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## Contents

<b>Chapter 1 : Whole Numbers, Real Numbers, and Integers.....</b>	<b>11</b>
Rounding.....	13
Estimates .....	15
Whole Number Addition and Subtraction .....	17
Whole Number Multiplication.....	19
Whole Number Division .....	21
Adding and Subtracting Integers.....	23
Multiplying and Dividing Integers.....	25
Arrange, Order, and Comparing Integers.....	27
Compare Integer .....	29
Order of Operations .....	31
Integers and Absolute Value .....	33
<b>Chapter 2 : Fractions and Decimals.....</b>	<b>35</b>
Simplifying Fractions .....	37
Factoring Numbers .....	39
Greatest Common Factor (GCF) .....	41
Least Common Multiple (LCM) .....	43
Divisibility Rules.....	45
Adding and Subtracting Fractions.....	47
Multiplying and Dividing Fractions .....	49
Adding Mixed Numbers.....	51
Subtracting Mixed Numbers .....	53
Multiplying Mixed Numbers .....	55
Dividing Mixed Numbers.....	57
Comparing Decimals.....	59
Rounding Decimals.....	61
Adding and Subtracting Decimals .....	63
Multiplying Decimals .....	65
Dividing Decimals .....	67
Converting Between Fractions, Decimals and Mixed Numbers.....	69
<b>Chapter 3 : Proportion, Ratio, Percent .....</b>	<b>71</b>
Writing Ratios.....	73
Simplifying Ratios.....	75
Create a Proportion.....	77
Similar Figures .....	79
Ratio and Rates Word Problems .....	81
Percentage Calculations .....	83
Percent Problems .....	85
Markup, Discount, and Tax .....	87
Simple Interest .....	89
Converting Between Percent, Fractions, and Decimals .....	91
<b>Chapter 4 : Exponents and Radicals .....</b>	<b>93</b>
Multiplication Property of Exponents .....	95
Division Property of Exponents .....	97
Powers of Products and Quotients.....	99

# FSA Math Prep Grade 8

Zero and Negative Exponents .....	101
Negative Exponents and Negative Bases .....	103
Writing Scientific Notation .....	105
Square Roots .....	107
<b>Chapter 5 : Algebraic Expressions .....</b>	<b>109</b>
Translate Phrases into an Algebraic Statement.....	111
The Distributive Property .....	113
Evaluating One Variable .....	115
Evaluating Two Variables.....	117
Expressions and Variables.....	119
Combining like Terms .....	121
Expressions .....	121
Simplifying Polynomial Expressions .....	123
<b>Chapter 6 : Equations and Inequalities.....</b>	<b>125</b>
One-Step Equations .....	127
Two-Step Equations .....	129
Multi-Step Equations.....	131
Graphing Single-Variable Inequalities .....	133
One-Step Inequalities .....	135
Two-Step Inequalities .....	137
Multi-Step Inequalities .....	139
Solving Systems of Equations by Substitution.....	141
Solving Systems of Equations by Elimination .....	143
Systems of Equations Word Problems .....	145
Linear Equations .....	147
Graphing Lines of Equations.....	149
Graphing Linear Inequalities.....	151
Finding Distance of Two Points .....	153
<b>Chapter 7 : Polynomials .....</b>	<b>155</b>
Classifying Polynomials.....	157
Adding and Subtracting Polynomials.....	159
Multiply and Divide Monomials .....	161
Multiplying Monomials.....	163
Multiply a Polynomial and a Monomial.....	165
Multiply Binomials.....	167
Factor Trinomials .....	169
Operations with Polynomials.....	171
Simplifying Polynomials .....	173
<b>Chapter 8 : Functions .....</b>	<b>175</b>
Relations and Functions .....	177
Rate of change .....	179
Slope .....	181
x and y intercept.....	183
Writing Linear Equations .....	185
Slope-intercept form .....	187
Point-slope form .....	189
Equation of Parallel or Perpendicular lines.....	191
Equation of Horizontal and Vertical Lines .....	193
Function Notation.....	195
Adding and Subtracting Functions.....	197

# FSA Math Prep Grade 8

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Multiplying and Dividing Functions .....	199
Composition of Functions .....	201
Solve a Quadratic Equation .....	203
<b>Chapter 9 : Geometry .....</b>	<b>205</b>
The Pythagorean Theorem.....	207
Angles .....	209
Area of Triangles.....	211
Area of Trapezoids .....	213
Area and Perimeter of Polygons.....	215
Area and Circumference of Circles .....	217
Volume of Cubes.....	219
Volume of Rectangle Prisms.....	221
Surface Area of Cubes.....	223
Surface Area of a Rectangle Prism.....	225
Volume of a Cylinder.....	227
Surface Area of a Cylinder.....	229
<b>Chapter 10 : Statistics .....</b>	<b>231</b>
Mean and Median .....	233
Mode and Range .....	235
Times Series .....	237
Box and Whisker Plot.....	239
Bar Graph .....	241
Dot plots.....	243
Scatter Plots .....	245
Stem-And-Leaf Plot .....	247
The Pie Graph or Circle Graph.....	249
Probability of Simple Events.....	251
<b>Chapter 11 : FSA Math Practice Tests .....</b>	<b>253</b>
FSA Grade 8 Mathematics Reference Materials .....	255
FSA Practice Test 1 .....	257
Session 1 .....	257
Session 2 .....	261
Session 3 .....	266
FSA Practice Test 2.....	271
Session 1 .....	271
Session 2 .....	274
Session 3 .....	278
<b>Chapter 12 : Answers and Explanations.....</b>	<b>283</b>
Answer Key.....	283
Practice Test 1 .....	285
Practice Test 2 .....	290



