Name: _KEY_

10.1 Exploring Quadratic Graphs: $y=ax^2+c$

1. Complete the table of values and graph.

| x	(a) $y=(x)^2$	(b) $y=\frac{1}{2}(x)^2$	(c) $y=2x^2$
-2	$(-2)^2=4$	2	8
-1	$(-1)^2=1$	0.5	2
0	$(0)^2=0$	0	0
1	$(1)^2=1$	0.5	2
2	$(2)^2=4$	2	8
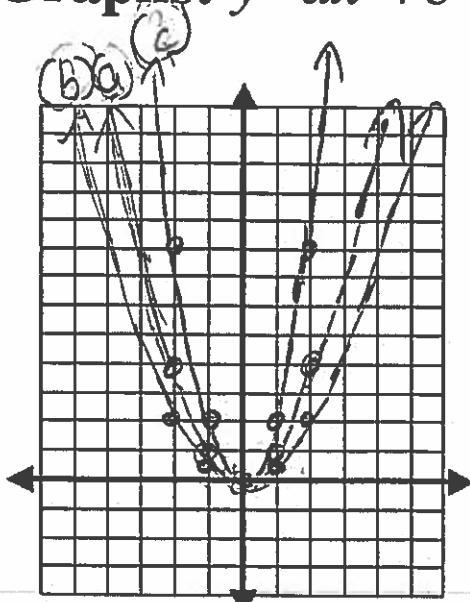
What was the effect of multiplying $y=x^2$ by $a=\frac{1}{2}$ and $a=2$? What is the vertex of the parabolas? $V(0,0)$

AOS: $x=0$

wider   narrower

2. Complete the table of values and graph.

x	(a) $y=(x)^2$	(b) $y=-\frac{1}{2}(x)^2$	(c) $y=-2x^2$
-2	4	-2	-8
-1	1	-0.5	-2
0	0	0	0
1	1	-0.5	-2
2	4	-2	-8
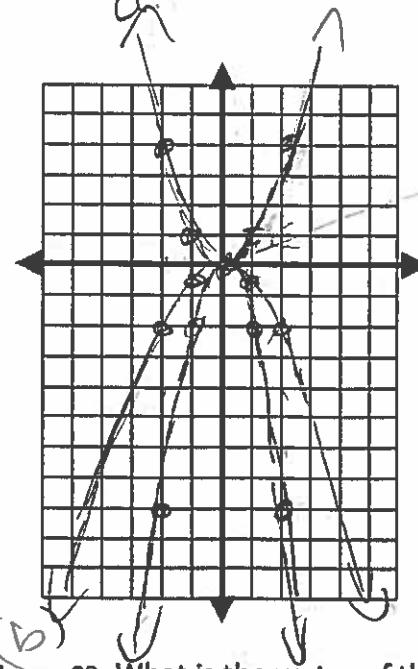
What was the effect of *multiplying* $y=x^2$ by $a=-\frac{1}{2}$ and $a=-2$? What is the vertex of these parabolas?

flips upside down =>
REFLECTS

$V(0,0)$

AOS: $x=0$

3. Complete the table of values and graph.

(a)

| x	$y=(x)^2$	$y=(x)^2-4$	$y=(x)^2+3$
−2	4	0	7
−1	1	−3	4
0	0	−4	3
1	1	−3	4
2	4	0	7
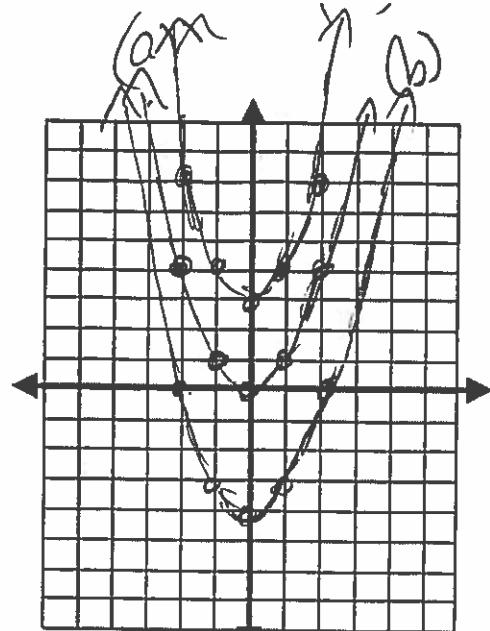
What was the effect of *adding* $k=-4$ and $k=3$ to $y=x^2$? What is the vertex of these parabolas?

AOS: x=0

down 4   up 4

V (0,−4)   V(0,3)

Homework 10.1 #s 1-20:

Identify the vertex of each graph. Tell whether it is a minimum or maximum.

1.

V(2,5)
max

2.

V(−3,−2)
min.

3.
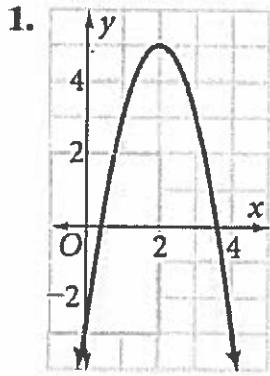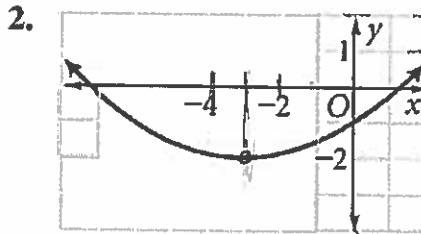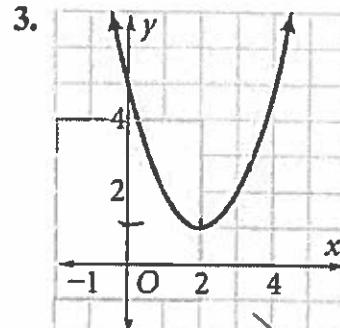
V(2,1)
min.

Graph each function.

