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Date: _____ Period: _____

SECONDARY MATH II
Module 3 Study Guide: Quadratic Equations

Directions: Show ALL work.

Simplify the following expressions using exponent rules and relationships. Write your answers in exponential form with no negative exponents in your answer.

1. $\frac{5^3}{5^2} = 5^{3-2} = 5^1 = 5$ 2. $x^4 \cdot x^6 = x^{4+6} = x^{10}$ 3. $\frac{7^{-2}y^2}{7^{-8}y} = 7^{-2-(-8)} \cdot y^{2-1}$
 $= 7^6 y$

Simplify each radical below, using $i = \sqrt{-1}$ or $i^2 = -1$ if necessary.

4. $\sqrt{18} = \sqrt{9 \cdot 2} = 3\sqrt{2}$ 5. $\sqrt[3]{32} = \sqrt[3]{8 \cdot 4} = 2\sqrt[3]{4}$ 6. $\sqrt{-45} = \sqrt{-1 \cdot 9 \cdot 5} = i \cdot 3 \cdot \sqrt{5} = 3i\sqrt{5}$

Simplify the following imaginary/complex numbers.

7. $(2i)(5i) = 2 \cdot 5 \cdot i \cdot i = 10i^2 = 10(-1) = -10$ 8. $2i^2 = 2(-1) = -2$ 9. $(3 + 2i) + (4 - i) = 3 + 4 + 2i - i = 7 + i$

Simplify the following radicals.

10. $3\sqrt{2} + 4\sqrt{2} - \sqrt{2} = (3+4-1)\sqrt{2} = 6\sqrt{2}$ 11. $\sqrt{27} - 2\sqrt{3} + 2\sqrt{6} = \sqrt{9 \cdot 3} - 2\sqrt{3} + 2\sqrt{6} = 3\sqrt{3} - 2\sqrt{3} + 2\sqrt{6} = \sqrt{3} + 2\sqrt{6}$ 12. $(-4\sqrt{5}) \cdot (2\sqrt{3}) = -4 \cdot 2 \cdot \sqrt{5} \cdot \sqrt{3} = -8\sqrt{15}$

Graph the following quadratic functions. Use a table of values or a graphing calculator to help you. Mark and label the axis of symmetry, the vertex, and two points on each side of the axis of symmetry.

13. $f(x) = (x - 1)(x + 3)$ 14. $f(x) = -(x + 1)^2 + 4$ 15. $f(x) = x^2 - x - 12$

Solve the following quadratic equations for the x-intercepts (also called roots, zeroes, or solutions) by factoring, completing the square, taking square roots, or using the quadratic formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. Simplify radicals as much as possible and use $i = \sqrt{-1}$ or $i^2 = -1$ if necessary. Round any decimals to two decimal places.

16. $x^2 - 8x = -12$

$$x^2 - 8x + 12 = 0$$

$$(x-6)(x-2) = 0$$

$$\boxed{x = 6, 2}$$

17. $n^2 - 24 = 2n$

$$n^2 - 2n - 24 = 0$$

$$(n-6)(n+4) = 0$$

$$\boxed{n = 6, -4}$$

18. $5x^2 - 2 = 318$

$$\begin{array}{r} +2 \quad +2 \\ \hline 5x^2 = 320 \\ \hline \frac{5x^2}{5} = \frac{320}{5} \\ \sqrt{x^2} = \sqrt{64} \\ \boxed{x = \pm 8} \end{array}$$

19. $7n^2 - 6 = -90$

$$\begin{array}{r} +6 \quad +6 \\ \hline 7n^2 = -84 \\ \hline \frac{7n^2}{7} = \frac{-84}{7} \\ \sqrt{n^2} = \sqrt{-12} \\ n = \sqrt{-1} \cdot \sqrt{4} \cdot \sqrt{3} \\ \boxed{n = \pm 2i\sqrt{3}} \end{array}$$

20. $11x^2 + 4x = -4$

$a=11, b=4, c=-4$

$$11x^2 + 4x + 4 = 0$$

$$x = \frac{-4 \pm \sqrt{(4)^2 - 4 \cdot 11 \cdot 4}}{2 \cdot 11} = \frac{-4 \pm \sqrt{-160}}{22}$$

$$= \frac{-4 \pm \sqrt{-1} \cdot \sqrt{16} \cdot \sqrt{10}}{22} = \frac{-4 \pm 4i\sqrt{10}}{22}$$

$$= \frac{-2 \pm 2i\sqrt{10}}{11} \rightarrow \boxed{\frac{-2 + 2i\sqrt{10}}{11} \text{ and } \frac{-2 - 2i\sqrt{10}}{11}}$$

21. $3n^2 = 12n + 36$

$a=3, b=-12, c=-36$

$$3n^2 - 12n - 36 = 0$$

$$x = \frac{-(-12) \pm \sqrt{(-12)^2 - 4 \cdot 3 \cdot (-36)}}{2 \cdot 3} = \frac{12 \pm \sqrt{576}}{6}$$

$$= \frac{12 \pm 24}{6} \rightarrow \frac{12+24}{6} \text{ and } \frac{12-24}{6}$$

$$\boxed{x = 6 \text{ and } -2}$$

22. $4a^2 - 8a - 33 = -4$

$$4a^2 - 8a - 29 = 0$$

$$4a^2 - 8a + 4 = 33$$

$$\frac{4(a-1)^2}{4} = \frac{33}{4}$$

$$\sqrt{(a-1)^2} = \sqrt{\frac{33}{4}}$$

$$a-1 = \pm \frac{\sqrt{33}}{2}$$

$$\boxed{a = 1 + \frac{\sqrt{33}}{2} \text{ and } 1 - \frac{\sqrt{33}}{2}}$$

add 33 to get -29 to equal 4.