## 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.

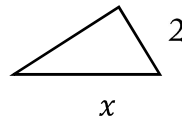
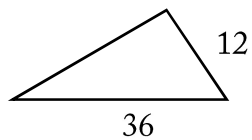
**EXAMPLE:**

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

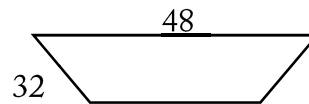
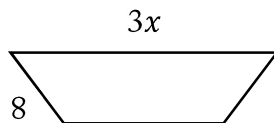
**PRACTICES:**

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

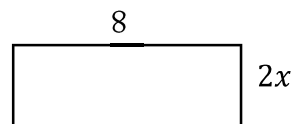
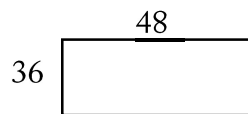
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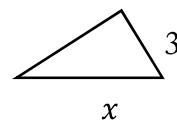
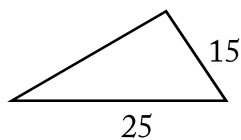
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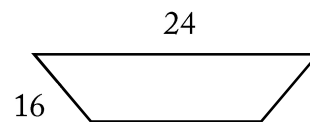
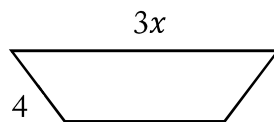
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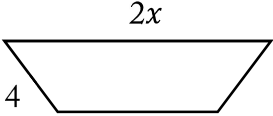
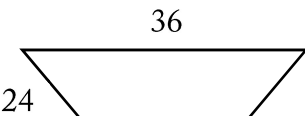
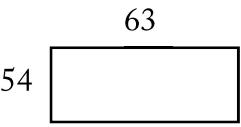
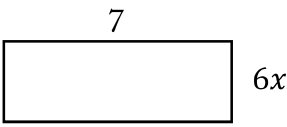
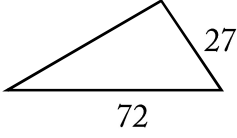
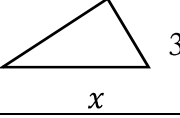
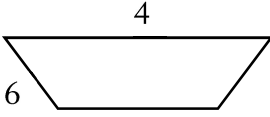
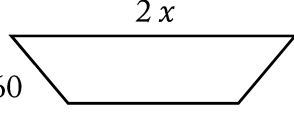
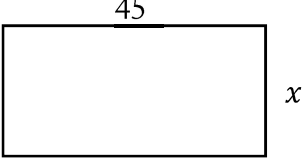
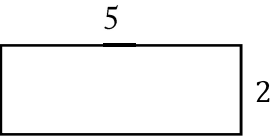
4)



5)



**FSA Math Prep Grade 8**

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?



## FSA Math Prep Grade 8

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: .....

**Markup, Discount, and Tax**

- ✓ Markup = selling price - cost
- ✓ Markup rate = markup is divided by the cost
- ✓ Discount = Multiply the rate of discount by regular price.
- ✓ Tax: To find tax, multiply the taxable amount (income, property value, etc.) to the tax rate.
- ✓ To find tip, multiply selling price to the rate.

**EXAMPLE:**

With an 10% discount, Ella was able to save \$20 on a dress. What was the original price of the dress?

$$10\% \text{ of } x = 20, \frac{10}{100} \times x = 20, x = \frac{100 \times 20}{10} = 200$$

**PRACTICES:**

**Find the selling price of each item.**

- 1) Cost of a chair: \$20, markup: 30%, discount: 10%, tax: 10%
- 2) Cost of computer: \$1,600.00, markup: 65%
- 3) Cost of a pen: \$3.20, markup: 50%, discount: 15%, tax: 5%
- 4) Cost of a puppy: \$1,800, markup: 40%, discount: 10%
- 5) Cost of a book: \$50, markup: 40%, discount: 20%, tax: 5%
- 6) Original price of a tablet: \$400, discount: 20% Tax: 5%,
- 7) Original price of a book: \$50, markup:20% Discount: 20%, Tax: 2.5%,
- 8) Original price of a cellphone: \$500, markup:14% Discount: 25%, Tax: 1.6%,
- 9) Original price of a sofa: \$800, markup:10% Discount: 15%, Tax: 1.5%,
- 10) Original price of a car: \$40,000, markup:12% Discount: 25%, Tax: 6.5%,

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><math>x</math></td><td>4.5</td><td>6</td><td>7.5</td><td>9</td></tr> <tr><td><math>y</math></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><math>x</math></td><td>41</td><td>47</td><td>53</td><td>59</td></tr> <tr><td><math>y</math></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 $x = 2$ ?																					