4. $y = -4x^2$
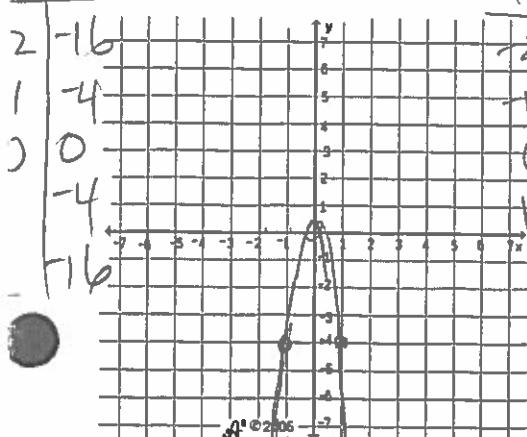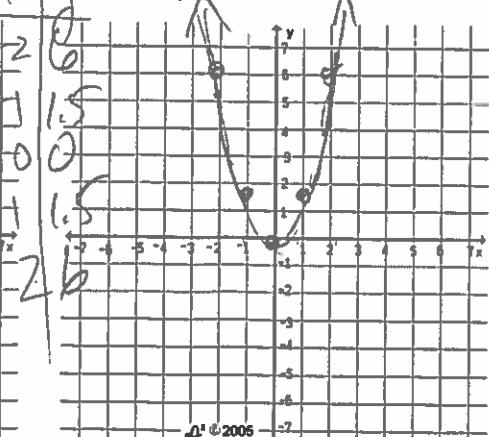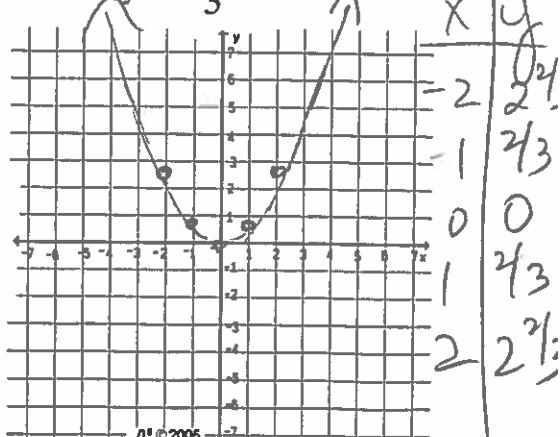
x	y
2	−16
1	−4
0	0
−4	
−16	

5. $f(x) = 1.5x^2$

x	y
−2	6
−1	1.5
0	0
1	1.5
2	6

6. $y = \frac{2}{3}x^2$

x	y
−2	2⅔
−1	⅔
0	0
1	⅔
2	2⅔

7. $f(x) = -\frac{1}{2}x^2$

8. $y = -\frac{1}{3}x^2$

9. $f(x) = 3x^2$

$$\begin{array}{c|c}
-2 & -4/3 \\
-1 & -1/3 \\
0 & 0 \\
1 & -1/3 \\
2 & -1/3
\end{array}$$
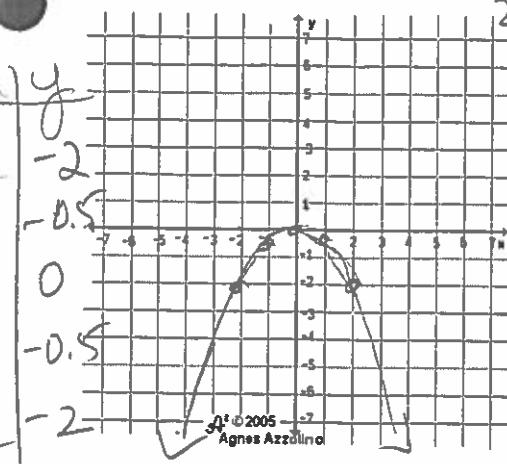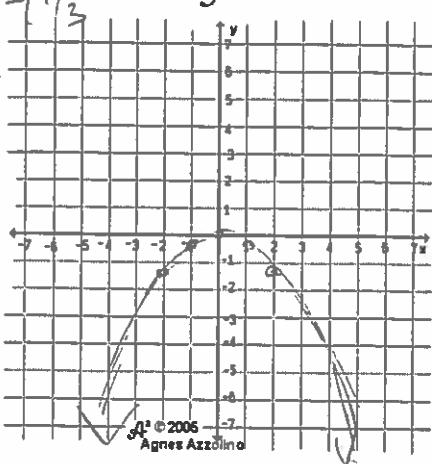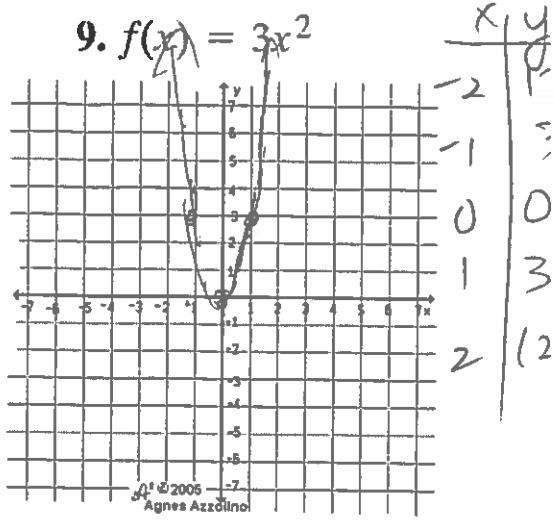
$$\begin{array}{c|c}
x & y \\
-2 & \\
-1 & \\
0 & 0 \\
1 & 3 \\
2 & 12
\end{array}$$

Order each group of quadratic functions from widest to narrowest graph.

10. $y = 3x^2, y = \frac{1}{2}x^2, y = 4x^2$

middle widest narrowest

11. $f(x) = 5x^2, f(x) = \frac{1}{3}x^2, f(x) = 1x^2$

narrowest widest middle

12. $y = -\frac{1}{2}x^2, y = 5x^2, y = -\frac{1}{4}x^2$

middle narrowest widest

13. $f(x) = -2x^2, f(x) = -\frac{2}{3}x^2, f(x) = -4x^2$

middle widest narrowest

Graph each function.

