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Chapter 3 : Proportion, Ratio, Percent

Topics that you'll learn in this chapter:

- Writing and Simplifying Ratios
- Create a Proportion
- Similar Figures
- Simple Interest
- Ratio and Rates Word Problems
- Percentage Calculations
- Converting Between Percent, Fractions, and Decimals
- Percent Problems
- Markup, Discount, and Tax

“Do not worry about your difficulties in mathematics. I can assure you mine are still greater.” – Albert Einstein

Name:

Writing Ratios

✓ A ratio is a comparison of two numbers, and it can be written as a division.

EXAMPLE:

3: 5 =?

Both numbers 3 and 5 are divisible by 8 , $\Rightarrow 3 \div 8 = \frac{3}{8}, 5 \div 8 = \frac{5}{8}$,

Then: $3: 5 = \frac{3}{8}$ and $\frac{5}{8}$.

PRACTICES:

Express each ratio as a rate and unite rate.	Express each ratio as a fraction in the simplest form
1) 80 dollars for 4 chairs.	2) 13 cups to 39 cups.
3) 125miles on 25 gallons of gas.	4) 17 cakes out of 51 cakes
5) 147 miles on 7 hours.	6) 35 red desks out of 125 desks
7) 12 inches of snow in 24 hours.	8) 8 story books out of 32 books
9) 14 dimes to 112 dimes.	10) 12 gallons to 20 gallons

Score:

Answer Key

1) $\frac{80 \text{ dollars}}{4 \text{ books}}$, 20.00 dollars per chair	2) $\frac{1}{3}$
3) $\frac{125 \text{ miles}}{25 \text{ gallons}}$, 5 miles per gallon	4) $\frac{1}{3}$
5) $\frac{147 \text{ miles}}{7 \text{ hours}}$, 21 miles per hour	6) $\frac{7}{25}$
7) $\frac{12" \text{ of snow}}{24 \text{ hours}}$, 0.5 inches of snow per hour	8) $\frac{1}{4}$
9) $\frac{14 \text{ dimes}}{112 \text{ dimes}}$, $\frac{1}{8}$ per dime	10) $\frac{3}{5}$

Name:

Simplifying Ratios

- ✓ Ratios are used to compare two numbers.
- ✓ Ratios can be written as a fraction, using colon or the word "to".
- ✓ You can calculate identical ratios by multiplying or dividing both sides of the ratio by the same number.

EXAMPLE:

Simplify. $8:4 =$

Both numbers 8 and 4 are divisible by 4 , $\Rightarrow 8 \div 4 = 2, 4 \div 4 = 1,$

Then: $8:4 = 2:1$

PRACTICES:

Reduce each ratio.

1) $49:14$

2) $22:55$

3) $35:25$

4) $18:99$

5) $16:36$

6) $64:72$

7) $4:60$

8) $70:40$

9) $8:64$

10) $16:24$

Score:

Answer Key

1) 7: 2	2) 2: 5
3) 7: 5	4) 2: 11
5) 4: 9	6) 8: 9
7) 1: 15	8) 7: 4
9) 1: 8	10) 2: 3

Name:

Create a Proportion

- ✓ A proportion carries two equal fractions! A proportion means equality of two fractions.
- ✓ If you want to create a proportion, simply find (or create) two equal fractions.

EXAMPLE:

Explain if these ratios form a proportion. $\frac{3}{5}$ and $\frac{24}{45}$

Use cross multiplication: $\frac{3}{5} = \frac{24}{45} \rightarrow 3 \times 45 = 5 \times 24 \rightarrow 135 = 120$, which is not correct.

Thus, this pair of ratios doesn't form a proportion.

PRACTICES:

Create proportion from the given set of numbers.

1) 3, 2, 9, 6	2) 4, 18, 12, 6
3) 5, 11, 25, 55	4) 24, 7, 21, 8
5) 49, 7, 12, 84	6) 15, 12, 30, 24
7) 20, 10, 200, 1	8) 9, 27, 81, 3
9) 4, 2, 16, 32	10) 9, 6, 27, 18

Score:

Answer Key

1) $2: 6 = 3: 9$	2) $4: 12 = 6: 18$
3) $5: 25 = 11: 55$	4) $8: 24 = 7: 21$
5) $7: 49 = 12: 84$	6) $12: 24 = 15: 30$
7) $1: 10 = 20: 200$	8) $3: 27 = 9: 81$
9) $2: 16 = 4: 32$	10) $6: 18 = 9: 27$

Name:

Similar Figures

✓ Two or more figures are equivalent if their corresponding angles are equal, and the corresponding sides are in proportion.

