2 hours and 15 minutes to clean 12 apartments. How many apartments can the team clean in 9 hours?  
A. 50              B. 48              C. 43              D. 45              E. 24

**4.** How many hours will it take to correct 20 essays if the teacher can correct 2 essays every 15 minutes?  
A. 150 hours              B. 2 hours 50 minutes              C. 1 hour 30 minutes  
D. 130 hours              E. 2 hours 30 minutes

## Proportion Word Problems with Expression Answers

**Example 1:** The price of generic all purpose flour is 4 one-pound bags for \$5. Which expression shows the cost of buying 50 bags of flour?

- A.  $\$5 \times 4 \div 50$                       B.  $4 \times 50 \div \$5$                       C.  $\$5 \times 50 \div 4$   
D.  $4 + 50 \times \$5$                       E.  $50 \div \$5 + 4$

Notice that the answer choices are expressions, not the actual value of  $x$ . Set up the proportion, then determine the cross multiplication problem that would solve it. That cross multiplication expression will be the answer.

$$\frac{\text{bags of flour}}{\$} \quad \frac{4}{5} = \frac{50}{x} \quad \$5 \times 50 \div 4 \quad \text{Answer: C. } \$5 \times 50 \div 4$$

Note that if you reverse the order of multiplication, the correct answer  $\$5 \times 50 \div 4$  could also be written as  $50 \times \$5 \div 4$ .

**Important:** You might also see the answer choices written with the division portion of the cross multiplication expression shown as a fraction. Remember – you can think of the fraction bar as a division sign.

### Start with the first cross multiplication expression: $\$5 \times 50 \div 4$

Make a fraction out of the  $50 \div 4$  and get  $\$5 \times \frac{50}{4}$

Reverse the order of multiplication to get  $\frac{50}{4} \times \$5$

### Then do the same with the other cross multiplication expression: $50 \times \$5 \div 4$

Make a fraction out of the  $\$5 \div 4$  and get  $50 \times \frac{\$5}{4}$

Reverse the order of multiplication to get  $\frac{\$5}{4} \times 50$

So, the original answer,  $\$5 \times 50 \div 4$  can also be written as  $50 \times \$5 \div 4$ , or as

$$\$5 \times \frac{50}{4} \quad \text{OR} \quad \frac{50}{4} \times \$5 \quad \text{OR} \quad 50 \times \frac{\$5}{4} \quad \text{OR} \quad \frac{\$5}{4} \times 50$$

The multiple choice answers will often look like these last four examples, so make sure you can convert an expression like  $\$5 \times 50 \div 4$  into this format. See a quicker way to do this in Example 2, and see Example 3 for a different method.

**Example 2:** An art student spends 12 hours painting every 4 days. Which expression shows how many hours the student will spend painting in 18 days?

- A.  $\frac{18}{12} \times 4$       B.  $\frac{12}{18} \times 4$       C.  $\frac{12}{4} + 18$       D.  $\frac{12}{4} \times 18$       E.  $\frac{18}{4} + 12$

$$\frac{\text{hours}}{\text{days}} \quad \frac{12}{4} = \frac{x}{18}$$

The cross multiplication expression is:

$$12 \times 18 \div 4 \quad \text{or} \quad 18 \times 12 \div 4$$

All the answer choices are in the form that includes a fraction instead of a division sign, so scan the answer choices for fractions that match the division part of each cross multiplication expression. Then see if that answer choice is multiplied by the correct third number.

**Start with the first cross multiplication expression:  $12 \times 18 \div 4$**

$18 \div 4$  is the same as  $\frac{18}{4}$ , so scan the answer choices until you find one that includes the fraction  $\frac{18}{4}$ . Then see if it is multiplied  $\times 12$ .

None of the answer choices match. Answer E does have the correct fraction, but it is not multiplied  $\times 12$ .

**Then do the same with the other cross multiplication expression:  $18 \times 12 \div 4$**

$12 \div 4$  is the same as  $\frac{12}{4}$ , so scan the answer choices until you find one that includes the fraction  $\frac{12}{4}$ . Then see if it is multiplied  $\times 18$ .

Answers C and D both have the correct fraction, but only D is multiplied  $\times 18$ .

**Answer: D.  $\frac{12}{4} \times 18$**



**Example 3:** A manufacturing process uses 50 liters of acid for every 6 grams of carbon. Which expression shows how many grams of carbon are needed for 275 liters of acid?

- A.  $\frac{50}{6} \times 275$       B.  $\frac{6}{275} \times 50$       C.  $\frac{6}{50} + 275$       D.  $\frac{6}{50} \times 275$       E.  $\frac{50}{6} + 275$

$$\frac{\text{liters of acid}}{\text{grams of carbon}} = \frac{50}{6} = \frac{275}{x}$$

The cross multiplication expression is:  
 $6 \times 275 \div 50$       or       $275 \times 6 \div 50$

Just like the last example, all the answer choices are in a form that includes a fraction instead of a division sign. You could scan the answer choices for the correct fraction that is multiplied by the correct third number as was done in Example 2.

A different method is to calculate the value of your answer (the cross multiplication expression), and then calculate the value of each multiple choice answer until you find one that is equal to your answer.

Calculate the value of your answer:  $6 \times 275 \div 50 = 33$

Try A.  $\frac{50}{6} \times 275 = 2,291.67$       **Does not** = 33, so **is not** equal to  $6 \times 275 \div 50$ .

*(Reminder – to calculate the value of a fraction on the calculator, enter top number ÷ bottom number.  $\frac{50}{6}$  is entered as  $50 \div 6$ .)*

Try B.  $\frac{6}{275} \times 50 = 1.09$       **Does not** = 33, so **is not** equal to  $6 \times 275 \div 50$ .

Try C.  $\frac{6}{50} + 275 = 275.12$       **Does not** = 33, so **is not** equal to  $6 \times 275 \div 50$ .

Try D.  $\frac{6}{50} \times 275 = 33$       **Does** = 33, so **is** equal to  $6 \times 275 \div 50$ .

**Answer: D.  $\frac{6}{50} \times 275$**

For this type of problem, use which ever method you like the best, the Calculation Method just shown, or the Scan For Correct Fraction Method, shown in Example 2.

**Example 4:** If \$2.79 is the price of a 20-ounce bag of candy, which of the expressions below could be used to calculate the cost per ounce of the candy?

- A.  $20 \times \$2.79$     B.  $\$2.79 \div 20$     C.  $20 - \$2.79$     D.  $20 \div \$2.79$     E.  $20 + \$2.79$

This is one of those questions where you might know that you have to divide, but aren't sure whether answer B or answer D is correct. Or, you might know you have to either multiply or divide, but aren't sure which to do.

Set up a proportion to determine the correct expression.

$$\frac{\text{ounces}}{\$} \quad \frac{20}{2.79} = \frac{1}{x}$$

$\$2.79 \times 1 \div 20$  is the cross multiplication expression.

It can be shortened to  $\$2.79 \div 20$  because

$\$2.79 \times 1$  is the same as  $\$2.79$ .

**Answer: B.  $\$2.79 \div 20$**

**Note** – Per ounce means for 1 ounce, so use the number 1 in your proportion.

**Tip** – When you come across problems where you can't decide which way a division calculation goes, or whether to multiply or divide, in many cases setting up a proportion will help you find the answer.

**Practice Six**    *Answers – p. 32*

**1.** Which expression below can be used to find the cost of a single marble if a bag of 75 marbles is sold for \$5.75?

- A.  $75 \times \$5.75$                       B.  $\$5.75 \div 75$                       C.  $75 - \$5.75$   
D.  $75 \div \$5.75$                       E.  $75 + \$5.75$

**2.** If 3 bottles of shampoo cost \$5, which expression shows how much 8 bottles of shampoo will cost?

- A.  $8 \times \$5 \div 3$     B.  $\$5 \times 3 \div 8$     C.  $(3 + 8) \times \$5$     D.  $(3 + 8) \div \$5$     E.  $8 \times 3 \div \$5$

**3.** Langley Party Supply is having a sale on bulk packages of paper plates. Each package of 200 paper plates is on sale for \$1.79. Which of the following expressions could be used to calculate the cost in dollars of 1,800 paper plates?

- A.  $\frac{1,800}{\$1.79} \times 200$                       B.  $\frac{\$1.79}{200} + 1,800$                       C.  $\frac{\$1.79}{200} \times 1,800$   
D.  $\frac{1,800}{200} + \$1.79$                       E.  $\frac{\$1.79}{1,800} - 200$

4. A family has driven 225 miles in 4 ½ hours. If they continue driving at the same rate, which expression shows how long it will take to drive the next 400 miles of their trip?

- A.  $\frac{225}{400} \times 4.5$     B.  $\frac{4.5}{225} + 400$     C.  $\frac{400}{225} + 4.5$     D.  $\frac{400}{4.5} \times 225$     E.  $\frac{400}{225} \times 4.5$

5. A person can type 1,950 words in 30 minutes. At the same rate, which expression shows how many words per minute the person can type?

- A.  $1,950 \div 30$     B.  $30 \div 1,950$     C.  $1,950 - 30$     D.  $1,950 \times 30$     E.  $1,950 + 30$

### **Multi-step and Tricky Proportion Word Problems**

**Example 1:** A machine that is run 6 days per week is operating at 80% efficiency and producing 56 units per day. Once it is tuned up it will run at 90% efficiency. How many more units per week will the machine produce after the tune up?

- A. 63    B. 7    C. 336    D. 378    E. 42

$$\frac{\text{units per day}}{\% \text{ efficiency}} \quad \frac{56}{80} = \frac{x}{90} \quad 56 \times 90 \div 80 = x = 63 \text{ units per day}$$

You have calculated the number of units per day the machine will make after the tune up, but that is not what the problem asks for. The problem asks “how many more units per week.”

First calculate how many more units per day the machine will produce.

$$63 - 56 = 7 \text{ more units per day}$$

Next, multiply times the 6 days per week that the machine is run.

$$7 \times 6 = 42 \text{ more units per week. } \textbf{Answer: E. 42}$$

**What to look out for:** Extra steps may be needed before or after you form your proportion, *and*, make sure you are answering the question that is asked.

**Example 2:** There are 750 cds for sale at the local rummage sale. If you can buy 3 cds for \$3.49, how much will 27 cds cost?

- A. \$10.47    B. \$83.33    C. \$31.41    D. \$23.21    E. \$27.78

$$\frac{\text{cost}}{\text{number of cds}} \quad \frac{3.49}{3} = \frac{x}{27} \quad \$3.49 \times 27 \div 3 = x = \$31.41$$

**Answer: C. \$31.41**

What about the 750 cds? How does that come into the problem? It doesn't. The number of cds that there are to choose from does not affect the cost of the cds.

**What to look out for:** Extra numbers that you don't need.

**Example 3:** The directions on a lemonade mix package say to mix 3 teaspoons of lemonade powder with 1 liter of water. Which of the following combinations of powder and water would produce lemonade with the correct concentration?