up 2

14. $f(x) = x^2 + 2$

down 3

15. $y = x^2 - 3$

16. $y = \frac{1}{2}x^2 + 4$

$$\begin{array}{c|c}
 & y \\
-2 & 6 \\
 & 3 \\
 & 2 \\
 & 3 \\
2 & 6
\end{array}$$

$$\begin{array}{c|c}
x & y \\
-2 & 1 \\
-1 & -2 \\
0 & -3 \\
1 & -2 \\
2 & 1
\end{array}$$
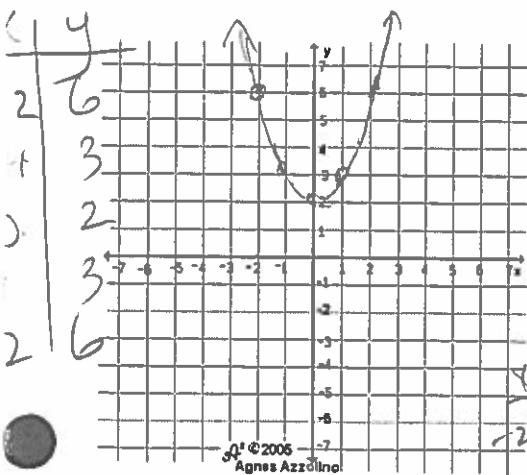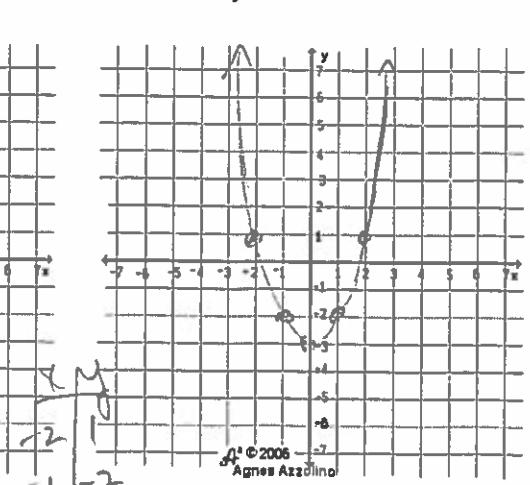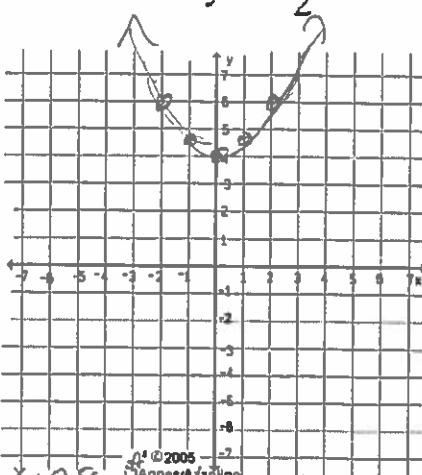
$$\begin{array}{c|c|c}
x & 0.5x & y \\
-2 & 1/2(4)+4 = 2+4 & 6 \\
-1 & 1/2(1)+4 = 1/2+4 & 4.5 \\
0 & 1/2(0)+4 = 0+4 & 4 \\
1 & 1/2(1)+4 = 1/2+4 & 4.5 \\
2 & 1/2(4)+4 = 2+4 & 6
\end{array}$$

17. $f(x) = -x^2 - 1$

18. $y = -2x^2 + 2$

19. $f(x) = 4x^2 - 7$

A² © 2005 Agnes Azzolino

A² © 2005 Agnes Azzolino

A² © 2005 Agnes Azzolino
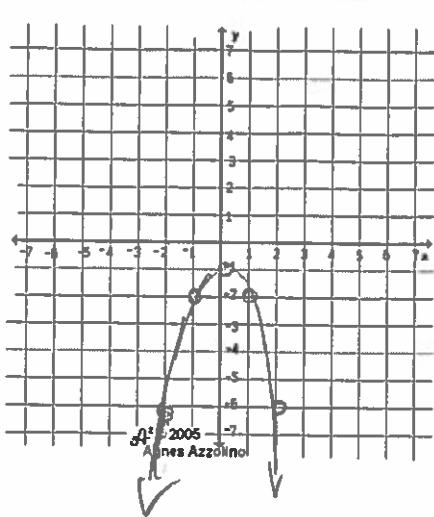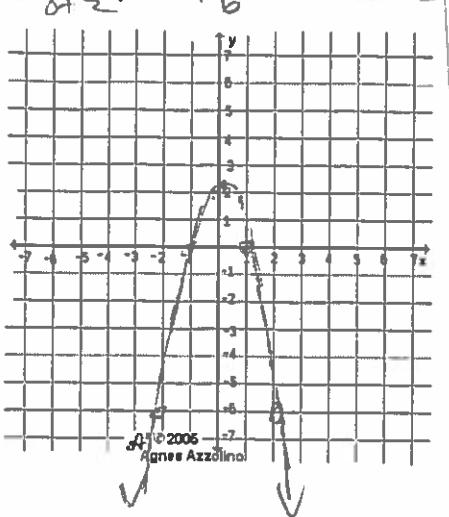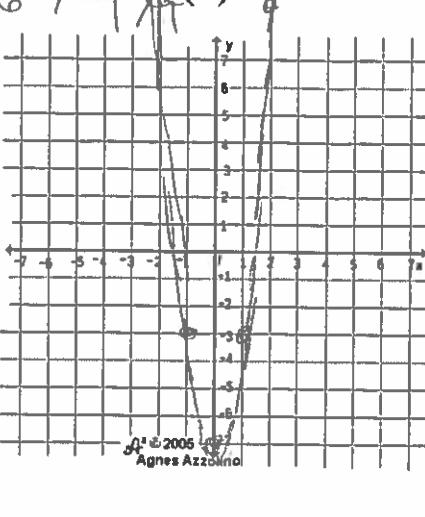
20. A gull drops a clam shell onto some rocks from a height of 50 ft. The function $h = -16t^2 + 50$ gives the shell's approximate height h in feet after t seconds. Graph the function.
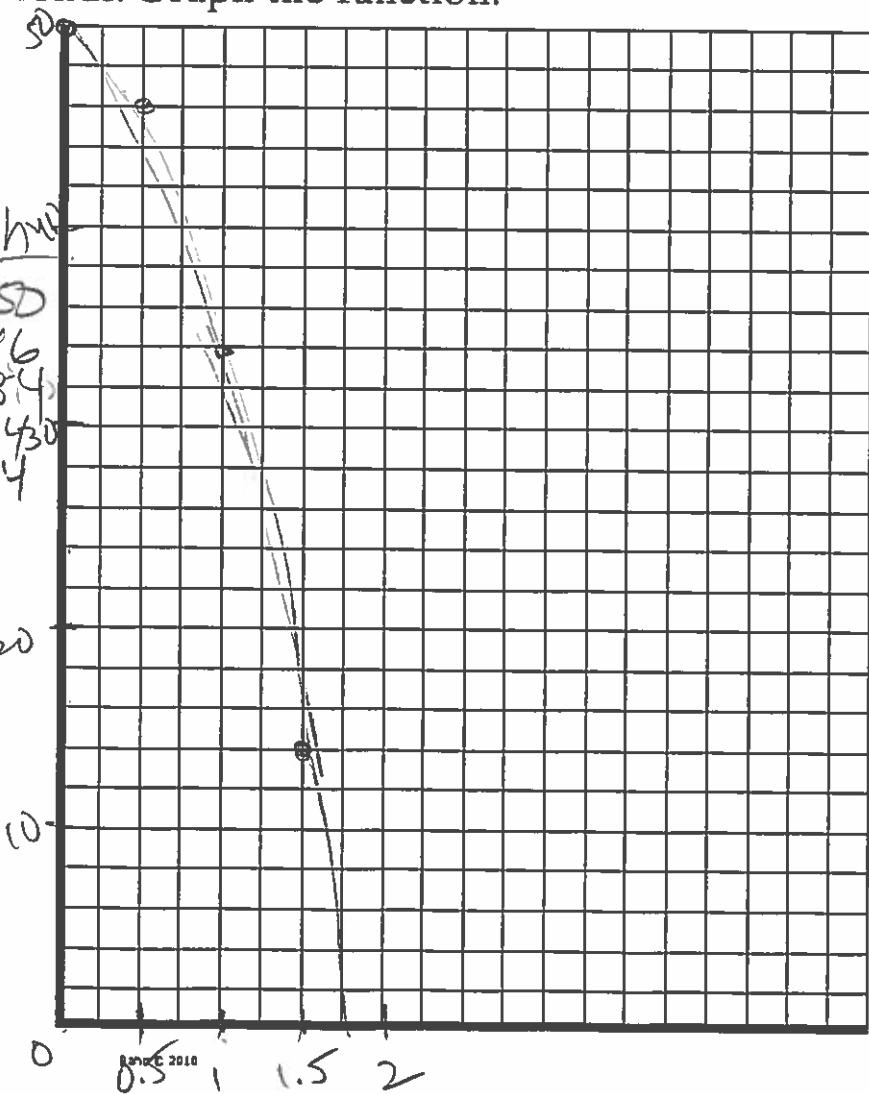
Graphing a Quadratic Functions: Axis of Symmetry

