SUPPLEMENTAL HANDOUT

PERCENT INCREASE AND DECREASE

Percent increase and percent decrease are measures of **percent change.** When computed, we are comparing the *change* between two given values to the *original value.* (*The *change* is found by subtracting the absolute values of the two given values.)

Example of Percent Increase

When finding the percent increase, we take the difference of the <u>absolute values</u> and divide it by the <u>original value</u>, then write it as a percent.

Ex. Ann works in a supermarket for $10.00 per hour. If her pay is increased to $12.00, then what is her percent increase in pay?

$$Percent\ Change = \frac{Difference\ of\ the\ Values}{Original\ Value} X\ 100\% = \frac{12-10}{10}\ X\ 100\% = \frac{2}{10}\ X\ 100\% = \frac{200}{10}\%$$
$$= 20\%$$

The percent increase in Ann's pay is 20%.

Example of Percent Decrease

When finding the percent decrease, we take the difference of the <u>absolute values</u> and divide it by the <u>original value</u>, then convert to a percent.

Ex. The staff at a company went from 40 to 29 employees. What is the percent decrease in staff?

$$Percent\ Change = \frac{Difference\ of\ the\ Values}{Original\ Value} X\ 100\% = \frac{40-29}{40}\ X\ 100\% = \frac{11}{40}\ X\ 100\% = \frac{1100}{40}\%$$
$$= 27.5\%$$

The percent decrease in staff is 27.5%.

SOLVING QUADRATIC EQUATIONS USING THE SQUARE ROOT PROPERTY

Definition:
• Quadratic Equation: is an equation that can be written in the form
$ax^2 + bx + c = 0$, where a, b, and c are real numbers, a ≠ 0.

Important Properties:
• All positive integers have two square roots, one positive and the other negative. For example the square roots of 81 are -9 and 9, because 9^2 = 81 and $(-9)^2$ = 81. The positive square root is called the principal square root.

• Square Root Property: If c is a positive number and if $x^2 = c$, then
$$x = \sqrt{c} \quad \text{or} \quad x = -\sqrt{c}.$$
(This can be written as one answer as $\pm \sqrt{c}$.) In other words, when solving a quadratic equation by the square root property, we want both the positive and negative square roots.

Common Mistakes to Avoid:
• Do NOT forget to include the negative square root in the answer.

• Before you apply the square root property make sure the squared term is isolated.

• $\sqrt{a + b} \neq \sqrt{a} + \sqrt{b}.$

Examples

1. $x^2 = 36$

$\sqrt{x^2} = \pm \sqrt{36}$

$x = \pm 6$

$x = -6, \quad x = 6$

2. $x^2 = 18$

$\sqrt{x^2} = \pm \sqrt{18}$

$x = \pm \sqrt{9}\sqrt{2}$

$x = \pm 3\sqrt{2}$

$x = -3\sqrt{2}, \quad x = 3\sqrt{2}$

3. $5x^2 - 125 = 0$

$5x^2 = 125$

$x^2 = 25$

$\sqrt{x^2} = \pm\sqrt{25}$

$x = \pm 5$

$x = -5, \qquad x = 5$

5. $(x - 3)^2 = 12$

$\sqrt{(x-3)^2} = \pm\sqrt{12}$

$x - 3 = \pm \sqrt{4}\sqrt{3}$

$x - 3 = \pm 2\sqrt{3}$

$x = 3 \pm 2\sqrt{3}$

$x = 3 - 2\sqrt{3}, \qquad x = 3 + 2\sqrt{3}$

4. $6x^2 - 240 = 0$

$6x^2 = 240$

$x^2 = 40$

$\sqrt{x^2} = \pm\sqrt{40}$

$x = \pm \sqrt{4}\sqrt{10}$

$x = \pm 2\sqrt{10}$

$x = -2\sqrt{10}, \qquad x = 2\sqrt{10}$

6. $(x + 4)^2 - 3 = 17$

$(x + 4)^2 = 20$

$\sqrt{(x+4)^2} = \pm\sqrt{20}$

$x + 4 = \pm \sqrt{4}\sqrt{5}$

$x + 4 = \pm 2\sqrt{5}$

$x = -4 \pm 2\sqrt{5}$

$x = -4 - 2\sqrt{5}, \qquad x = -4 + 2\sqrt{5}$

Practice Problems

Absolute Value:
1. A. $|-13|$, B. $|5 - 4|$
2. A. $-|4|$, B. $|7 - 9|$
3. $-|12 - 18|$
4. $-|20 - 15|$