- A.  $\frac{1}{4}$  tsp powder & 4 liters water      B.  $\frac{1}{2}$  tsp powder &  $1\frac{1}{2}$  liters water  
C. 4 tsp powder & 2 liters water      D.  $1\frac{1}{2}$  tsp powder &  $\frac{1}{2}$  liter water  
E. 1 tsp powder & 3 liters water

In this type of problem, the question provides the first ratio of a proportion, and the answer choices provide five possibilities for the second ratio of the proportion. Remember that both ratios in a proportion are equal so both will simplify to the same number.

**Step 1** – Simplify the first ratio of the proportion, which is given in the problem.

You are given:  $\frac{\text{tsp of powder}}{\text{liters of water}} = \frac{3}{1}$       Divide to simplify:  $3 \div 1 = 3$

**Step 2** – Find one of the answer choices that also simplifies to 3 and you will have found the other half of your proportion.

Try A.  $\frac{\text{powder}}{\text{water}} = \frac{\frac{1}{4}}{4}$        $0.25 \div 4 = 0.0625$

**Does not** simplify to 3, so answer A.  $\frac{1}{4}$  **is not** correct.

Try B.  $\frac{\text{powder}}{\text{water}} = \frac{\frac{1}{2}}{1\frac{1}{2}}$        $0.5 \div 1.5 = 0.33$

**Does not** simplify to 3, so answer B.  $\frac{1}{2}$  **is not** correct.

Try C.  $\frac{\text{powder}}{\text{water}} = \frac{4}{2}$        $4 \div 2 = 2$

**Does not** simplify to 3, so answer C.  $\frac{4}{2}$  **is not** correct.

Try D.  $\frac{\text{powder}}{\text{water}} = \frac{1\frac{1}{2}}{\frac{1}{2}}$        $1.5 \div 0.5 = 3$

**Does** simplify to 3, so answer D.  $\frac{1\frac{1}{2}}{\frac{1}{2}}$  **is** correct.

**Answer: D.  $1\frac{1}{2}$  tsp powder &  $\frac{1}{2}$  liter water**

**Note** – it is usually easier to simplify using decimals, as shown above, but you could also use the abc key to enter the fractions that are given.

**What to look out for:** A problem where you are given the first ratio of a proportion and need to choose the correct second ratio. This is different from all of the other proportion problems you have seen where you are given three of the four parts of a proportion and need to calculate the one missing part.

**Example 4:** The legend on a map of Italy shows a scale of 3.2 kilometers (km) in actual distance = 2 centimeters (cm) on the map. Which expression would you use to get the best estimate of the distance across a lake if the distance measures 9.6 cm on the map?

- A.  $\frac{3}{2} \times 9$       B.  $\frac{2}{3} \times 9$       C.  $\frac{10}{4} \times 2$       D.  $\frac{3}{2} \times 10$       E.  $\frac{2}{3} \times 10$

Notice that the question asks for the best estimate. That means that the numbers in your proportion need to be rounded up or down. First, set up the proportion with the numbers given in the problem. Then, round them up or down.

Remember, when rounding, 5 or greater rounds up, and 4 or less rounds down.

9.6 rounds up to 10 because 6 is greater than 5.

3.2 rounds down to 3 because 2 is less than 5.

$$\frac{\text{actual km}}{\text{cm on map}} \quad \frac{3.2}{2} = \frac{x}{9.6} \rightarrow \frac{3}{2} = \frac{x}{10} \quad \text{The cross multiplication expression is:}$$

$$3 \times 10 \div 2 \quad \text{or} \quad 10 \times 3 \div 2$$

All the answer choices are expressions that include a fraction. Use either the scan for correct fraction method or the calculation method to see which answer choice is the same as your cross multiplication expression.

**Method One – Scan answer choices for the correct fraction multiplied by the correct third number.**

$$3 \times 10 \div 2 \quad \text{Look for } \frac{10}{2} \text{ multiplied } \times 3. \text{ Not found.}$$

$$10 \times 3 \div 2 \quad \text{Look for } \frac{3}{2} \text{ multiplied } \times 10. \text{ Answer: D. } \frac{3}{2} \times 10$$

**Method Two – Calculation.** Calculate the value of your answer. Then calculate the value of each multiple choice answer until you find one that is equal to your answer.

Calculate the value of your answer:  $3 \times 10 \div 2 = 15$

$$\text{Try A. } \frac{3}{2} \times 9 = 13.5 \quad \text{Does not} = 15, \text{ so is not correct.}$$

$$\text{Try B. } \frac{2}{3} \times 9 = 6 \quad \text{Does not} = 15, \text{ so is not correct.}$$

$$\text{Try C. } \frac{10}{4} \times 2 = 5 \quad \text{Does not} = 15, \text{ so is not correct.}$$

$$\text{Try D. } \frac{3}{2} \times 10 = 15 \quad \text{Does} = 15, \text{ so is correct. Answer: D. } \frac{3}{2} \times 10$$

**What to look out for:** Problems that ask for the best estimate. Round numbers up or down before forming your cross multiplication expression.

**Test Taking Tip:** In the last problem, the three numbers in your cross multiplication expression, 3 10 2, only appear in answer choices D and E, so those are really the only ones you need to check. This will save time.

Or, let's say that you recognize that the word estimate in the question means that you have to round the numbers, but you don't know what to do next. You could eliminate the first three answers because they don't have the correct rounded numbers, and then take a guess between answer choices D and E.

**Practice Seven**    *Answers – p. 35*

**1.** A home recipe for a cleaning liquid calls for  $\frac{3}{4}$  ounce of ammonia (NH<sub>4</sub>) for every 3 cups of water (H<sub>2</sub>O). Which combination below will make the cleaning liquid with the correct concentration?

- A.  $\frac{1}{4}$  ounce ammonia & 4 cups water                      B.  $\frac{1}{2}$  ounce ammonia & 4 cups water  
C.  $1\frac{1}{4}$  ounces ammonia & 6 cups water                      D.  $1\frac{1}{2}$  ounces ammonia & 6 cups water  
E.  $1\frac{3}{4}$  ounces ammonia & 5 cups water

**2.** Notebooks are on sale at \$3.29 for a 4-pack. If each of the 5 Dawson children needs 8 notebooks for school, how much will all of the notebooks cost?

- A. \$6.58                      B. \$32.90                      C. \$48.63                      D. \$16.45                      E. \$26.32

**3.** Marie charges \$10 per hour to babysit 2 children and \$12 per hour to babysit 3 children. How much will she charge to babysit for 4 hours and thirty minutes if a family has 3 children?

- A. \$45                      B. \$51.6                      C. \$43                      D. \$16.45                      E. \$54

**4.** Every 4 days, Ayala spends  $\frac{1}{2}$  hour grooming her dog. Which combination below shows the same relationship between days and grooming time?

- A. 8 days &  $\frac{1}{4}$  hour of grooming                      B. 9 days &  $\frac{3}{4}$  hours grooming  
C. 12 days &  $1\frac{1}{2}$  hours of grooming                      D. 5 days &  $\frac{1}{4}$  hour grooming  
E. 7 days & 1 hour of grooming

**5.** A company needs 3.2 feet of copper to manufacture 40 Model X switches. If the company has 26.4 feet of copper left in stock, which expression will provide the best estimate of the number of Model X switches the company can make?

- A.  $\frac{40}{3} \times 27$                       B.  $\frac{3}{26} \times 40$                       C.  $\frac{4}{40} \times 27$                       D.  $\frac{26}{3} \times 40$                       E.  $\frac{26}{4} \times 40$

6. On a map of Europe where the scale reads 1.8 centimeters (cm) = 20 kilometers (km), two towns are measured to be 12.6 centimeters apart. Choose the expression below that you would use to get the best estimate of how many kilometers there are between the two towns.

- A.  $\frac{20}{2} \times 12$       B.  $\frac{20}{13} \times 2$       C.  $\frac{13}{2} \times 20$       D.  $\frac{2}{12} \times 20$       E.  $\frac{13}{1} \times 20$

### **Proportion Word Problems – Test**    *Answers – p. 40*

The following problems include all the different types of proportion problems covered in this Study Guide, in mixed order.

1. A scientist tracks the flight of the birds he is studying and finds that they can fly 60 kilometers in  $1\frac{1}{2}$  hours. At the same rate, how long will it take the birds to fly 200 kilometers?

- A. 90 hours      B. 5 hours      C. 40 hours      D. 3.3 hours      E. 50 hours

2. A salesman has driven 150 miles in  $3\frac{1}{2}$  hours. If he continues driving at the same rate, which expression shows how long it will take to drive the final 95 miles of his trip?

- A.  $\frac{150}{95} \times 3.5$       B.  $\frac{95}{150} + 3.5$       C.  $\frac{95}{150} \times 3.5$       D.  $\frac{95}{3.5} \times 150$       E.  $\frac{3.5}{150} + 95$

3. In a survey of 450 students at a large university, 343 said they are likely to rent textbooks instead of buying them. Based on this survey, how many of the 12,000 total students at the university would you predict are likely to buy textbooks instead of renting them?

- A. 9,147      B. 2,853      C. 3,743      D. 11,207      E. 2,538

4. The Farm Co-op recommends planting 56 fruit trees per  $\frac{1}{2}$  acre. Which of the following will result in the same proportion of trees per acre?

- A. 150 trees &  $1\frac{1}{2}$  acres      B. 84 trees &  $\frac{3}{4}$  acre      C. 40 trees &  $\frac{1}{4}$  acre  
D. 300 trees & 3 acres      E. 100 trees &  $\frac{3}{4}$  acre

**5.** The cost to outfit 12 students with band uniforms is \$425. How much will it cost to buy uniforms for all 40 students that are in the band?

- A. \$5,100      B. \$4,117      C. \$1,275      D. \$1,417      E. \$1,500

**6.** 12 grams of flavor powder concentrate are used for every 65 liters of grape soda. Which expression shows how many grams of flavor powder concentrate will be needed to make 450 liters of grape soda?

- A.  $\frac{450}{65} \div 12$       B.  $\frac{12}{65} + 450$       C.  $\frac{65}{12} \times 450$       D.  $\frac{12}{65} \times 450$       E.  $\frac{65}{450} \times 12$

**7.** In a survey of 450 voters in Boone County, 65 said they would vote No on ballot question #1. How many of the 16,500 voters in Boone County do you predict will vote No on ballot question #1, based on these survey results?

- A. 2,383      B. 254      C. 385      D. 2,833      E. 238

**8.** On the blueprints for a house,  $\frac{1}{4}$  inch is equal to 1 foot. What are the dimensions on the blueprint of a room with actual measurements of 30 feet long and 20 feet wide?

- A. 8 inches by 4 inches      B. 50 inches by 10 inches      C. 15 inches by 10 inches  
D. 7.5 inches by 5 inches      E. 60 inches by 40 inches

**9.** At New You Yoga School, there are currently 353 students enrolled, which corresponds to 72% of maximum enrollment. How many more students would the school need to sign up to reach their goal of 95% enrollment?

