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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.

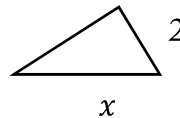
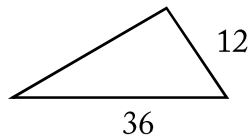
EXAMPLE:

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

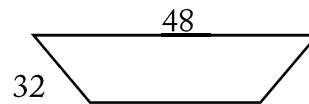
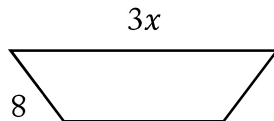
PRACTICES:

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

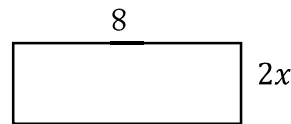
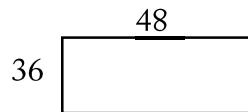
1)



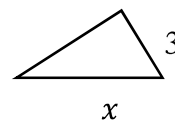
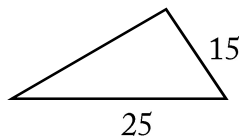
2)



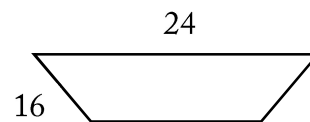
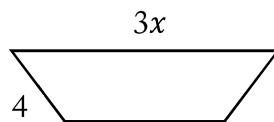
3)



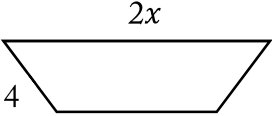
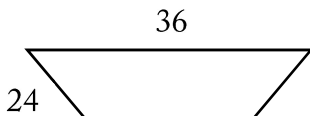
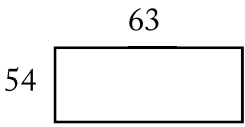
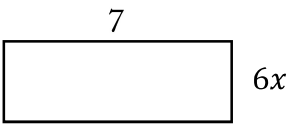
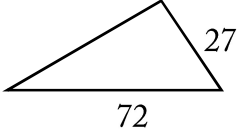
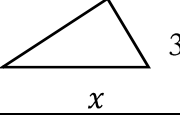
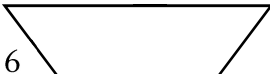

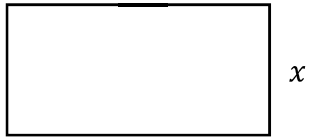

4)



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?

| | | | | | | | | | | | | | | | | | | | | | |
|---|--|-----|-----|-----|---|-------|----|-----|-----|-----|--|----------|-----|-----|-----|-----|-------|-----|-----|-----|-----|
| <p>1)</p> <table border="1" style="margin-left: 20px;"> <tr><td style="text-align: center;">Gallons</td><td style="text-align: center;">3</td><td style="text-align: center;">5</td><td style="text-align: center;">7</td><td style="text-align: center;">9</td></tr> <tr><td style="text-align: center;">Miles</td><td style="text-align: center;">81</td><td style="text-align: center;">135</td><td style="text-align: center;">189</td><td style="text-align: center;">243</td></tr> </table> | Gallons | 3 | 5 | 7 | 9 | Miles | 81 | 135 | 189 | 243 | <p>2)</p> <table border="1" style="margin-left: 20px;"> <tr><td style="text-align: center;">Products</td><td style="text-align: center;">145</td><td style="text-align: center;">159</td><td style="text-align: center;">173</td><td style="text-align: center;">187</td></tr> <tr><td style="text-align: center;">Costs</td><td style="text-align: center;">761</td><td style="text-align: center;">719</td><td style="text-align: center;">677</td><td style="text-align: center;">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 | | | | | | | | | | | | | | | | | |
| <p>3)</p> <table border="1" style="margin-left: 20px;"> <tr><td style="text-align: center;">x</td><td style="text-align: center;">4.5</td><td style="text-align: center;">6</td><td style="text-align: center;">7.5</td><td style="text-align: center;">9</td></tr> <tr><td style="text-align: center;">y</td><td style="text-align: center;">6</td><td style="text-align: center;">15</td><td style="text-align: center;">24</td><td style="text-align: center;">33</td></tr> </table> | x | 4.5 | 6 | 7.5 | 9 | y | 6 | 15 | 24 | 33 | <p>4)</p> <table border="1" style="margin-left: 20px;"> <tr><td style="text-align: center;">x</td><td style="text-align: center;">41</td><td style="text-align: center;">47</td><td style="text-align: center;">53</td><td style="text-align: center;">59</td></tr> <tr><td style="text-align: center;">y</td><td style="text-align: center;">67</td><td style="text-align: center;">52</td><td style="text-align: center;">37</td><td style="text-align: center;">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 | | | | | | | | | | | | | | | | | |
| <p>5) $f(x) = -2x + 4$, from $x = -1$ to $x = 4$?</p> | <p>6) $f(x) = x - 6$, from $x = -5$ to $x = 1$?</p> | | | | | | | | | | | | | | | | | | | | |
| <p>7) $f(x) = -4$, from $x = 3$ to $x = -2$?</p> | <p>8) $f(x) = 3x^2 + 5$, from $x = 3$ to $x = 6$?</p> | | | | | | | | | | | | | | | | | | | | |
| <p>9) $f(x) = -2x^2 - 4$, from $x = 2$ to $x = 4$?</p> | <p>10) $f(x) = x^3 + 3$, from $x = 1$ to $x = 2$?</p> | | | | | | | | | | | | | | | | | | | | |

13) If $y = 3ab + 5b^3$, what is y when $a = 4$ and $b = 3$?

A. 65

D. 81

B. 39

E. 171

C. 51

14) When a number is subtracted from 48 and the difference is divided by that number, the result is 7. What is the value of the number?

A. 24

D. 14

B. 8

E. 7

C. 6

15) If car A drives 405 miles in 9 hours and car B drives the same distance in 8.1 hours, how many miles per hour does car B drive faster than car A?

A. 45

D. 15

B. 50

E. 5

C. 10

16) The ratio of boys to girls in a school is 4:3. If there are 560 students in a school, how many boys are in the school?

A. 250

D. 120

B. 260

E. 320

C. 350