Percents:
5. What is 25% of 120?
6. 15 is 12% of what number?
7. 8 is what percent of 400?
8. What percent of 30 is 6?
9. 40% of what number is 12?
10. 60% of what number is 15?
11. In 2010 there were 11,000 students in the Math Immersion Program. In 2011 there was a 3% increase in the number of students. How many students were there in the 2011 program?
12. In 2008 there were 875 fish in a pond. In 2009 there was an 8% decrease in the number of fish. How many fish were in the pond in 2009?
13. Kim answered 45 out of 60 questions correctly. What % of her answers are correct?
14. John answered 48 out of 80 questions correctly. What % of his answers are correct?
15. In 2013 the price of a house was $534,000. In 2014 there was a 22% increase in price. What was the price of the house   in 2014?
16. In September, there were 240 students registered for a calculus class. In February, there was a 15% decrease in enrollment. How many students were registered for the class in February?

Percent Increase and Decrease:
17. The US government classified 8 million documents as secret in 2001. By 2003, this number had increased to 14 million. What is the percent increase? (Source: Time, April 12, 2004)
18. Lynn is an accountant and charges $80 per hour. If she raises her hourly rate to $110 per hour, what is the percent increase?
19. A stock closed at $12 per share on Monday. By Friday, the closing price was $9 per share. What was the percent decrease?
20. To lose weight, Kelly reduced her calorie intake from 3000 calories per day to 1800 calories per day. What is the percent decrease in calories?
21. A student who scores a 90 on his first test in a class scores a 72 on the second test. Find the percent of increase/decrease.
22. An executive, who is earning $40,000 per year, receives an increase in salary and now earns $42,500 per year. What is her percent of increase in salary?

Ratios and Proportions:
23. In a school there 16 girls for every 12 boys. If a class in the school has 24 girls, how many boys should there be?
24. If 9 tires cost $540, what is the cost of 5 tires?
25. Don can read 40 pages of a book in 50 minutes. How many pages should he be able to read in 80 minutes?
26. If a car can travel 40 miles in 60 minutes, how far can it travel in 15 minutes?

Perimeter:

27. The length of a rectangle is one more than twice its width. What are the dimensions of the rectangle if the perimeter is 20ft?
28. The length of a rectangle is eight more than twice the width. What are the dimensions of the rectangle if the perimeter is 58ft?
29. The length of a rectangle is two more than three times the width. What are the dimensions of the rectangle if the perimeter is 100ft?

Solving Systems of Equations:

30. Is (2,3) a solution to the system?
$$3x + 4y = 18$$
$$2x - y = 1$$

31. Is $(2, -1)$ a solution to the system?
$$x - 2y = 4$$
$$2x + y = 3$$

32. Is $(-1, -1)$ a solution to the system?
$$x - 4y = 3$$
$$3x + y = 2$$

33. Is $(1, -2)$ a solution to the system?
$$3x - y = 5$$
$$2x + 5y = -8$$

34. Is (2,5) a solution to the system?
$$3x + 2y = 16$$
$$2x - 3y = 11$$

35. Is $(0, -3)$ a solution to the system?
$$4x - 3y = 9$$
$$2x + 5y = -15$$

Solving Systems of Equations by Graphing:

36. $y = x - 3$
$y = -x + 5$

37. $y = -x + 5$
$y = 2x - 4$

38. $y = \frac{2}{3}x - 5$
$y = -2x + 3$

39. $y = -\frac{1}{2}x + 1$
$y = x - 2$

40. $3x - y = 3$
$2x + y = 2$

41. $x - y = 3$
$x + y = 3$

Square Root Property:

42. $x^2 = 121$
43. $x^2 = 72$
44. $3x^2 - 300 = 0$
45. $(x + 2)^2 = 52$
46. $x^2 = 64$
47. $x^2 = 45$
48. $7x^2 - 112 = 0$
49. $(x - 5)^2 = 108$