- A. 466      B. 335      C. 113      D. 265      E. 268

**10.** If a school system can purchase a bulk package of 500 workbooks for \$195, what is the cost per workbook?

- A. \$3.90      B. \$2.56      C. \$0.39      D. \$0.49      E. \$0.93

**11.** How many patterns can a machine cut in 15 minutes, if it is set to cut 32 patterns per hour?

- A. 2.13      B. 4.8      C. 16      D. 48      E. 8



**12.** The formula to make Ocean Blue paint calls for 6 gallons of blue paint and  $\frac{1}{2}$  gallon of green paint. Which of the following combinations will correctly produce Ocean Blue paint?

- A. 12 gal. blue &  $\frac{3}{4}$  gal. green      B. 15 gal. blue & 2 gal. green  
C. 4 gal. blue &  $\frac{1}{4}$  gal. green      D. 21 gal. blue &  $1\frac{3}{4}$  gal. green  
E. 8 gal. blue & 1 gal. green

**13.** Two tourist attractions are 9.4 centimeters (cm) apart on a map of France, and the scale on the map is 2.2 centimeters (cm) = 25 kilometers (km). Choose one of the expressions below that you would use to get the best estimate of the actual distance between the two locations.

- A.  $\frac{25}{2} \times 10$       B.  $\frac{25}{2} \times 9$       C.  $\frac{9}{2} + 25$       D.  $\frac{10}{3} \times 25$       E.  $\frac{2}{9} \times 25$

**14.** A local road map has a scale of 6 miles per inch. If the actual distance between two towns is 57 miles, how many inches apart will they be on the map?

- A. 9      B. 51      C. 5.9      D. 9.5      E. 10.5

**15.** Which expression below shows the cost of one ounce of Supersuds Laundry Powder if a 48 ounce box is on sale for \$3.29?

- A.  $48 \div \$3.29$       B.  $\$3.29 \div 48$       C.  $48 - \$3.29$       D.  $48 \times \$3.29$       E.  $48 + \$3.29$

**16.** A company has 150 clerks and 6 shift supervisors. If each clerk can produce 12 invoices in 3 hours, how many invoices can a clerk produce in an 8 hour shift?

- A. 32      B. 12.5      C. 37.5      D. 23      E. 50

**17.** A company can manufacture 525 Fluid Analyzer Machines per week when it is working under normal conditions at 95% capacity. How many Fluid Analyzer Machines per week can the company make when it is undergoing renovations and working at only 65% capacity?

- A. 341      B. 11      C. 359      D. 395      E. 314

**18.** How long will it take to polish a 120 piece silver service if it takes 30 minutes to polish 16 pieces of silver?

- A. 3 hours 75 minutes      B. 64 minutes      C. 3 hours 15 minutes  
D. 4 hours      E. 3 hours 45 minutes

**19.** If a package of 75 cups costs \$12.99, which expression shows the cost of 35 cups?

- A.  $\$12.99 \div 75$       B.  $75 \div \$12.99$       C.  $35 \times \$12.99 \div 75$   
D.  $75 \times \$12.99 \div 35$       E.  $35 \div \$12.99$

**20.** Synthesis of Formula A is in direct proportion to the amount of carbon present. If  $\frac{1}{2}$  ounce (oz) of Formula A can be synthesized from every 8 pounds (lb) of carbon, how many ounces of Formula A can be synthesized from 60 pounds of carbon?

- A. 4      B.  $3\frac{3}{4}$       C. 30      D. 960      E.  $3\frac{1}{4}$

**21.** On the floor plan of a new restaurant, the cashier/waiting area measures 6 inches wide x 12 inches long, and each inch on the floor plan equals  $2\frac{1}{2}$  feet of actual distance. What are the actual length and width of the cashier/waiting area?

- A. 30 feet x 15 feet      B. 4.8 feet x 2.4 feet      C. 30 inches x 15 inches  
D. 4.8 inches x 2.4 inches      E. 14.5 feet x 8.5 feet

**22.** If a 24-pack of pens costs \$7.99, which expression shows the cost per pen?

- A.  $\$7.99 \div 24$       B.  $24 \div \$7.99$       C.  $24 - \$7.99$       D.  $24 \times \$7.99$       E.  $24 + \$7.99$

**23.** To make 50 pounds of colored plaster it takes 7.5 ounces of tint. Which expression shows the best estimate of the number of pounds of colored plaster that can be made with 3.7 ounces of tint?

- A.  $\frac{8}{50} \times 4$       B.  $\frac{50}{8} + 4$       C.  $\frac{50}{8} \times 3$       D.  $\frac{4}{7} \times 50$       E.  $\frac{4}{8} \times 50$

**24.** There is  $\frac{3}{4}$  ounce of salt in every 12 pounds of cake mix. How many ounces of salt will be needed to make 200 pounds of cake mix?

- A.  $12\frac{1}{2}$       B.  $12\frac{3}{4}$       C. 9      D.  $16\frac{1}{2}$       E.  $16\frac{3}{4}$

**25.** A flavor formula calls for  $1\frac{1}{2}$  grams of coffee and 2 liters of water (H<sub>2</sub>O). Which of the following combinations will produce the same concentration of these two ingredients?

- A.  $\frac{1}{2}$  gram coffee & 3 liters water      B. 3 grams coffee & 6 liters water  
C.  $8\frac{1}{4}$  grams coffee & 11 liters water      D.  $2\frac{1}{2}$  grams coffee & 6 liters water  
E.  $10\frac{1}{2}$  grams coffee & 5 liters water

**26.** Old Kings Trail is 24 cm long on a trail map of Shetland Downs. If the scale on the trail map is 2 cm = 1.5 km, how long is Old Kings Trail?

- A. 32 km      B. 12 km      C. 16 km      D. 36 km      E. 18 km

**27.** If a lawyer bills her time at \$125 per hour, what is the charge for 2 hours and 45 minutes of legal time?

- A. \$306.25      B. \$250      C. \$433.75      D. \$343.75      E. \$360.25

**28.** If a worker can process 12 forms each hour, which expression shows how many hours it will take to process 450 forms?

- A.  $12 \div 450$       B.  $12 + 450$       C.  $450 - 12$       D.  $12 \times 450$       E.  $450 \div 12$

**29.** Decorative ribbon trim costs \$1.99 for 16 inches. Sacha is trimming the front side of the 8 tables she will be using at her event. If each table is 4 feet across the front side, how much will the ribbon trim cost?

- A. \$5.97      B. \$63.68      C. \$3.98      D. \$95.52      E. \$47.76

## Answer Key – Proportion Word Problems

**Practice One** – Write your ratios in fraction form.

1. A 24-piece box of candy has 6 chocolates, 5 caramels, 10 jellies, and 3 mints.

- a) What is the ratio of chocolates to caramels?  $\frac{6}{5}$
- b) What is the ratio of caramels to chocolates?  $\frac{5}{6}$
- c) What is the ratio of jellies to mints?  $\frac{10}{3}$
- d) What is the ratio of mints to total number of candies?  $\frac{3}{24}$  reduces to  $\frac{1}{8}$
- e) What is the ratio of total number of candies to chocolates?  $\frac{24}{6}$  reduces to  $\frac{4}{1}$
- f) What is the ratio of total number of candies to jellies?  $\frac{24}{10}$  reduces to  $\frac{12}{5}$   
*(Reduce the improper fraction  $\frac{24}{10}$  by hand, or reduce  $\frac{10}{24}$  on the calculator and flip the result.)*

2. Sammy played 12 games of chess and won 7 of them.

- a) What is the ratio of games won to games played?  $\frac{7}{12}$
- b) What is the ratio of games played to games won?  $\frac{12}{7}$
- c) What is the ratio of games won to games lost?  $\frac{7}{5}$   
*(The problem does not provide the number of games lost. Subtract total games minus games won to get games lost.  $12 - 7 = 5$  games lost.)*
- d) What is the ratio of games lost to games to games played?  $\frac{5}{12}$

**Practice Two** – Solve each proportion using cross multiplication.

1.  $\frac{x}{5} = \frac{24}{30}$       $5 \times 24 \div 30 = x = 4$      2.  $\frac{9}{12} = \frac{3}{x}$       $12 \times 3 \div 9 = x = 4$
3.  $\frac{5}{8} = \frac{x}{88}$       $5 \times 88 \div 8 = x = 55$      4.  $\frac{4}{x} = \frac{36}{63}$       $4 \times 63 \div 36 = x = 7$
5.  $\frac{10}{x} = \frac{25}{100}$       $10 \times 100 \div 25 = x = 40$      6.  $\frac{x}{9} = \frac{75}{45}$       $9 \times 75 \div 45 = x = 15$
7.  $\frac{9}{3} = \frac{12}{x}$       $3 \times 12 \div 9 = x = 4$      8.  $\frac{24}{80} = \frac{x}{10}$       $10 \times 24 \div 80 = x = 3$

### Practice Three

1. Remco has canned tomato sauce on sale for 5 cans for \$2. How much would it cost to buy 35 cans of sauce?

- A. \$20      B. \$9      C. **\$14**      D. \$87.50      E. \$45

$$\frac{\text{number of cans}}{\$} \quad \frac{5}{2} = \frac{35}{x} \quad \$2 \times 35 \div 5 = x = \$14 \quad \text{Answer: C. \$14}$$

**OR**

$$\frac{\$}{\text{number of cans}} \quad \frac{2}{5} = \frac{x}{35} \quad \$2 \times 35 \div 5 = x = \$14 \quad \text{Answer: C. \$14}$$

Both ways are correct and produce the same cross multiplication problem and the same answer. It doesn't matter which value is chosen for the top and bottom of the proportion, as long as it is the same throughout the problem.

The rest of the problems in the Answer Key will only show the proportion set up one way. As long as your proportion produces the same cross multiplication problem and the same answer, it is correct.

**Note** – The cross multiplication problem above is  $\$2 \times 35 \div 5 = x$ .

It could also have been written as  $35 \times \$2 \div 5 = x$ .

$\$2 \times 35$  is the same as  $35 \times \$2$ . It doesn't matter in which order you multiply the two diagonal numbers.

2. A warehouse currently stores 5,200 manufactured units using 65% of its storage capacity. How many units can it store when using 100% of its storage capacity?

- A. 3,380      B. **8,000**      C. 338,000      D. 800      E. 80,000

$$\frac{\% \text{ storage capacity}}{\text{units stored}} \quad \frac{65}{5,200} = \frac{100}{x} \quad 100 \times 5,200 \div 65 = x = 8,000$$

**Answer: B. 8,000 units**

3. A case of candy containing 300 pieces is on sale for \$5.99. How much will 24,000 pieces of candy cost?

- A. \$47.92      B. \$1,797.00      C. \$4,006.67      D. \$400.67      E. **\$479.20**

$$\frac{\$}{\text{pieces of candy}} \quad \frac{5.99}{300} = \frac{x}{24,000} \quad \$5.99 \times 24,000 \div 300 = x = \$479.20$$

**Answer: E. \$479.20**

4. The weight of a shipment of granola bars is directly proportional to the number of packages in the shipment. If 8 packages of granola bars weigh 5 pounds, what is the weight in pounds of a shipment of 300 packages?