Axis of Symmetry Formula: $x=-b/2a$

$$AOS: x=\frac{-b}{2a}$$

$\frac{2}{a}$

Example: $y=-4x^2+16x+2$

$y = ax^2 + bx + c$

1. What is the axis of symmetry of the quadratic function? Draw it on the graph.

$a=-4$
$b=16$
$c=2$

$x=\frac{-16}{2(-4)} = \frac{-16}{-8} = 2$

AOS: $x=2$

2. Use the axis of symmetry to find the coordinates of the vertex. Plot this point. $V(2, 18)$

$y=-4(2)^2+16(2)+2$
$= -16+32+2$
$= 18$

3. How can we plot more points to make our parabola?

X	$-4(x)^2+16(x)+2$	y
0	$0+0+2$	2
1	$-4+16+2$	14
2	$-16+32+2$	18
3	$-36+48+2$	14
4	$-64+64+2$	2
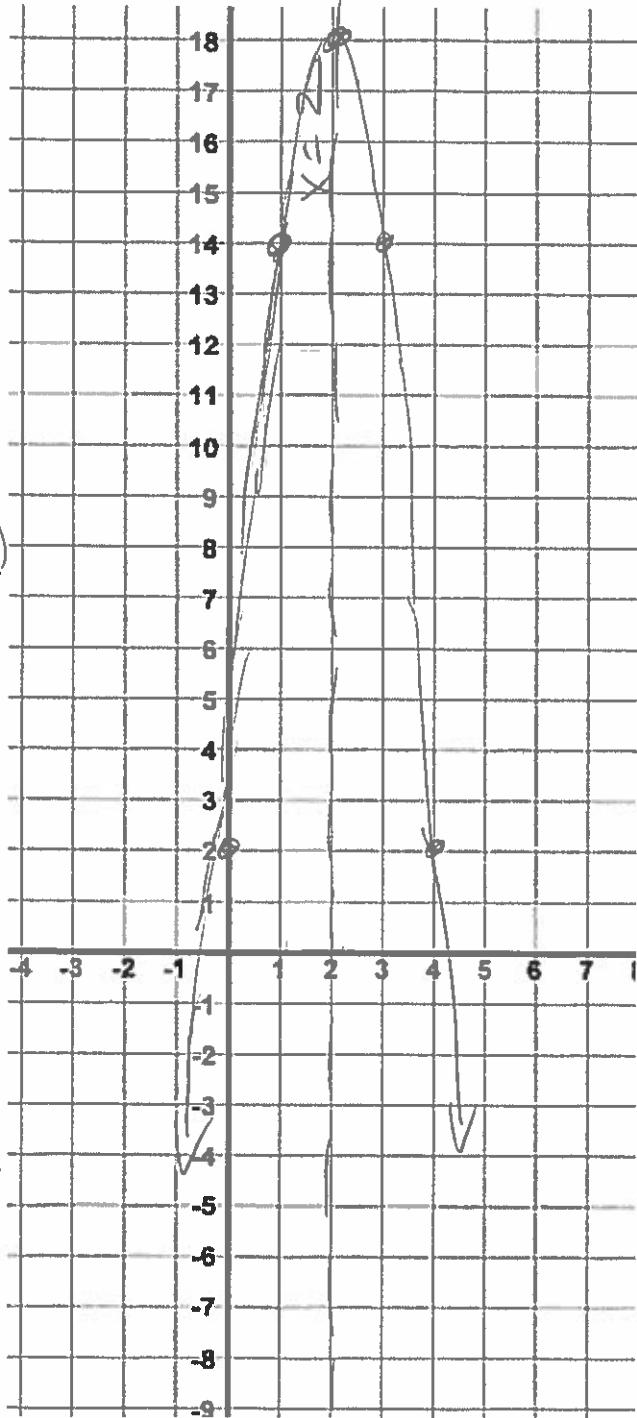
10.2 #s 1-16 Homework

Find the equation of the axis of symmetry and the coordinates of the vertex of the graph of each function.