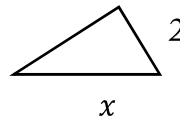
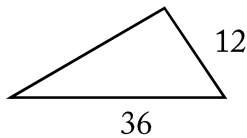
EXAMPLE:

4-5-6 triangle is like an 8-10-12 triangle.

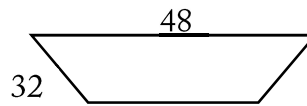
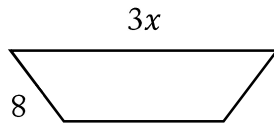
PRACTICES:

Each pair of figures is similar. Find the missing side.

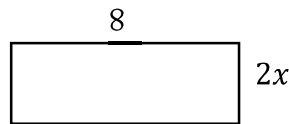
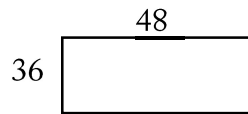
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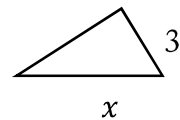
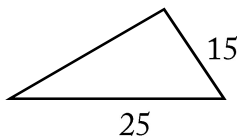
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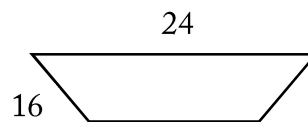
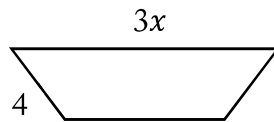
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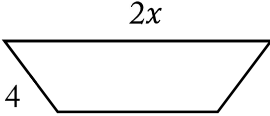
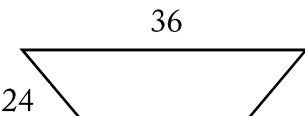
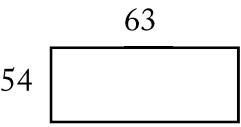
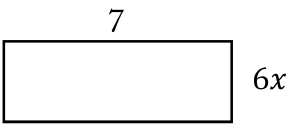
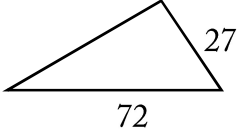
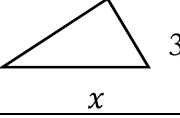
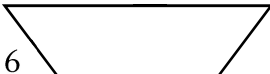

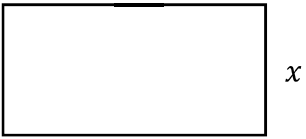

4)



5)



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6) 	
7) 	
8) 	
9) 	
10) 	

Score:

Answer Key

1) 6	2) 4
3) 3	4) 5
5) 2	6) 3
7) 1	8) 8
9) 20	10) 18

Name:

Ratio and Rates Word Problems

✓ To solve a rate word problem or a ratio, create a proportion and then use cross multiplication method.

EXAMPLE:

A tree 32 feet tall has a shadow 12 feet long. Jack is 6 feet tall. How long is Jack’s shadow?

To solve for the missing number, write in a proportion.

$$\frac{32}{12} = \frac{6}{x} \rightarrow 32x = 6 \times 12 = 72$$

$$32x = 72 \rightarrow x = \frac{72}{32} = 2.25$$

PRACTICES:

Solve.

- 1) In a party, 8 soft drinks are required for every 35 guests. If there are 560 guests, how many soft drinks is required?
- 2) You can buy 6 cans of green beans at a supermarket for \$3.50. How much does it cost to buy 42 cans of green beans?
- 3) The price of 5 bananas at the first Market is \$1.05. The price of 7 of the same bananas at second Market is \$1.07. Which place is the better buy?
- 4) In Peter’s class, 21 of the students are tall and 9 are short. In Elise’s class 56 students are tall and 24 students are short. Which class has a higher ratio of tall to short students?
- 5) The bakers at a Bakery can make 110 bagels in 4 hours. How many bagels can they bake in 6 hours? What is that rate per hour?
- 6) A certain sweet recipe calls for 3 kg of sugar for every 6 kg of flour. If 63 kg of this sweet must be prepared, how much sugar is required?