- A. 480      **B. 187.5**      C. 1,500      D. 2,400      E. 1,875

$$\frac{\text{packages}}{\text{pounds}} \quad \frac{8}{5} = \frac{300}{x} \quad 5 \times 300 \div 8 = x = 187.5 \quad \text{Answer: B. 187.5 Pounds}$$

5. To make Powerzone cleaning solution, the directions say to use  $\frac{1}{2}$  cup of Powerzone powder for 20 ounces of water. How many cups of powder will be used with 70 ounces of water?

- A.  $1 \frac{3}{4}$       B.  $1 \frac{1}{4}$       C. 25      D. 10      E.  $1 \frac{1}{2}$

$$\frac{\text{cups of powder}}{\text{ounces of water}} \quad \frac{\frac{1}{2}}{20} = \frac{x}{70} \quad 70 \times \frac{1}{2} \div 20 = x = 1.75 \quad \text{Answer: A. } 1 \frac{3}{4} \text{ cups}$$

**Note** – you will probably get 1.75 on your calculator. Your answer choices are expressed in fractions, so 1.75 needs to be converted to a fraction. You should know that  $.75 = \frac{3}{4}$ , just like in money, 75 cents is the same as 3 quarters.

**Tip** – Memorize these fraction/decimal conversions if you don't already know them.

$$\frac{3}{4} = 0.75$$

$$\frac{1}{2} = 0.50$$

$$\frac{1}{4} = 0.25$$

6. A factory that manufactures a patented metal alloy produces 327 liters of liquid waste for every 2 million kilograms of the alloy that are made. How many liters of liquid waste are produced when 6.5 million kilograms of alloy are made?

- A. 2,125.5      B. 100.62      C. 654      **D. 1,062.75**      E. 2,779.50

$$\frac{\text{liters of waste}}{\text{million kilograms of alloy}} \quad \frac{327}{2} = \frac{x}{6.5} \quad 6.5 \times 327 \div 2 = x = 1,062.75$$

**Answer: D. 1,062.75 liters**

### Practice Four

1. The distance between Leo's house and his daughter's college is 325 kilometers (km), and on a map that shows both locations, 3 centimeters (cm) equals 25 kilometers (km). On the map, how many centimeters apart are Leo's house and the college?

- A. 13      **B. 39**      C. 100      D. 75      E. 117

$$\frac{\text{actual distance in km}}{\text{cm on map}} \quad \frac{25}{3} = \frac{325}{x} \quad 325 \times 3 \div 25 = x = 39$$

**Answer: B. 39 centimeters**

2. The distance on a local map between Rob's house and his job is 5 inches. If 2 inches represents 3 miles on the map, how many miles is Rob's house from his job?  
 A. 7.5                      B. 75                      C. 3.3                      D. 15                      E. 10

$$\frac{\text{inches on map}}{\text{actual miles}} \frac{2}{3} = \frac{5}{x} \quad 3 \times 5 \div 2 = x = 7.5 \quad \text{Answer: A. 7.5 miles}$$

3. Kayla is painting a large wall mural and will plan out the design and colors on a grid. The mural will be 40 feet long and 15 feet wide. 5 feet on the mural is equivalent to 3 units on the grid. What are the dimensions of the mural on the grid?  
 A. 24 units by 9 units                      B. 67 units by 25 units                      C. 13 units by 8 units  
 D. 120 units by 45 units                      E. 120 units by 75 units

$$\text{LENGTH: } \frac{\text{units on grid}}{\text{actual feet}} \frac{3}{5} = \frac{x}{40} \quad 3 \times 40 \div 5 = x = 24 \quad \text{Length} = 24 \text{ units}$$

$$\text{WIDTH: } \frac{\text{units on grid}}{\text{actual feet}} \frac{3}{5} = \frac{x}{15} \quad 3 \times 15 \div 5 = x = 9 \quad \text{Width} = 9 \text{ units}$$

**Answer: A. 24 units by 9 units**

A common mistake in problems like this is to use length and width as the two related values for the first ratio of the proportion. Remember that in scale problems, the two related values are almost always the two scale measurements, which in this problem are units on the grid and actual feet.

4. A new hotel ballroom will measure 60 meters long and 42 meters wide, and a scale model will be built to use in mapping out different floor plan arrangements. Each centimeter (cm) on the scale model is equal to 2 meters (m) of actual distance. What will the length and width of the ballroom be on the scale model?  
 A. 120 cm by 84 cm                      B. 60 cm by 42 cm                      C. 58 cm by 40 cm  
 D. 30 cm by 30 cm                      E. 30 cm by 21 cm

$$\text{LENGTH: } \frac{\text{cm on model}}{\text{actual m}} \frac{1}{2} = \frac{x}{60} \quad 60 \times 1 \div 2 = x = 30 \quad \text{Length} = 30 \text{ cm}$$

$$\text{WIDTH: } \frac{\text{cm on model}}{\text{actual m}} \frac{1}{2} = \frac{x}{42} \quad 42 \times 1 \div 2 = x = 21 \quad \text{Width} = 21 \text{ cm}$$

**Answer: E. 30 cm by 21 cm**

The two related values are 1 cm on the model and 2 m of actual distance. Note that it says each cm in the problem, not 1 cm. You have to realize that each means 1 even though the number 1 is not stated.

5. A detailed diagram of an airplane is drawn to scale, with each inch on the diagram equivalent to 5 feet of length on the airplane. If the wingspan is 25 inches long on the diagram, how many feet long is the actual wingspan of the airplane?

- A. 5                      B. 30                      C. **125**                      D. 152                      E. 20

$$\frac{\text{inches on diagram}}{\text{actual feet}} \frac{1}{5} = \frac{25}{x} \quad 25 \times 5 \div 1 = x = 125 \quad \text{Answer: C. 125 feet}$$

### **Practice Five**

1. Ebony charges \$11 per hour to babysit 2 children. If Mrs. Parks needs a sitter for 3 hours and 15 minutes for her 2 children, how much will she have to pay Ebony?

- A. \$34.65              B. \$69.30              C. **\$35.75**              D. \$71.50              E. \$37.55

First, convert 3 hours 15 minutes to 3.25 hours. You may recognize that this problem can be solved by multiplying \$11 per hour times 3.25 hours.

$$\$11 \times 3.25 = \mathbf{\$35.75}$$

If you're not sure what to do, set up a proportion. Note that \$11 per hour means \$11 for 1 hour. Also note that the number of children is extra information and does not enter into the calculation.

$$\frac{\$}{\text{hours}} \frac{11}{1} = \frac{x}{3.25} \quad \$11 \times 3.25 \div 1 = x = \$35.75 \quad \text{Answer: C. \$35.75}$$

2. Celine can make 36 party favors per hour. How many party favors can she make in 45 minutes?

- A. 16                      B. 1,620                      C. 81                      D. **27**                      E. 72

Solve using hours.

**OR**

Solve using minutes.

$$\frac{\text{party favors}}{\text{hours}} \frac{36}{1} = \frac{x}{0.75}$$

$$\frac{\text{party favors}}{\text{minutes}} \frac{36}{60} = \frac{x}{45}$$

$$36 \times 0.75 \div 1 = x = 27$$

$$36 \times 45 \div 60 = x = 27$$

**Answer: D. 27 party favors**

**Answer: D. 27 party favors**

3. It takes a team of 8 workers 2 hours and 15 minutes to clean 12 apartments. How many apartments can the team clean in 9 hours?

- A. 50                      B. **48**                      C. 43                      D. 45                      E. 24

First, convert 2 hours and 15 minutes to 2.25 hours.

Note that the value 8 workers is extra information and is not part of the calculation.

$$\frac{\text{hours}}{\text{apartments}} \frac{2.25}{12} = \frac{9}{x} \quad 12 \times 9 \div 2.25 = x = 48 \quad \text{Answer: B. 48 apartments}$$



4. How many hours will it take to correct 20 essays if the teacher can correct 2 essays every 15 minutes?

- A. 150 hours                      B. 2 hours 50 minutes                      C. 1 hour 30 minutes  
D. 130 hours                      E. **2 hours 30 minutes**

Note that you are given minutes, but the answer is asked for in hours. Convert the 15 minutes to 0.25 hours and then set up the proportion. Convert the .5 part of the 2.5 answer to 30 minutes.

$$\frac{\text{hours}}{\text{essays}} \frac{0.25}{2} = \frac{x}{20} \quad 20 \times 0.25 \div 2 = x = 2.5 \quad \text{Answer: E. 2 hours 30 minutes}$$

**Be careful** – 2.5 hours is 2 hours 30 minutes; **it is not** 2 hours 50 minutes

### Practice Six

1. Which expression below can be used to find the cost of a single marble if a bag of 75 marbles is sold for \$5.75?

- A.  $75 \times \$5.75$                       B.  **$\$5.75 \div 75$**                       C.  $75 - \$5.75$   
D.  $75 \div \$5.75$                       E.  $75 + \$5.75$

$$\frac{\text{marbles}}{\$} \frac{75}{5.75} = \frac{1}{x} \quad \$5.75 \times 1 \div 75 \text{ is the cross multiplication expression.}$$

It can be shortened to  **$\$5.75 \div 75$**  because  $\$5.75 \times 1$  is the same as  $\$5.75$ .

**Answer: B.  $\$5.75 \div 75$**

Note that the problem says “a single marble.” This is 1 marble, so use 1 in your proportion, even though the number 1 is not stated in the problem. It could also have said “per marble,” “each marble,” or “a marble.” These also mean 1 marble.

2. If 3 bottles of shampoo cost \$5, which expression shows how much 8 bottles of shampoo will cost?

- A.  **$8 \times \$5 \div 3$**     B.  $\$5 \times 3 \div 8$     C.  $(3 + 8) \times \$5$     D.  $(3 + 8) \div \$5$     E.  $8 \times 3 \div \$5$

$$\frac{\text{bottles}}{\$} \frac{3}{5} = \frac{8}{x}$$

The cross multiplication expression is:

$$\$5 \times 8 \div 3 \quad \text{or} \quad \mathbf{8 \times \$5 \div 3} \quad \text{Answer: A. } \mathbf{8 \times \$5 \div 3}$$

**3.** Langley Party Supply is having a sale on bulk packages of paper plates. Each package of 200 paper plates is on sale for \$1.79. Which of the following expressions could be used to calculate the cost in dollars of 1,800 paper plates?

A.  $\frac{1,800}{\$1.79} \times 200$

B.  $\frac{\$1.79}{200} + 1,800$

C.  $\frac{\$1.79}{200} \times 1,800$

D.  $\frac{1,800}{200} + \$1.79$

E.  $\frac{\$1.79}{1,800} - 200$

$$\frac{\text{plates}}{\$} \frac{200}{1.79} = \frac{1,800}{x}$$

The cross multiplication expression is:

$$\$1.79 \times 1,800 \div 200 \quad \text{or} \quad 1,800 \times \$1.79 \div 200$$

All the answer choices are in a form that includes a fraction instead of a division sign, so you must figure out which of the answer choices is the same as one of your cross multiplication expressions. Use either the scan for correct fraction method or the calculation method.