1. $y = 2x^2 + 4$

$= 2x^2 + 0x + 4$ $x = \frac{-0}{2(2)} = \frac{-0}{4} = 0$

$a = 2$ $b = 0$ $c = 4$ $y = 2(0)^2 + 4 = 0 + 4 = 4$

$V(0, 4)$ AOS: $x = 0$

2. $f(x) = 2x^2 + 4x - 5$ $x = \frac{-4}{2(2)} = \frac{-4}{4} = -1$

a b c AOS: $x = -1$

$V(-1, -7)$ $y = 2(-1)^2 + 4(-1) - 5 = 2 - 4 - 5 = -7$

3. $y = 1x^2 - 8x - 9$

$a = 1$ $b = -8$ $c = -9$ $x = \frac{-(-8)}{2(1)} = \frac{8}{2} = 4$ AOS: $x = 4$

$y = (4)^2 - 8(4) - 9 = 16 - 32 - 9 = -25$ $V(4, -25)$

4. $y = 3x^2 - 9x + 5$

a b c $x = \frac{-(-9)}{2(3)} = \frac{9}{6} = \frac{3}{2} = 1.5$ AOS: $x = 1.5$

$y = 3(1.5)^2 - 9(1.5) + 5 = 6.75 - 13.5 + 5 = -1.75$ $V(1.5, -1.7)$

Match each graph with its function.

A. $y = x^2 - 6x + 2$ $x = \frac{-(-6)}{2} = \frac{6}{2} = 3$ B. $y = x^2 + 6x + 5$ $x = \frac{-6}{2(1)} = -3$ C. $y = -x^2 - 6x$ $x = \frac{-(-6)}{2(-1)} = \frac{6}{-2} = -3$

D. $y = -x^2 + 6x + 1$ $x = \frac{-6}{2(-1)} = \frac{-6}{-2} = 3$ E. $y = -x^2 + 6$ $x = \frac{-6}{2(1)} = \frac{-6}{2}$ $x = -3$ F. $y = x^2 - 6$

B 5.

E 6.

C 7.

F 8.

A 9.

D 10.
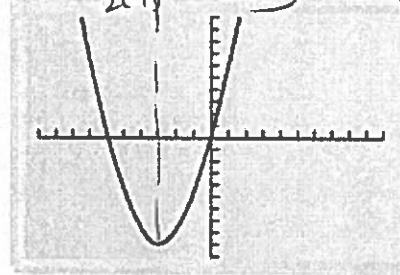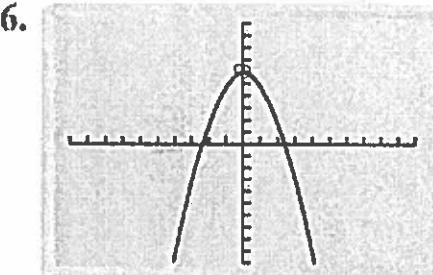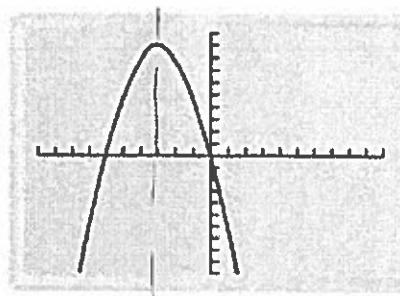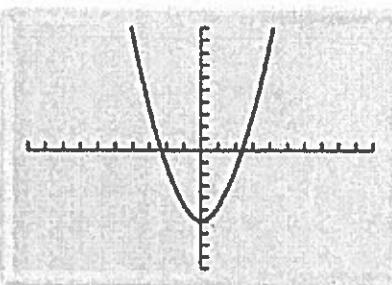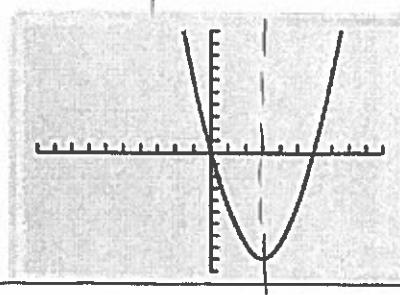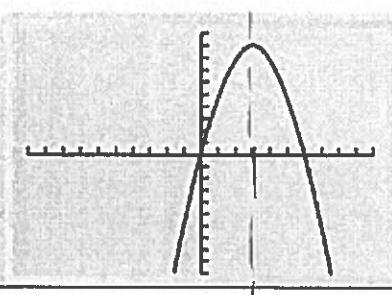
Graph each function. Label the axis of symmetry and the vertex. AOS: $x = \frac{-(-6)}{2(2)} = \frac{6}{4}$

11. $f(x) = x^2 + 4x + 3$ AOS: $x = \frac{-4}{2(1)} = \frac{-4}{2}$ **12.** $y = 2x^2 - 6x + 0$ $x = 1.5$

$x = -2$
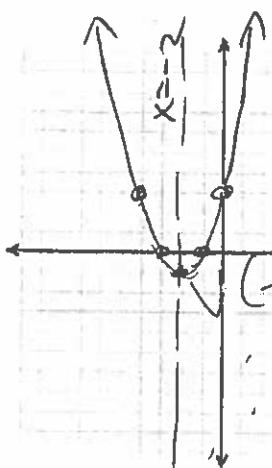
x	$(x)^2 + 4(x) + 3$	y
-4	$16 - 16 + 3$	3
-3	$9 - 12 + 3$	0
-2	$4 - 8 + 3$	-1
-1	$1 - 4 + 3$	0
0	$0 + 0 + 3$	3

$(-2, -1)$

x	$2(x)^2 - 6(x)$	y
0	$0 - 0$	0
1	$2 - 6$	-4
1.5	$4.5 - 9$	-4.5
2	$8 - 12$	-4
3	$18 - 18$	0

$N(1.5, -4.5)$
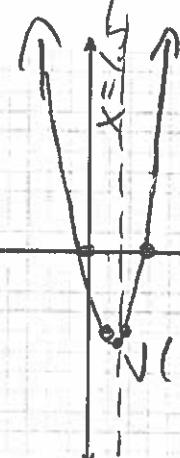
AOS: $x = \frac{-4}{2(-1)} = \frac{-4}{-2} = 2$ AOS: $x = \frac{-3}{2(2)} = \frac{-3}{4}$