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7) In a mixture of 45 liters, the ratio of sugar solution to salt solution is 1:2. What is the amount of sugar solution to be added if the ratio must be 2:1?
8) In a bag of red and green sweets, the ratio of red sweets to green sweets is 3:4. If the bag contains 120 green sweets, how many red sweets are there?
9) If the ratio of chocolates to ice-cream cones in a box is 5:8 and the number of chocolates is 30, find the number of ice-cream cones.
10) In a group, the ratio of doctors to lawyers is 5:4. If the total number of people in the group is 72, what is the number of lawyers in the group?

Score:

Answer Key

1) 128	2) \$24.5
3) The price at the second Market is a better buy.	4) The ratio for both classes equal 7 to 3.
5) 165, the rate is 27.5 per hour.	6) 21 kg ($3+6=9$, $\frac{63}{9} = 7$. Therefore, $3:6=21:42$)
7) 45	8) 90
9) 48	10) 32

Name:

Percentage Calculations

✓ Percent is called the ratio of a number and 100. It always possesses the same denominator, 100. The symbol used for percent is %.

✓ Percent is another method to write decimals or fractions. For example:

$$40\% = 0.40 = \frac{40}{100} = \frac{2}{5}$$

✓ Use the given formula to find part, whole, or percent:

$$\text{part} = \frac{\text{percent}}{100} \times \text{whole}$$

EXAMPLE:

What is 10% of 45?

Use this formula: $\text{part} = \frac{\text{percent}}{100} \times \text{whole}$

$$\text{part} = \frac{10}{100} \times 45 \rightarrow \text{part} = \frac{1}{10} \times 45 \rightarrow \text{part} = \frac{45}{10} \rightarrow \text{part} = 4.5$$

PRACTICES:

Calculate the percentages.

1) 75% of 45

2) 50% of 66

3) 90% of 58

4) 25% of 88

5) 5% of 100

6) 80% of 60

Solve.

7) What percentage of 60 is 6

8) 6.76 is what percentage of 52?

9) 17 is what percentage of 85?

10) Find what percentage of 96 is 24.

Score:

Answer Key

1) 33.75	2) 33
3) 52.2	4) 22
5) 5	6) 48
7) 10%	8) 13%
9) 20%	10) 25%

Name:

Percent Problems

- ✓ In each percent question, we are finding the base, or part or the percent.
- ✓ Use the following equations to find each missing portion.
 - $\text{Base} = \text{Part} \div \text{Percent}$
 - $\text{Part} = \text{Percent} \times \text{Base}$
 - $\text{Percent} = \text{Part} \div \text{Base}$

EXAMPLE:

20 is 5% of what number?

Use the formula: $\text{Base} = \text{Part} \div \text{Percent} \rightarrow \text{Base} = 20 \div 0.05 = 400$

20 is 5% of 400

PRACTICES:

Solve each problem.

1) 52% of what number is 13?

2) What is 15% of 9 inches?

3) What percent of 185.6 is 23.2?

4) 24 is 72% of what?

5) 35 is what percent of 70?

6) 10 is 200% of what?

7) 14 is what percent of 70?

8) 26% of 100 is what number?

9) Mia requires 50% to pass. If she gets 250 marks and falls short by 90 marks, what were the maximum marks she could have got?

10) Jack scored 14 out of 70 marks in mathematics, 9 out of 10 marks in history and 56 out of 100 marks in science. In which subject his percentage of marks is the best?

Score:

Answer Key

1) 25	2) 1.35
3) 12.5	4) 33.33
5) 50%	6) 5
7) 20%	8) 26
9) 680	10) History

Name:

Rate of change

- ✓ Slope can be described as "rate of change".
- ✓ Rate of change is a ratio between a change in one variable comparing to a corresponding change in another variable. Rate of change = $\frac{\text{change in output } (y)}{\text{change in input } (x)}$
- ✓ Rates of change can be positive, negative, or zero.