**Method One – Scan answers choices for the correct fraction multiplied by the correct third number.**

$\$1.79 \times 1,800 \div 200$     Look for  $\frac{1,800}{200}$  multiplied  $\times$  \$1.79. Not found.

$1,800 \times \$1.79 \div 200$     Look for  $\frac{\$1.79}{200}$  multiplied  $\times$  1,800.

**Answer: C.  $\frac{\$1.79}{200} \times 1,800$**

**Method Two – Calculation.** Calculate the value of your answer. Then calculate the value of each multiple choice answer until you find one that is equal to your answer.

Calculate the value of your answer:  $\$1.79 \times 1,800 \div 200 = \$16.11$

Try A.  $\frac{1,800}{\$1.79} \times 200 = \$201,117$     **Does not** = \$16.11, so **is not** correct.

Try B.  $\frac{\$1.79}{200} + 1,800 = \$1,800$     **Does not** = \$16.11, so **is not** correct.

Try C.  $\frac{\$1.79}{200} \times 1,800 = \$16.11$     **Does** = \$16.11, so **is** correct.

**Answer: C.  $\frac{\$1.79}{200} \times 1,800$**

**Shortcut** – You may have noticed that 1,800 plates is 9 times as big as 200 plates, so the price will also be 9 times as big.  $9 \times \$1.79 = \$16.11$ . Check multiple choice answers for a match, as just shown in method two.

4. A family has driven 225 miles in 4 ½ hours. If they continue driving at the same rate, which expression shows how long it will take to drive the next 400 miles of their trip?

- A.  $\frac{225}{400} \times 4.5$     B.  $\frac{4.5}{225} + 400$     C.  $\frac{400}{225} + 4.5$     D.  $\frac{400}{4.5} \times 225$     E.  $\frac{400}{225} \times 4.5$

$$\frac{\text{miles}}{\text{hours}} \frac{225}{4.5} = \frac{400}{x}$$

The cross multiplication expression is:

$$400 \times 4.5 \div 225 \quad \text{or} \quad 4.5 \times 400 \div 225$$

All the answer choices are in a form that includes a fraction instead of a division sign, so you must figure out which of the answer choices is the same as one of your cross multiplication expressions. Use either the scan for correct fraction method or the calculation method.

**Method One – Scan answer choices for the correct fraction multiplied by the correct third number.**

$400 \times 4.5 \div 225$     Look for  $\frac{4.5}{225}$  multiplied  $\times 400$ . Not found.

$4.5 \times 400 \div 225$     Look for  $\frac{400}{225}$  multiplied  $\times 4.5$ . **Answer: E.  $\frac{400}{225} \times 4.5$**

**Method Two – Calculation.** Calculate the value of your answer. Then calculate the value of each multiple choice answer until you find one that is equal to your answer.

Calculate the value of your answer:  $4.5 \times 400 \div 225 = 8$

Try A.  $\frac{225}{400} \times 4.5 = 2.53$     **Does not = 8, so is not correct.**

Try B.  $\frac{4.5}{225} + 400 = 400$     **Does not = 8, so is not correct.**

Try C.  $\frac{400}{225} + 4.5 = 6.28$     **Does not = 8, so is not correct.**

Try D.  $\frac{400}{4.5} \times 225 = 20,000$     **Does not = 8, so is not correct**

Try E.  $\frac{400}{225} \times 4.5 = 8$     **Does = 8, so is correct**

**Answer: E.  $\frac{400}{225} \times 4.5$**

5. A person can type 1,950 words in 30 minutes. At the same rate, which expression shows how many words per minute the person can type?

- A.  $1,950 \div 30$    B.  $30 \div 1,950$    C.  $1,950 - 30$    D.  $1,950 \times 30$    E.  $1,950 + 30$

$$\frac{\text{words}}{\text{minutes}} \quad \frac{1,950}{30} = \frac{x}{1}$$

$1,950 \times 1 \div 30$  is the cross multiplication expression.

It can be shortened to  $1,950 \div 30$  because

$1,950 \times 1$  is the same as 1,950.

**Answer: A.  $1,950 \div 30$**

The time given and the time asked for in the question are both in minutes, so no time conversion is needed.

Note that the problem says “per minute.” You have to recognize that this is 1 minute, and use the number 1 in your proportion, even though the number 1 is not stated.

### Practice Seven

1. A home recipe for a cleaning liquid calls for  $\frac{3}{4}$  ounce of ammonia ( $\text{NH}_4$ ) for every 3 cups of water ( $\text{H}_2\text{O}$ ). Which combination below will make the cleaning liquid with the correct concentration?

- A.  $\frac{1}{4}$  ounce ammonia & 4 cups water      B.  $\frac{1}{2}$  ounce ammonia & 4 cups water  
C.  $1 \frac{1}{4}$  ounces ammonia & 6 cups water      D.  **$1 \frac{1}{2}$  ounces ammonia & 6 cups water**  
E.  $1 \frac{3}{4}$  ounces ammonia & 5 cups water

In this type of problem, the question provides the first ratio of a proportion, and the answer choices are five possibilities for the second ratio of the proportion. Remember that both ratios in a proportion are equal so both will simplify to the same number.

**Step 1** – Simplify the first ratio of the proportion that is given in the problem.

$$\text{You are given: } \frac{\text{oz of NH}_4}{\text{cups of H}_2\text{O}} \quad \frac{\frac{3}{4}}{3} \quad 0.75 \div 3 = 0.25$$

**Step 2** – Find one of the answer choices that also simplifies to 0.25 and you will have found the other half of your proportion.

$$\text{Try A. } \frac{\text{NH}_4}{\text{H}_2\text{O}} \quad \frac{\frac{1}{4}}{4} \quad 0.25 \div 4 = 0.0625 \quad \text{Does not simplify to 0.25, so is not correct.}$$

$$\text{Try B. } \frac{\text{NH}_4}{\text{H}_2\text{O}} \quad \frac{\frac{1}{2}}{4} \quad 0.5 \div 4 = 0.125 \quad \text{Does not simplify to 0.25, so is not correct.}$$

$$\text{Try C. } \frac{\text{NH}_4}{\text{H}_2\text{O}} \quad \frac{1 \frac{1}{4}}{6} \quad 1.25 \div 6 = 0.2083 \quad \text{Does not simplify to 0.25, so is not correct.}$$

$$\text{Try D. } \frac{\text{NH}_4}{\text{H}_2\text{O}} \quad \frac{1 \frac{1}{2}}{6} \quad 1.5 \div 6 = 0.25 \quad \text{Does simplify to 0.25, so is correct.}$$

**Answer: D.  $1 \frac{1}{2}$  ounces ammonia & 6 cups water**

2. Notebooks are on sale at \$3.29 for a 4-pack. If each of the 5 Dawson children needs 8 notebooks for school, how much will all of the notebooks cost?  
 A. \$6.58      **B. \$32.90**      C. \$48.63      D. \$16.45      E. \$26.32

$$\frac{\text{notebooks}}{\text{cost in \$}} \quad \frac{4}{3.29} = \frac{40}{x} \quad 40 \times \$3.29 \div 4 = x = \$32.90 \quad \text{Answer: B. \$32.90}$$

Calculate the total number of notebooks needed in order to get the number for the second ratio. 5 children x 8 notebooks per child = 40 total notebooks.

The two related values are number of notebooks and cost. That is the relationship given in the problem (4 notebooks for \$3.29) and it is also what is asked for in the question (all of the notebooks for how many \$).

**Shortcut** – You may have noticed 40 notebooks are needed, and 40 is 10 times bigger than a 4-pack of notebooks, so the price will also be 10 times bigger.  
 $10 \times \$3.29 = \$32.90$ . **Answer: B. \$32.90**

3. Marie charges \$10 per hour to babysit 2 children and \$12 per hour to babysit 3 children. How much will she charge to babysit for 4 hours and thirty minutes if a family has 3 children?  
 A. \$45      B. \$51.6      C. \$43      D. \$16.45      **E. \$54**

The related values are \$ and number of hours. The \$10 per hour for 2 children is extra information that is not needed to solve the problem. Choose the \$12 rate because the family has 3 children. Convert 4 hours thirty minutes to 4.5 hours.

You may recognize that this is a multiplication problem:  
 $\$12 \text{ per hour} \times 4.5 \text{ hours} = \mathbf{\$54}$ .

If you don't see that and are not sure what to do, set up a proportion.

$$\frac{\text{Hours}}{\$} \quad \frac{1}{12} = \frac{4.5}{x} \quad \$12 \times 4.5 \div 1 = x = \$54 \quad \text{Answer: E. \$54}$$

4. Every 4 days, Ayala spends  $\frac{1}{2}$  hour grooming her dog. Which combination below shows the same relationship between days and grooming time?

- A. 8 days &  $\frac{1}{4}$  hour of grooming  
B. 9 days &  $\frac{3}{4}$  hours grooming  
C. **12 days & 1  $\frac{1}{2}$  hours of grooming**  
D. 5 days &  $\frac{1}{4}$  hour grooming  
E. 7 days & 1 hour of grooming

In this type of problem, the question provides the first ratio of a proportion, and the answer choices provide five possibilities for the second ratio of the proportion. Remember that both ratios in a proportion are equal so both will simplify to the same number.

**Step 1** – Simplify the first ratio of the proportion that is given in the problem.

$$\text{You are given: } \frac{\text{days}}{\text{grooming hrs}} \quad \frac{4}{\frac{1}{2}} \quad 4 \div 0.5 = 8$$

**Step 2** – Find one of the answer choices that also simplifies to 8 and you will have found the other half of your proportion.

$$\text{Try A. } \frac{\text{days}}{\text{hrs}} \quad \frac{8}{\frac{1}{4}} \quad 8 \div 0.25 = 32 \quad \text{Does not simplify to 8, so is not correct.}$$

$$\text{Try B. } \frac{\text{days}}{\text{hrs}} \quad \frac{9}{\frac{3}{4}} \quad 9 \div 0.75 = 12 \quad \text{Does not simplify to 8, so is not correct.}$$

$$\text{Try C. } \frac{\text{days}}{\text{hrs}} \quad \frac{12}{1 \frac{1}{2}} \quad 12 \div 1.5 = 8 \quad \text{Does simplify to 8, so is correct.}$$

**Answer: C. 12 days & 1  $\frac{1}{2}$  hours of grooming**

5. A company needs 3.2 feet of copper to manufacture 40 Model X switches. If the company has 26.4 feet of copper left in stock, which expression will provide the best estimate of the number of Model X switches the company can make?

- A.  $\frac{40}{3} \times 27$       B.  $\frac{3}{26} \times 40$       C.  $\frac{4}{40} \times 27$       D.  $\frac{26}{3} \times 40$       E.  $\frac{26}{4} \times 40$

The problem asks for the best estimate, so numbers will be rounded.