13. $y = -x^2 + 4x - 4$ $x = 2$ **14.** $y = 2x^2 + 3x + 1$
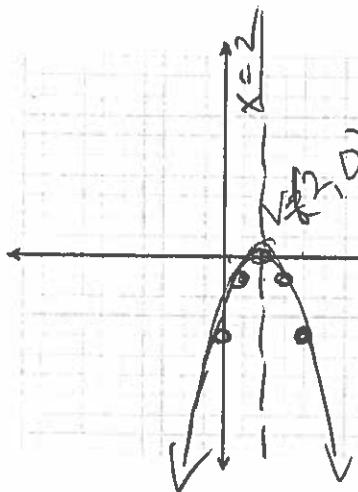
x	$-(x)^2 + 4(x) - 4$	y
0	$0 + 0 - 4$	-4
1	$-1 + 4 - 4$	-1
2	$-4 + 8 - 4$	0
3	$-9 + 12 - 4$	-1
4	$-16 + 16 - 4$	-4

$(2, 0)$
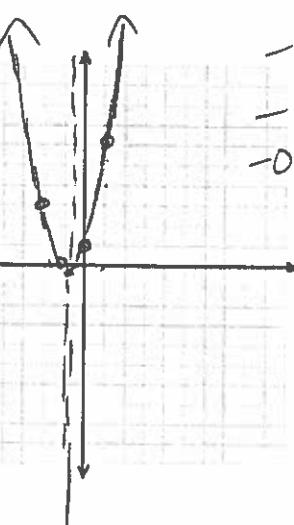
x	$2(x)^2 + 3(x) + 1$	
-2	$8 - 6 + 1$	
-1	$2 - 3 + 1$	
-0.75		$-1/8$ or $-0.$
0	$0 + 0 + 1$	
1	$2 + 3 + 1$	

15. Gardening Suppose you have 80 ft of fence to enclose a rectangular garden. The function $A = 40x - x^2$ gives you the area of the garden in square feet where x is the width in feet. $A = -x^2 + 40x + 0$

a. What width gives you the maximum gardening area? Max area is at the vertex

b. What is the maximum area? $V(20, 400)$ $x = \frac{-40}{2(-1)} = \frac{-40}{-2} = 20$ ft

Max area is at the vertex: $V(20, 400)$

$A = 40(20) - (20)^2 = 800 - 400 = 400$ ft²

16. A ball is thrown into the air with an upward velocity of 40 ft/s. Its height h in feet after t seconds is given by the function $h = -16t^2 + 40t + 6$.

a. In how many seconds does the ball reach its maximum height?

b. What is the ball's maximum height?

(a) AOS: $t = \frac{-40}{2(-16)} = \frac{-40}{-32} = 1.25$ s

(b) $V(1.25, 31)$ $h = -16(1.25)^2 + 40(1.25) + 6 = 31$ ft

Name: **KEY**

10.3 Notes

Quadratic Equation

$y = (x)^2 - 3$

$y = x^2 - 3$

Describe the graph in comparison to $y = x^2$.

Same width ($a = 1$)

opens upward / $\cup$ is min.

down 3

AOS: $x = 0$

$V(0, -3)$

Table	
x	y
-2	$4 - 3$ → 1
-1	$1 - 3$ → -2
0	$0 - 3$ → -3
1	-2
2	1

Graph

$V(0, -3)$

$x = 0$
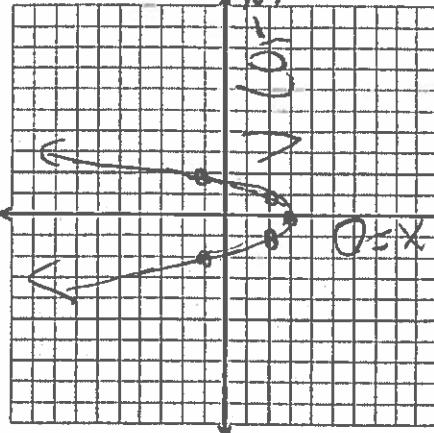
Solve for x when y=0

$0 = x^2 - 3$

$+3 \qquad +3$

$3 = x^2$

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

$x = \pm 1.7$

Quadratic Equation

$y = \frac{1}{2}(x)^2 - 6$

$y = \frac{1}{2} x^2 - 6$

Describe the graph in comparison to $y = x^2$.

wider $(a = \frac{1}{2})$

opens upward ($\cup = $ min)

down 6

AOS: $x = 0$

$V(0, -6)$

Table	
x	y
-2	$\frac{1}{2}(-2)^2 - 6$ → -4
-1	$\frac{1}{2}(-1)^2 - 6$ → -5.5
0	$\frac{1}{2}(0)^2 - 6$ → -6
1	$\frac{1}{2}(1)^2 - 6$ → -5.5
2	$\frac{1}{2}(2)^2 - 6$ → -4

Graph

$V(0, -6)$
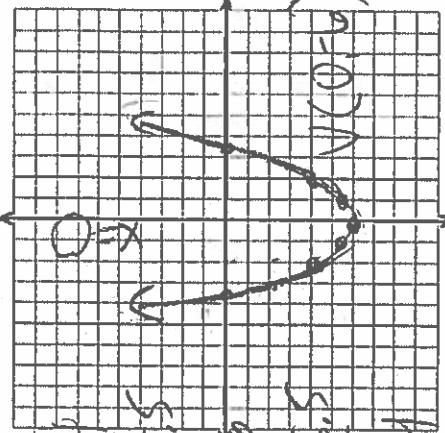
Solve for x when y=0

$0 = \frac{1}{2}x^2 - 6$

$+6 \qquad +6$

$(\frac{2}{1})6 = \frac{1}{2}x^2(\frac{2}{1})$

$\sqrt{12} = \sqrt{x^2}$

$x = \pm 3.5$

Problem 1

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

Describe the graph in comparison to $y=x^2$.