23. $n^2 + 20n - 105 = -9$

$$n^2 + 20n - 96 = 0$$

$$+196 + 196$$

$$n^2 + 20n + 100 = 196$$

$$(n+10)(n+10) = 196$$

$$\sqrt{(n+10)^2} = \sqrt{196}$$

$$n+10 = \pm 14$$

$$\frac{-10 \quad -10}{-10 \quad -10}$$

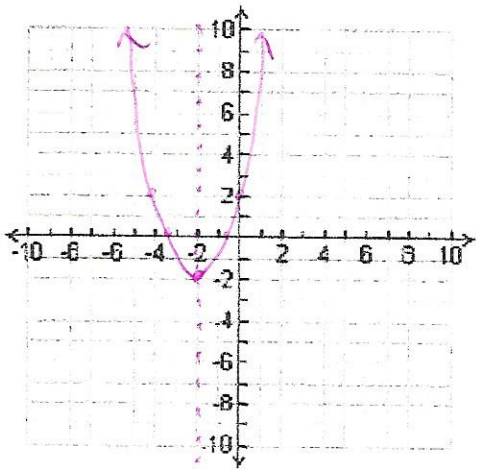
$$n = -10 \pm 14$$

$$n = -10 + 14 \text{ and } -10 - 14$$

$$\boxed{n = 4 \text{ and } -24}$$

add 196 to -96 to get 100

24. Graph $f(x) = (x + 2)^2 - 2$



25. For #24, write the quadratic in the following forms:

Standard Form: $x^2 + 4x + 2$

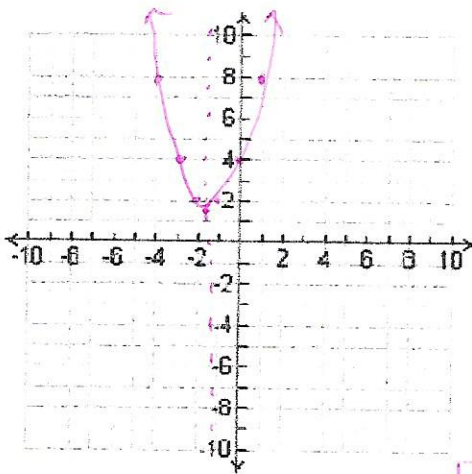
Factored Form: $(x + 2 + \sqrt{2})(x + 2 - \sqrt{2})$

$$(x+2)(x+2) - 2 = x^2 + 4x + 4 - 2 = x^2 + 4x + 2$$

$a=1$
 $b=4$
 $c=2$

$$x = \frac{-4 \pm \sqrt{16 - 4 \cdot 1 \cdot 2}}{2 \cdot 1} = \frac{-4 \pm \sqrt{8}}{2} = \frac{-4 \pm 2\sqrt{2}}{2} = -2 \pm \sqrt{2}$$

26. Graph $f(x) = x^2 + 3x + 4$



27. For #26, write the quadratic in the following forms:

Vertex Form: $(x + 1.5)^2 + 1.75$

Factored Form: $(x + \frac{3+i\sqrt{7}}{2})(x + \frac{3-i\sqrt{7}}{2})$

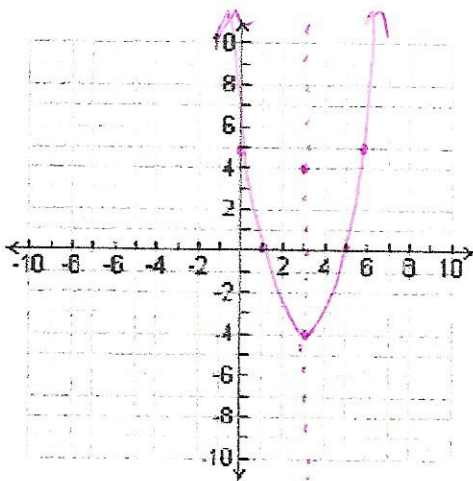
$a=1$
 $b=3$
 $c=4$

$$x = \frac{-3 \pm \sqrt{9 - 4 \cdot 1 \cdot 4}}{2} = \frac{-3 \pm \sqrt{-7}}{2} = \frac{-3 \pm i\sqrt{7}}{2}$$

Handwritten notes for #26:

- Completing the square: $x^2 + 3x + 4 = 0$. Subtract 1.75 to get $x^2 + 3x + 2.25 = -1.75$. Then $(x + 1.5)^2 = -1.75$.
- Factored form: $(x + 1.5)(x + 1.5) = -1.75$.

28. Graph $f(x) = (x - 1)(x - 5)$



29. For #28, write the quadratic in the following forms:

Standard Form: $x^2 - 6x + 5$

Vertex Form: $(x - 3)^2 - 4$

Handwritten notes for #28:

- Completing the square: $x^2 - 6x + 5 = 0$. Add 4 to get $x^2 - 6x + 9 = -4$. Then $(x - 3)^2 = -4$.

$$x^2 - 6x + 5 = 0$$

$$\begin{array}{r} x^2 - 6x + 5 = 0 \\ +4 \quad +4 \\ \hline x^2 - 6x + 9 = -4 \\ (x-3)(x-3) = -4 \\ (x-3)^2 - 4 = 0 \end{array}$$