3.2 rounds down to 3 because 2 is less than 5.

26.4 rounds down to 26 because 4 is less than 5.

$$\frac{\text{ft. of copper}}{\text{switches}} \quad \frac{3.2}{40} = \frac{26.4}{x} \quad \rightarrow \quad \frac{3}{40} = \frac{26}{x} \quad \text{The cross multiplication expression is:}$$

$$40 \times 26 \div 3 \quad \text{or} \quad 26 \times 40 \div 3$$

All the answer choices are in a form that includes a fraction instead of a division sign, so you must figure out which of the answer choices is the same as one of your cross multiplication expressions. Use either the scan for correct fraction method or the calculation method.

**Method One – Scan answer choices for the correct fraction multiplied by the correct third number.**

$$40 \times 26 \div 3 \quad \text{Look for } \frac{26}{3} \text{ multiplied } \times 40. \quad \text{Answer: D. } \frac{26}{3} \times 40$$

The answer has been found so you don't need to check the other cross multiplication expression, but if you do, you won't find a match.

$$26 \times 40 \div 3 \quad \text{Look for } \frac{40}{3} \text{ multiplied } \times 26. \quad \text{Not found.}$$

**Method Two – Calculation.** Calculate the value of your answer. Then calculate the value of each multiple choice answer until you find one that is equal to your answer.

Calculate the value of your answer:  $40 \times 26 \div 3 = 346.67$

$$\text{Try A. } \frac{40}{3} \times 27 = 360 \quad \text{Does not} = 346.67, \text{ so is not correct.}$$

$$\text{Try B. } \frac{3}{26} \times 40 = 4.62 \quad \text{Does not} = 346.67, \text{ so is not correct.}$$

$$\text{Try C. } \frac{4}{40} \times 27 = 2.7 \quad \text{Does not} = 346.67, \text{ so is not correct.}$$

$$\text{Try D. } \frac{26}{3} \times 40 = 346.67 \quad \text{Does} = 346.67, \text{ so is correct.}$$

$$\text{Answer: D. } \frac{26}{3} \times 40$$

6. On a map of Europe where the scale reads 1.8 centimeters (cm) = 20 kilometers (km), two towns are measured to be 12.6 centimeters apart. Choose the expression below that you would use to get the best estimate of how many kilometers there are between the two towns.

- A.  $\frac{20}{2} \times 12$       B.  $\frac{20}{13} \times 2$       C.  $\frac{13}{2} \times 20$       D.  $\frac{2}{12} \times 20$       E.  $\frac{13}{1} \times 20$

The problem asks for the best estimate, so numbers will be rounded.

12.6 cm rounds up to 13 cm.

1.8 cm rounds up to 2 cm.

$$\frac{\text{actual km}}{\text{cm on map}} \frac{20}{1.8} = \frac{x}{12.6} \rightarrow \frac{20}{2} = \frac{x}{13} \quad \text{The cross multiplication expression is:}$$

$$13 \times 20 \div 2 \quad \text{or} \quad 20 \times 13 \div 2.$$

All the answer choices are in a form that includes a fraction instead of a division sign, so you must figure out which of the answer choices is the same as one of your cross multiplication expressions. Use either the scan for correct fraction method or the calculation method.

**Method One – Scan answer choices for the correct fraction multiplied by the correct third number.**

$13 \times 20 \div 2$       Look for  $\frac{20}{2}$  multiplied x 13. Not found.

$20 \times 13 \div 2$       Look for  $\frac{13}{2}$  multiplied x 20. **Answer: C.  $\frac{13}{2} \times 20$**

**Method Two – Calculation.** Calculate the value of your answer. Then calculate the value of each multiple choice answer until you find one that is equal to your answer.

Calculate the value of your answer:  $13 \times 20 \div 2 = 130$

Try A.  $\frac{20}{2} \times 12 = 120$       **Does not** = 130, so **is not** correct.

Try B.  $\frac{20}{13} \times 2 = 3.08$       **Does not** = 130, so **is not** correct.

Try C.  $\frac{13}{2} \times 20 = 130$       **Does** = 130, so **is** correct.

**Answer: C.  $\frac{13}{2} \times 20$**



## Proportion Word Problems – Test

1. A scientist tracks the flight of the birds he is studying and finds that they can fly 60 kilometers in  $1\frac{1}{2}$  hours. At the same rate, how long will it take the birds to fly 200 kilometers?

- A. 90 hours    **B. 5 hours**    C. 40 hours    D. 3.3 hours    E. 50 hours

$$\frac{\text{km}}{\text{hours}} \quad \frac{60}{1\frac{1}{2}} = \frac{200}{x} \quad 1\frac{1}{2} \times 200 \div 60 = x = 5 \quad \text{Answer: B. 5 hours}$$

2. A salesman has driven 150 miles in  $3\frac{1}{2}$  hours. If he continues driving at the same rate, which expression shows how long it will take to drive the final 95 miles of his trip?

- A.  $\frac{150}{95} \times 3.5$     B.  $\frac{95}{150} + 3.5$     **C.  $\frac{95}{150} \times 3.5$**     D.  $\frac{95}{3.5} \times 150$     E.  $\frac{3.5}{150} + 95$

$$\frac{\text{miles}}{\text{hours}} \quad \frac{150}{3.5} = \frac{95}{x} \quad \text{The cross multiplication expression is:}$$
$$3.5 \times 95 \div 150 \quad \text{or} \quad 95 \times 3.5 \div 150$$

All the answer choices are in a form that includes a fraction instead of a division sign, so you must figure out which of the answer choices is the same as one of your cross multiplication expressions. Use either the scan for correct fraction method or the calculation method.

**Method One – Scan answer choices for the correct fraction multiplied by the correct third number.**

$$3.5 \times 95 \div 150 \quad \text{Look for } \frac{95}{150} \text{ multiplied } \times 3.5. \quad \text{Answer: C. } \frac{95}{150} \times 3.5$$

You can check the other cross multiplication expression, but you don't need to since you have already found the answer.

$$95 \times 3.5 \div 150 \quad \text{Look for } \frac{3.5}{150} \text{ multiplied } \times 95. \text{ Not found.}$$

**Method Two – Calculation.** Calculate the value of your answer. Then calculate the value of each multiple choice answer until you find one that is equal to your answer.

$$\text{Calculate the value of your answer: } 3.5 \times 95 \div 150 = 2.2$$

$$\text{Try A. } \frac{150}{95} \times 3.5 = 5.5 \quad \text{Does not} = 2.2, \text{ so is not correct.}$$

$$\text{Try B. } \frac{95}{150} + 3.5 = 4.1 \quad \text{Does not} = 2.2, \text{ so is not correct.}$$

$$\text{Try C. } \frac{95}{150} \times 3.5 = 2.2 \quad \text{Does} = 2.2, \text{ so is correct.} \quad \text{Answer: C. } \frac{95}{150} \times 3.5$$

**3.** In a survey of 450 students at a large university, 343 said they are likely to rent textbooks instead of buying them. Based on this survey, how many of the 12,000 total students at the university would you predict are likely to buy textbooks instead of renting them?

- A. 9,147      **B. 2,853**      C. 3,743      D. 11,207      E. 2,538

$$\frac{\text{students}}{\text{students likely to rent}} = \frac{450}{343} = \frac{12,000}{x} \quad 343 \times 12,000 \div 450 = x = 9,146.67$$

rounds to 9,147

You have just calculated the number of students that are likely to rent, but the question asks how many students are likely to **buy**. Subtract from the total to get the number of students who are likely to buy.

$$12,000 - 9,147 = 2,853 \quad \text{Answer: B. 2,853 students}$$

**Note** – This is tricky not only because it requires an extra step, but also because all three numbers that you are given are numbers of students. Remember to keep the related numbers together in the same ratio.

First ratio: 450 students is related to 343 students because both refer to just the students in the survey. These two numbers make up the first ratio.

Second ratio: 12,000 students is related to the unknown number because both refer to all the students at the university. These two values make up the second ratio.

**4.** The Farm Co-op recommends planting 56 fruit trees per  $\frac{1}{2}$  acre. Which of the following will result in the same proportion of trees per acre?

- A. 150 trees &  $1\frac{1}{2}$  acres      **B. 84 trees &  $\frac{3}{4}$  acre**      C. 40 trees &  $\frac{1}{4}$  acre  
D. 300 trees & 3 acres      E. 100 trees &  $\frac{3}{4}$  acre

In this type of problem, the question provides the first ratio of a proportion, and the answer choices provide five possibilities for the second ratio of the proportion. Remember that both ratios in a proportion are equal so both will simplify to the same number.

**Step 1** – Simplify the first ratio of the proportion that is given in the problem.

$$\text{You are given } \frac{\text{trees}}{\text{acres}} = \frac{56}{\frac{1}{2}} \quad \text{Divide to simplify: } 56 \div 0.5 = 112$$

**Step 2** – Find one of the answer choices that also simplifies to 112 and you will have found the other half of your proportion.

$$\text{Try A. } \frac{\text{trees}}{\text{acres}} = \frac{150}{1\frac{1}{2}} \quad 150 \div 1.5 = 100 \quad \text{Does not simplify to 112, so is not correct.}$$

$$\text{Try B. } \frac{\text{trees}}{\text{acres}} = \frac{84}{\frac{3}{4}} \quad 84 \div 0.75 = 112 \quad \text{Does simplify to 112, so is correct.}$$

**Answer: B. 84 trees &  $\frac{3}{4}$  acre**

5. The cost to outfit 12 students with band uniforms is \$425. How much will it cost to buy uniforms for all 40 students that are in the band?

- A. \$5,100      B. \$4,117      C. \$1,275      **D. \$1,417**      E. \$1,500

$$\frac{\text{cost}}{\text{students}} \quad \frac{425}{12} = \frac{x}{40} \quad \$425 \times 40 \div 12 = x = \$1,416.67 \quad \text{Answer: D. \$1,417}$$

6. 12 grams of flavor powder concentrate are used for every 65 liters of grape soda. Which expression shows how many grams of flavor powder concentrate will be needed to make 450 liters of grape soda?

- A.  $\frac{450}{65} \div 12$       B.  $\frac{12}{65} + 450$       C.  $\frac{65}{12} \times 450$       **D.  $\frac{12}{65} \times 450$**       E.  $\frac{65}{450} \times 12$

$$\frac{\text{grams of powder}}{\text{liters of soda}} \quad \frac{12}{65} = \frac{x}{450} \quad \text{The cross multiplication expression is:}$$

$$12 \times 450 \div 65 \quad \text{or} \quad 450 \times 12 \div 65$$

All the answer choices are in a form that includes a fraction instead of a division sign, so you must figure out which of the answer choices is the same as one of your cross multiplication expressions. Use either the scan for correct fraction method or the calculation method.