- Same width ($a=1$)
- upside down ($\cup \to \cap$) nox
- up 4
- AOS: $x=0$
- $V(0,4)$

x	$y = -(x)^2 + 4$
-2	0
-1	3
0	4
1	3
2	0

$0 = -1x^2 + 4$
$-4 \quad\quad -4$
$\dfrac{-4}{-1} = \dfrac{-1x^2}{-1}$
$\sqrt{4} = \sqrt{x^2}$
$\boxed{x = \pm 2}$

Problem 2
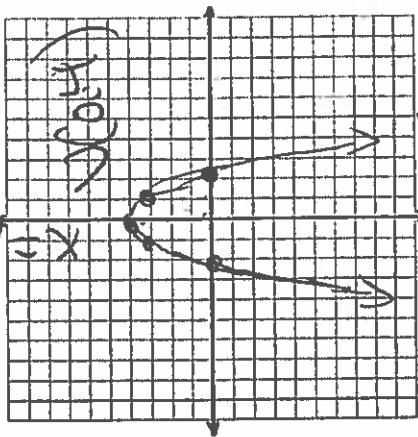
$y = -(\tfrac{1}{2})(x)^2 + 9$

Describe the graph in comparison to $y=x^2$.
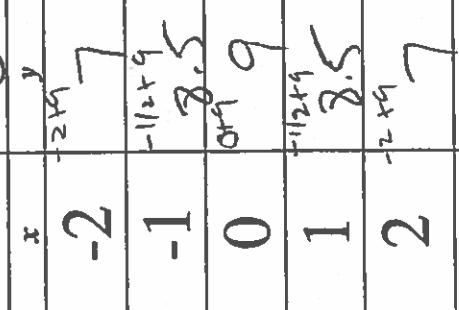
- wider ($a=\tfrac{1}{2}$)
- upside down
- up 9
- AOS: $x=0$
- $V(0,9)$

x	$y = -\tfrac{1}{2}x^2 + 9$
-2	7
-1	8.5
0	9
1	8.5
2	7

$0 = -\tfrac{1}{2}x^2 + 9$
$-9 \quad\quad -9$
$-9 = -\tfrac{1}{2}x^2$
$\sqrt{\ } = \sqrt{x^2}$
$\boxed{x = \pm 4.2}$

Problem 3

$y = 2(x)^2 - 5$

Describe the graph in comparison to $y=x^2$.

- narrower ($a=2$)
- opens upward ($\cup$)
- down 5
- AOS: $x=0$
- $V(0,-5)$

x	$y = 2x^2 - 5$
-2	3
-1	-3
0	-5
1	-3
2	3

$0 = 2x^2 - 5$
$+5 \quad\quad +5$
$\dfrac{5}{2} = \dfrac{2x^2}{2}$
$\sqrt{2.5} = \sqrt{x^2}$
$\boxed{x = \pm 1.6}$

Name _____15-7_____ Class _____ Date _____
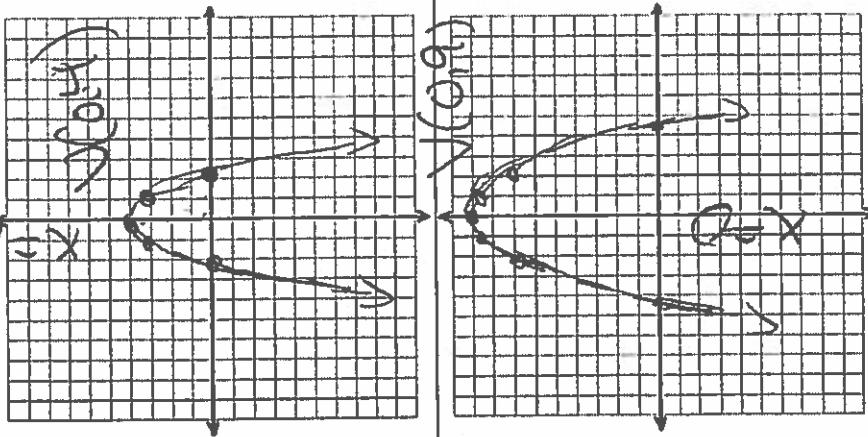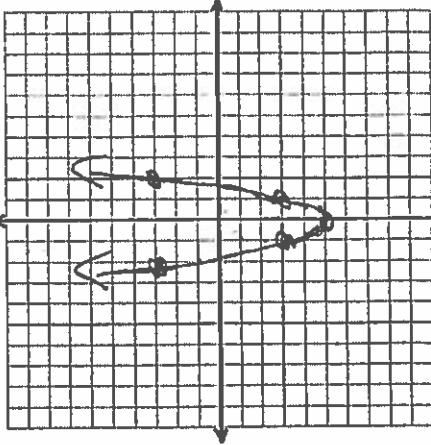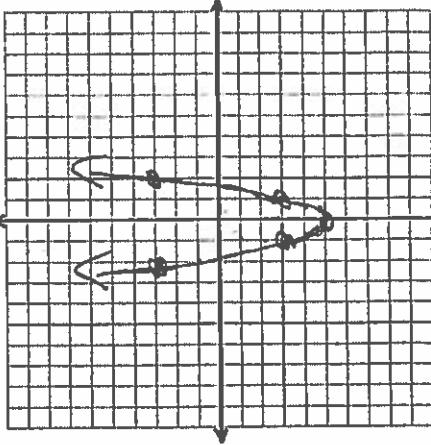
Practice 10-3

Solving Quadratic Equation

Solve each equation by graphing the related function. If the equation has
no solution, write *no solution*.