EXAMPLE:

The table shows the amount of money SB carwash made washing car. Find the rate of change in dollar per car?

SB Carwash	Number	4	8	12	16
	Money (\$)	32	56	80	104

$$\text{Rate of change} = \frac{\text{change in output } (y)}{\text{change in input } (x)} = \frac{\text{Change in money}}{\text{Change in car}} = \frac{56-32}{8-4} = \frac{24}{4} = \frac{6}{1}, \text{ or } \$6 \text{ per car}$$

PRACTICES:

What is the average rate of change of the function?

1)	<table border="1"> <tr><td>Gallons</td><td>3</td><td>5</td><td>7</td><td>9</td></tr> <tr><td>Miles</td><td>81</td><td>135</td><td>189</td><td>243</td></tr> </table>	Gallons	3	5	7	9	Miles	81	135	189	243	2)	<table border="1"> <tr><td>Products</td><td>145</td><td>159</td><td>173</td><td>187</td></tr> <tr><td>Costs</td><td>761</td><td>719</td><td>677</td><td>635</td></tr> </table>	Products	145	159	173	187	Costs	761	719	677	635
Gallons	3	5	7	9																			
Miles	81	135	189	243																			
Products	145	159	173	187																			
Costs	761	719	677	635																			
3)	<table border="1"> <tr><td>x</td><td>4.5</td><td>6</td><td>7.5</td><td>9</td></tr> <tr><td>y</td><td>6</td><td>15</td><td>24</td><td>33</td></tr> </table>	x	4.5	6	7.5	9	y	6	15	24	33	4)	<table border="1"> <tr><td>x</td><td>41</td><td>47</td><td>53</td><td>59</td></tr> <tr><td>y</td><td>67</td><td>52</td><td>37</td><td>22</td></tr> </table>	x	41	47	53	59	y	67	52	37	22
x	4.5	6	7.5	9																			
y	6	15	24	33																			
x	41	47	53	59																			
y	67	52	37	22																			
5) $f(x) = -2x + 4$, from $x = -1$ to $x = 4$?		6) $f(x) = x - 6$, from $x = -5$ to $x = 1$?																					
7) $f(x) = -4$, from $x = 3$ to $x = -2$?		8) $f(x) = 3x^2 + 5$, from $x = 3$ to $x = 6$?																					
9) $f(x) = -2x^2 - 4$, from $x = 2$ to $x = 4$?		10) $f(x) = x^3 + 3$, from $x = 1$ to $x = 2$?																					

Practice Test 1
Answers and Explanations

1) Answer: B

Let x be the number. Write the equation and solve for x .

$$\frac{(30-x)}{x} = 5 \text{ (Cross multiply)}$$

$$(30 - x) = 5x, \text{ then add } x \text{ both sides. } 30 = 6x,$$

$$\text{now divide both sides by 6. } \Rightarrow x = 5.$$

2) Answer: D

Use simple interest formula: $I = prt$ (I = interest, p = principal, r = rate, t = time)

$$I = (10,000)(0.015) (4) = 600$$

3) Answer: 6

Use formula of rectangle prism volume.

$$V = (\text{length}) (\text{width}) (\text{height}) \Rightarrow 1,008 = (14) (12) (\text{height}) \Rightarrow$$

$$\text{height} = 1,008 \div 168 = 6$$

4) Answer: B

the population is increased by 7% and 20%. 7% increase changes the population to 107% of original population.

For the second increase, multiply the result by 120%.

$$(1.07) \times (1.20) = (1.284) = 128.40 \%$$

28.40 percent of the population is increased after two years.

5) Answer: B

Five years ago, Amy was five times as old as Mike. Mike is 10 years now. Therefore, 5 years ago Mike was 5 years.

$$\text{Five years ago, Amy was: } A = 5 \times 5 = 25$$

$$\text{Now Amy is 25 years old: } 25 + 5 = 30$$

6) Answer: A

A linear equation is a relationship between two variables, x and y , that can be put in the form $y = mx + b$.

A non-proportional linear relationship takes on the form $y = mx + b$, where $b \neq 0$ and its graph is a line that does not cross through the origin.