**Method One – Scan answer choices for the correct fraction multiplied by the correct third number.**

$$12 \times 450 \div 65 \quad \text{Look for } \frac{450}{65} \text{ multiplied } \times 12. \text{ Not found.}$$

$$450 \times 12 \div 65 \quad \text{Look for } \frac{12}{65} \text{ multiplied } \times 450. \text{ Answer: D. } \frac{12}{65} \times 450$$

**Method Two – Calculation.** Calculate the value of your answer. Then calculate the value of each multiple choice answer until you find one that is equal to your answer.

$$\text{Calculate the value of your answer: } 12 \times 450 \div 65 = 83.08$$

$$\text{Try A. } \frac{450}{65} \div 12 = 0.58 \quad \text{Does not} = 83.08, \text{ so is not correct.}$$

$$\text{Try B. } \frac{12}{65} + 450 = 450.18 \quad \text{Does not} = 83.08, \text{ so is not correct.}$$

$$\text{Try C. } \frac{65}{12} \times 450 = 2437.5 \quad \text{Does not} = 83.08, \text{ so is not correct.}$$

$$\text{Try D. } \frac{12}{65} \times 450 = 83.08 \quad \text{Does} = 83.08, \text{ so is correct.}$$

$$\text{Answer: D. } \frac{12}{65} \times 450$$

7. In a survey of 450 voters in Boone County, 65 said they would vote No on ballot question #1. How many of the 16,500 voters in Boone County do you predict will vote No on ballot question #1, based on these survey results?

- A. **2,383**      B. 254      C. 385      D. 2,833      E. 238

$$\frac{\text{voters}}{\text{\# of No votes}} \quad \frac{450}{65} = \frac{16,500}{x} \quad 65 \times 16,500 \div 450 = x = 2,383.3$$

**Answer: A. 2,383 voters**

8. On the blueprints for a house,  $\frac{1}{4}$  inch is equal to 1 foot. What are the dimensions on the blueprint of a room with actual measurements of 30 feet long and 20 feet wide?

- A. 8 inches by 4 inches      B. 50 inches by 10 inches      C. 15 inches by 10 inches  
**D. 7.5 inches by 5 inches**      E. 60 inches by 40 inches

$$\text{LENGTH: } \frac{\text{actual feet}}{\text{inches on blueprint}} \quad \frac{1}{\frac{1}{4}} = \frac{30}{x} \quad 30 \times \frac{1}{4} \div 1 = x = 7.5$$

Length = 7.5 inches

$$\text{WIDTH: } \frac{\text{actual feet}}{\text{inches on blueprint}} \quad \frac{1}{\frac{1}{4}} = \frac{20}{x} \quad 20 \times \frac{1}{4} \div 1 = x = 5$$

Width = 5 inches

**Answer: D. 7.5 inches long by 5 inches wide**

9. At New You Yoga School, there are currently 353 students enrolled, which corresponds to 72% of maximum enrollment. How many more students would the school need to sign up to reach their goal of 95% enrollment?

- A. 466      B. 335      **C. 113**      D. 265      E. 268

$$\frac{\% \text{ enrollment}}{\text{students}} \quad \frac{72}{353} = \frac{95}{x} \quad 353 \times 95 \div 72 = x = 465.76$$

rounds up to 466

466 is the number of students the school will have at 95% enrollment. The question asks how many **more** students are needed to reach this goal.

Subtract: goal – current students     $466 - 353 = 113$

**Answer: C. 113 more students**

10. If a school system can purchase a bulk package of 500 workbooks for \$195, what is the cost per workbook?

- A. \$3.90      B. \$2.56      **C. \$0.39**      D. \$0.49      E. \$0.93

$$\frac{\text{workbooks}}{\text{cost}} \quad \frac{500}{195} = \frac{1}{x} \quad \$195 \times 1 \div 500 = x = \$0.39 \quad \text{Answer: C. \$0.39}$$

**11.** How many patterns can a machine cut in 15 minutes, if it is set to cut 32 patterns per hour?

- A. 2.13                  B. 4.8                  C. 16                  D. 48                  E. 8

$$\frac{\text{minutes}}{\text{patterns}} \frac{60}{32} = \frac{15}{x} \quad 15 \times 32 \div 60 = x = 8 \quad \text{Answer: E. 8 patterns}$$

**OR**

$$\frac{\text{hours}}{\text{patterns}} \frac{1}{32} = \frac{0.25}{x} \quad 0.25 \times 32 \div 1 = x = 8 \quad \text{Answer: E. 8 patterns}$$

**Shortcut** – If you see that there are four 15 minute periods in 1 hour, divide the 32 patterns in 1 hour by 4.  $32 \div 4 = 8$       **Answer: E. 8 patterns**

**12.** The formula to make Ocean Blue paint calls for 6 gallons of blue paint and  $\frac{1}{2}$  gallon of green paint. Which of the following combinations will correctly produce Ocean Blue paint?

- A. 12 gal. blue &  $\frac{3}{4}$  gal. green                  B. 15 gal. blue & 2 gal. green  
 C. 4 gal. blue &  $\frac{1}{4}$  gal. green                  **D. 21 gal. blue &  $1 \frac{3}{4}$  gal. green**  
 E. 8 gal. blue & 1 gal. green

In this type of problem, the question provides the first ratio of a proportion, and the answer choices provide five possibilities for the second ratio of the proportion. Remember that both ratios in a proportion are equal so both will simplify to the same number.

**Step 1** – Simplify the first ratio of the proportion that is given in the problem.

You are given:  $\frac{\text{blue}}{\text{green}} \frac{6}{\frac{1}{2}}$       Divide to simplify:  $6 \div 0.5 = 12$

**Step 2** – Find one of the answer choices that also simplifies to 12 and you will have found the other half of your proportion.

Try A.  $\frac{\text{blue}}{\text{green}} \frac{12}{\frac{3}{4}}$        $12 \div 0.75 = 16$       **Does not** simplify to = 12, so **is not** correct.

Try B.  $\frac{\text{blue}}{\text{green}} \frac{15}{2}$        $15 \div 2 = 7.5$       **Does not** simplify to = 12, so **is not** correct.

Try C.  $\frac{\text{blue}}{\text{green}} \frac{4}{\frac{1}{4}}$        $4 \div 0.25 = 16$       **Does not** simplify to = 12, so **is not** correct.

Try D.  $\frac{\text{blue}}{\text{green}} \frac{21}{1 \frac{3}{4}}$        $21 \div 1.75 = 12$       **Does** = 12, so **is** correct.

**Answer: D. 21 gal. blue &  $1 \frac{3}{4}$  gal. green**

**13.** Two tourist attractions are 9.4 centimeters (cm) apart on a map of France, and the scale on the map is 2.2 centimeters (cm) = 25 kilometers (km). Choose one of the expressions below that you would use to get the best estimate of the actual distance between the two locations.

- A.  $\frac{25}{2} \times 10$       B.  $\frac{25}{2} \times 9$       C.  $\frac{9}{2} + 25$       D.  $\frac{10}{3} \times 25$       E.  $\frac{2}{9} \times 25$

The problem asks for the best estimate, so numbers will be rounded.

2.2 cm rounds down to 2 cm.

9.4 cm rounds down to 9 cm.

$$\frac{\text{cm on map}}{\text{actual km}} \quad \frac{2.2}{25} = \frac{9.4}{x} \quad \rightarrow \quad \frac{2}{25} = \frac{9}{x} \quad \text{The cross multiplication expression is:}$$

$$25 \times 9 \div 2 \quad \text{or} \quad 9 \times 25 \div 2$$

All the answer choices are in a form that includes a fraction instead of a division sign, so you must figure out which of the answer choices is the same as one of your cross multiplication expressions. Use either the scan for correct fraction method or the calculation method.

**Method One – Scan answer choices for the correct fraction multiplied by the correct third number.**

$25 \times 9 \div 2$       Look for  $\frac{9}{2}$  multiplied  $\times 25$ . Not found.

$9 \times 25 \div 2$       Look for  $\frac{25}{2}$  multiplied  $\times 9$ . **Answer: B.  $\frac{25}{2} \times 9$**

**Method Two – Calculation.** Calculate the value of your answer. Then calculate the value of each multiple choice answer until you find one that is equal to your answer.

Calculate the value of your answer:  $25 \times 9 \div 2 = 112.5$

Try A.  $\frac{25}{2} \times 10 = 125$       **Does not** = 112.5, so **is not** correct.

Try B.  $\frac{25}{2} \times 9 = 112.5$       **Does** = 112.5, so **is** correct.      **Answer: B.  $\frac{25}{2} \times 9$**

**14.** A local road map has a scale of 6 miles per inch. If the actual distance between two towns is 57 miles, how many inches apart will they be on the map?

- A. 9      B. 51      C. 5.9      D. **9.5**      E. 10.5

$$\frac{\text{actual miles}}{\text{inches on map}} \quad \frac{6}{1} = \frac{57}{x} \quad 1 \times 57 \div 6 = x = 9.5 \quad \text{Answer: D. 9.5 inches}$$

**15.** Which expression below shows the cost of one ounce of Supersuds Laundry Powder if a 48 ounce box is on sale for \$3.29?

- A.  $48 \div \$3.29$     **B.  $\$3.29 \div 48$**     C.  $48 - \$3.29$     D.  $48 \times \$3.29$     E.  $48 + \$3.29$

$$\frac{\text{ounces}}{\$} \quad \frac{48}{3.29} = \frac{1}{x}$$

$\$3.29 \times 1 \div 48$  is the cross multiplication expression.

It can be shortened to  $\$3.29 \div 48$  because  $\$3.29 \times 1$  is the same as  $\$3.29$ .

**Answer: B.  $\$3.29 \div 48$**

**16.** A company has 150 clerks and 6 shift supervisors. If each clerk can produce 12 invoices in 3 hours, how many invoices can a clerk produce in an 8 hour shift?

- A. **32**            B. 12.5            C. 37.5            D. 23            E. 50

$$\frac{\text{invoices}}{\text{hours}} \quad \frac{12}{3} = \frac{x}{8}$$

$$8 \times 12 \div 3 = x = 32 \quad \text{Answer: A. 32 invoices}$$

**Watch out** for extra numbers included in the problem that are not needed to calculate the answer to the question being asked. The numbers of clerks and supervisors do not enter into the calculation for the number of invoices 1 clerk can produce.

**17.** A company can manufacture 525 Fluid Analyzer Machines per week when it is working under normal conditions at 95% capacity. How many Fluid Analyzer Machines per week can the company make when it is undergoing renovations and working at only 65% capacity?

- A. 341            B. 11            **C. 359**            D. 395            E. 314

$$\frac{\% \text{ capacity}}{\text{machines}} \quad \frac{95}{525} = \frac{65}{x}$$

$$525 \times 65 \div 95 = x = 359.2$$

**Answer: C. 359 machines**

**18.** How long will it take to polish a 120 piece silver service if it takes 30 minutes to polish 16 pieces of silver?

- A. 3 hours 75 minutes            B. 64 minutes            C. 3 hours 15 minutes  
D. 4 hours            **E. 3 hours 45 minutes**

$$\frac{\text{hours}}{\text{pieces of silver}} \quad \frac{0.5}{16} = \frac{x}{120}$$

$$120 \times 0.5 \div 16 = x = 3.75$$

**Answer: E. 3 hours 45 minutes**

**19.** If a package of 75 cups costs \$12.99, which expression shows the cost of 35 cups?

- A.  $\$12.99 \div 75$       B.  $75 \div \$12.99$       C.  **$35 \times \$12.99 \div 75$**   
 D.  $75 \times \$12.99 \div 35$       E.  $35 \div \$12.99$

$$\frac{\text{cups}}{\$} \frac{75}{12.99} = \frac{35}{x}$$

The cross multiplication expression is:

$$\$12.99 \times 35 \div 75 \quad \text{or} \quad 35 \times \$12.99 \div 75$$

**Answer: C.  $35 \times \$12.99 \div 75$**

**20.** Synthesis of Formula A is in direct proportion to the amount of carbon present. If  $\frac{1}{2}$  ounce (oz) of Formula A can be synthesized from every 8 pounds (lb) of carbon, how many ounces of Formula A can be synthesized from 60 pounds of carbon?

- A. 4      B.  **$3 \frac{3}{4}$**       C. 30      D. 960      E.  $3 \frac{1}{4}$

$$\frac{\text{lb carbon}}{\text{oz Formula A}} \quad \frac{8}{\frac{1}{2}} = \frac{60}{x}$$

$$\frac{1}{2} \times 60 \div 8 = x = 3.75$$

**Answer: B.  $3 \frac{3}{4}$  oz of Formula A**

**21.** On the floor plan of a new restaurant, the cashier/waiting area measures 6 inches wide x 12 inches long, and each inch on the floor plan equals  $2 \frac{1}{2}$  feet of actual distance. What are the actual length and width of the cashier/waiting area?

- A. **30 feet x 15 feet**      B. 4.8 feet x 2.4 feet      C. 30 inches x 15 inches  
 D. 4.8 inches x 2.4 inches      E. 14.5 feet x 8.5 feet

$$\text{LENGTH: } \frac{\text{actual feet}}{\text{inches on floor plan}} \quad \frac{2 \frac{1}{2}}{1} = \frac{x}{12}$$

$$12 \times 2 \frac{1}{2} \div 1 = x = 30$$

Length = 30 feet

$$\text{WIDTH: } \frac{\text{actual feet}}{\text{inches on floor plan}} \quad \frac{2 \frac{1}{2}}{1} = \frac{x}{6}$$

$$6 \times 2 \frac{1}{2} \div 1 = x = 15$$

Width = 15 feet

**Answer: A. 30 feet long x 15 feet wide**

**Shortcut** – If every inch =  $2 \frac{1}{2}$  feet, 6 inches x  $2 \frac{1}{2}$  = 15 feet for the width, and 12 inches x  $2 \frac{1}{2}$  = 30 feet for the length.

**22.** If a 24-pack of pens costs \$7.99, which expression shows the cost per pen?

- A.  **$\$7.99 \div 24$**       B.  $24 \div \$7.99$       C.  $24 - \$7.99$       D.  $24 \times \$7.99$       E.  $24 + \$7.99$

$$\frac{\text{pens}}{\$} \quad \frac{24}{7.99} = \frac{1}{x}$$

$1 \times \$7.99 \div 24$  is the cross multiplication expression.

It can be shortened to  $\$7.99 \div 24$  because

$1 \times \$7.99$  is the same as  $\$7.99$ .

**Answer: A.  $\$7.99 \div 24$**



**23.** To make 50 pounds of colored plaster it takes 7.5 ounces of tint. Which expression shows the best estimate of the number of pounds of colored plaster that can be made with 3.7 ounces of tint?

- A.  $\frac{8}{50} \times 4$       B.  $\frac{50}{8} + 4$       C.  $\frac{50}{8} \times 3$       D.  $\frac{4}{7} \times 50$       E.  $\frac{4}{8} \times 50$

The problem asks for the best estimate, so numbers will be rounded.

7.5 rounds up to 8.

3.7 rounds up to 4.

$$\frac{\text{lb plaster}}{\text{oz tint}} \quad \frac{50}{7.5} = \frac{x}{3.7} \quad \rightarrow \quad \frac{50}{8} = \frac{x}{4} \quad \text{The cross multiplication expression is:}$$

$$50 \times 4 \div 8 \quad \text{or} \quad 4 \times 50 \div 8$$

All the answer choices are in a form that includes a fraction instead of a division sign, so you must figure out which of the answer choices is the same as one of your cross multiplication expressions. Use either the scan for correct fraction method or the calculation method.

**Method One – Scan answer choices for the correct fraction multiplied by the correct third number.**

$$50 \times 4 \div 8 \quad \text{Look for } \frac{4}{8} \text{ multiplied } \times 50. \quad \text{Answer: E. } \frac{4}{8} \times 50$$

You can check the other cross multiplication expression if you want, but you don't need to since you have already found the answer.

$$4 \times 50 \div 8 \quad \text{Look for } \frac{50}{8} \text{ multiplied } \times 4. \text{ Not found.}$$

**Method Two – Calculation.** Calculate the value of your answer. Then calculate the value of each multiple choice answer until you find one that is equal to your answer.

$$\text{Calculate the value of your answer: } 50 \times 4 \div 8 = 25$$

$$\text{Try A. } \frac{8}{50} \times 4 = 0.64 \quad \text{Does not} = 25, \text{ so is not correct.}$$

$$\text{Try B. } \frac{50}{8} + 4 = 10.25 \quad \text{Does not} = 25, \text{ so is not correct.}$$

$$\text{Try C. } \frac{50}{8} \times 3 = 18.75 \quad \text{Does not} = 25, \text{ so is not correct.}$$

$$\text{Try D. } \frac{4}{7} \times 50 = 28.57 \quad \text{Does not} = 25, \text{ so is not correct.}$$

$$\text{Try E. } \frac{4}{8} \times 50 = 25 \quad \text{Does} = 25, \text{ so is correct.} \quad \text{Answer: E. } \frac{4}{8} \times 50$$

**24.** There is  $\frac{3}{4}$  ounce of salt in every 12 pounds of cake mix. How many ounces of salt will be needed to make 200 pounds of cake mix?

- A.  $12\frac{1}{2}$       B.  $12\frac{3}{4}$       C. 9      D.  $16\frac{1}{2}$       E.  $16\frac{3}{4}$

$$\frac{\text{oz salt}}{\text{lb cake mix}} = \frac{\frac{3}{4}}{12} = \frac{x}{200} \quad \frac{3}{4} \times 200 \div 12 = x = 12.5 \quad \text{Answer: A. } 12\frac{1}{2} \text{ oz}$$

**25.** A flavor formula calls for  $1\frac{1}{2}$  grams of coffee and 2 liters of water (H<sub>2</sub>O). Which of the following combinations will produce the same concentration of these two ingredients?

- A.  $\frac{1}{2}$  gram coffee & 3 liters water      B. 3 grams coffee & 6 liters water  
C.  **$8\frac{1}{4}$  grams coffee & 11 liters water**      D.  $2\frac{1}{2}$  grams coffee & 6 liters water  
E.  $10\frac{1}{2}$  grams coffee & 5 liters water

In this type of problem, the question provides the first ratio of a proportion, and the answer choices provide five possibilities for the second ratio of the proportion. Remember that both ratios in a proportion are equal so both will simplify to the same number.

**Step 1** – Simplify the first ratio of the proportion that is given in the problem.

$$\text{You are given: } \frac{\text{grams of coffee}}{\text{liters of H}_2\text{O}} = \frac{1\frac{1}{2}}{2} \quad \text{Divide to simplify: } 1.5 \div 2 = 0.75$$

**Step 2** – Find one of the answer choices that also simplifies to 0.75 and you will have found the other half of your proportion.

Try A.  $\frac{\text{grams of coffee}}{\text{liters of H}_2\text{O}} = \frac{\frac{1}{2}}{3} \quad 0.5 \div 3 = 0.17$   
**Does not** simplify to 0.75, so **is not** correct.

Try B.  $\frac{\text{grams of coffee}}{\text{liters of H}_2\text{O}} = \frac{\frac{3}{6}}{6} \quad 3 \div 6 = 0.5$   
**Does not** simplify to 0.75, so **is not** correct.

Try C.  $\frac{\text{grams of coffee}}{\text{liters of H}_2\text{O}} = \frac{8\frac{1}{4}}{11} \quad 8.25 \div 11 = 0.75$   
**Does** simplify to 0.75, so **is** correct.  
**Answer: C.  $8\frac{1}{4}$  grams coffee & 11 liters water**

**26.** Old Kings Trail is 24 cm long on a trail map of Shetland Downs. If the scale on the trail map is 2 cm = 1.5 km, how long is Old Kings Trail?

- A. 32 km      B. 12 km      C. 16 km      D. 36 km      **E. 18 km**

$$\frac{\text{cm on map}}{\text{actual km}} \quad \frac{2}{1.5} = \frac{24}{x} \quad 1.5 \times 24 \div 2 = x = 18 \quad \text{Answer: E. 18 km}$$

**27.** If a lawyer bills her time at \$125 per hour, what is the charge for 2 hours and 45 minutes of legal time?

- A. \$306.25      B. \$250      C. \$433.75      **D. \$343.75**      E. \$360.25

$$\frac{\text{hours}}{\$} \quad \frac{1}{125} = \frac{2.75}{x} \quad \$125 \times 2.75 \div 1 = x = \$343.75 \quad \text{Answer: D. \$343.75}$$

**Shortcut** – 2.75 hours x \$125 per hour = 2.75 x \$125 = \$343.75. If you can see it this way from reading the problem, you can skip setting up the proportion.

**28.** If a worker can process 12 forms each hour, which expression shows how many hours it will take to process 450 forms?

- A.  $12 \div 450$       B.  $12 + 450$       C.  $450 - 12$       D.  $12 \times 450$       **E.  $450 \div 12$**

$$\frac{\text{forms}}{\text{hours}} \quad \frac{12}{1} = \frac{450}{x} \quad 450 \times 1 \div 12 \text{ is the cross multiplication expression.}$$

It can be shortened to  $450 \div 12$  because  $450 \times 1$  is the same as 450.

**Answer: E.  $450 \div 12$**

**29.** Decorative ribbon trim costs \$1.99 for 16 inches. Sacha is trimming the front side of the 8 tables she will be using at her event. If each table is 4 feet across the front side, how much will the ribbon trim cost?

- A. \$5.97      B. \$63.68      C. \$3.98      D. \$95.52      **E. \$47.76**

$$\frac{\$}{\text{inches}} \quad \frac{1.99}{16} = \frac{x}{384} \quad 384 \times \$1.99 \div 16 = x = \$47.76 \quad \text{Answer: E. \$47.76}$$

Extra steps are needed before you form the proportion. You must calculate the number of inches needed to get the number to use in the second ratio.

Each table is 4 feet. Multiply x 12 inches per foot to get 48 inches per table.

8 tables are used. Multiply 48 inches x 8 tables to get 384 total inches needed.