1. $\sqrt{x^2} = \sqrt{16}$ $x = \pm 4$

2. $x^2 - 144 = 0$

3. $3x^2 - 27 = 0$ $3x^2 = 27$ $x = \pm 3$ $x^2 = \sqrt{9}$

4. $x^2 + 16 = 0$ $\sqrt{x^2} = \sqrt{-16}\,\emptyset$

5. $x^2 = 25$ ± 5

6. $x^2 = 49$

7. $x^2 + 8 = -10$ $x^2 = -18\,\emptyset$

8. $3x^2 = 300$

9. $2x^2 - 6 = 26$ $2x^2 = 32$ $x = \pm 4$ $x^2 = 16$

10. $\sqrt{x^2} = \sqrt{80}$ ± 8.9

11. $81x^2 - 10 = 15$ $81x^2 = 25$ $x = \pm 5/9$

12. $2x^2 = 90$

13. $x^2 = 300$ ± 17.3

14. $4x^2 + 9 = 41$

15. $2x^2 + 8 = 4$ $2x^2 = -4\,\emptyset$ $-8\,-8$

16. $x^2 + 8 = 72$ ± 8 $x^2 = 64$

17. $4x^2 + 6 = 7$ $4x^2 = 1$ $x^2 = \frac{1}{4}$ $x = \pm \frac{1}{2}$

18. $x^2 = 121$

19. $5x^2 + 20 = 30$ $5x^2 = 10$ $x^2 = 2$ ± 1.4

20. $x^2 + 6 = 17$

21. $3x^2 + 1 = 54$ $3x^2 = 53$ $\sqrt{x^2} = \sqrt{17.6}$ $x = \pm 4$

22. $2x^2 - 7 = 74$ ± 40.5

23. $x^2 + 1 = 0$ $x^2 = -1\,\emptyset$

24. $4x^2 - 8 = -20$

25. $9x^2 = 1$ $\pm \frac{1}{3}$

26. $x^2 + 4 = 4$

27. $3x^2 = 1875$ $x^2 = 625$ $x = \pm 25$

28. $x^2 = 9$ ± 3

29. $5x^2 - 980 = 0$ $5x^2 = 980$ $x^2 = 196$ $x = \pm 14$

30. $x^2 - 10 = 100$

31. $4x^2 - 2 = 1$ $x^2 = \frac{3}{4}$ ± 0.87

32. $3x^2 - 75 = 0$

33. $x^2 + 25 = 0$ $x^2 = -25\,\emptyset$

34. $2x^2 - 10 = -4$

35. $4x^2 + 3 = 3$ $4x^2 = 0$ $x^2 = 0$ $x = 0$ $-3\,-3$

36. $4x^2 - 8 = 32$

37. $7x^2 + 8 = 15$ $7x^2 = 7$ $x^2 = 1$ $x = \pm 1$

38. $x^2 + 1 = 26$

39. $\frac{6x^2}{6} = \frac{-3}{6}$ $\emptyset$

40. $x^2 - 400 = 0$ $5x^2 = 65$

41. $7x^2 - 8 = 20$ $7x^2 = 28$ $x^2 = 4$ $x = \pm 2$

42. $2x^2 - 1400 = 0$

43. $5x^2 + 25 = 90$ $x^2 = 13$ $x = \pm 3.6$

44. $x^2 + 4x^2 = 20$ $x^2 = 3$

45. $5x^2 - 18 = -23$ $5x^2 = -5\,\emptyset$

46. $3x^2 - x^2 = 10$

47. $2x^2 + 6 - x^2 = 9$ $x = \pm 1.7$ $-6\,-6$

48. $x^2 - 225 = 0$

49. $-3 + 4x^2 = 2$ $4x^2 = 5$ $x^2 = \frac{5}{4}$ $x = \pm 1.1$ $+3\,+3$

50. $7x^2 - 1008 = 0$

51. $6x^2 - 6 = 12$ $6x^2 = 18$ $x^2 = 3$ $x = \pm 1.7$

Solve each problem. If necessary, round to the nearest tenth.

52. You want to build a fence around a square garden that covers 506.25 ft². How many
feet of fence will you need to complete the job?

53. The formula $A = 6s^2$ will calculate the surface area of a cube. Suppose you have a cube
that has a surface area of 216 in². What is the length of each side?

54. You drop a pencil out of a window that is 20 ft above the ground. Use the formula $V^2 =
64s$, where V is the speed and s is the distance fallen, to calculate the speed the pencil is
traveling when it hits the ground.

55. Suppose you are going to construct a circular fish pond in your garden. You want the
pond to cover an area of 300 ft². What is the radius of the pond?

56. During the construction of a skyscraper, a bolt fell from 400 ft. What was the speed of the
bolt when it hit the ground? Use $V^2 = 64s$.

1.) a = 2 b = 5 c = 3

$2x^2 + 5x + 3 = 0$

$$x = \frac{-5 \pm \sqrt{5^2 - 4(2)(3)}}{2(2)}$$

$$x = \frac{-5 \pm \sqrt{25 - 24}}{4}$$

$$x = \frac{-5 \pm \sqrt{1}}{4}$$

$$x = \frac{-5 \pm 1}{4}$$

$$x = \frac{-5 + 1}{4} = \frac{-4}{4} \quad \text{and} \quad x = \frac{-5 - 1}{4} = \frac{-6}{4}$$

x = __-1__ and x = __$\frac{-3}{2}$ or -1.5__

2.) a = 5 b = 16 c = -84

$5x^2 + 16x - 84 = 0$

$$x = \frac{-16 \pm \sqrt{16^2 - 4(5)(-84)}}{2(5)}$$

$$x = \frac{-16 \pm \sqrt{256 - (-1680)}}{10}$$

$$x = \frac{-16 \pm \sqrt{1936}}{10}$$

$$x = \frac{-16 \pm 44}{10}$$

$$x = \frac{-16 + 44}{10} = \frac{28}{10} \quad \text{and} \quad x = \frac{-16 - 44}{10} = \frac{-60}{10}$$

x = __2.8__ and x = __-6__

3.) a = 4 b = -12 c = 9

$4x^2 - 12x + 9 = 0$

$$x = \frac{-(-12) \pm \sqrt{12^2 - 4(4)(9)}}{2(4)}$$

$$x = \frac{+12 \pm \sqrt{144 - 144} = \sqrt{0}}{8}$$

$$x = \frac{+12 \pm 0}{8}$$

$$x = \frac{+12 + 0}{8} = \frac{12}{8} \quad \text{and} \quad x = \frac{+12 - 0}{8}$$

x = __1.5__ and x = __1.5__

4.) a = 3 b = 47 c = 30

$3x^2 + 47x = -30$
$3x^2 + 47x + 30 = 0$

$$x = \frac{-47 \pm \sqrt{47^2 - 4(3)(30)}}{2(3)}$$

$$x = \frac{-47 \pm \sqrt{2209 - 360} = \sqrt{1849}}{6}$$

$$x = \frac{-47 \pm 43}{6}$$

$$x = \frac{-47 + 43}{6} = \frac{-4}{6} \quad \text{and} \quad x = \frac{-47 - 43}{6} = \frac{-90}{6}$$

x = __$\frac{-2}{3}$__ and x = __-15__
-0.67

DOUBLE ROOT

$12x^2 - 77x - 20 = 0$

5.) $a = \underline{12}$ $b = \underline{-77}$ $c = \underline{-20}$

$$x = \frac{-(-77) \pm \sqrt{(-77)^2 - 4(12)(-20)}}{2(12)} \quad \sqrt{5929 + 960}$$

$$x = \frac{+77 \pm \sqrt{10889}}{24}$$

$$x = \frac{+77 \pm 83}{24}$$

$\frac{160}{24} = 6.6$

$\frac{-6}{24} = -0.25$

$x = \underline{6.6}$ and $x = \underline{-0.25}$

$3x^2 + 39x + 108 = 0$

6.) $a = \underline{3}$ $b = \underline{39}$ $c = \underline{108}$

$$x = \frac{-39 \pm \sqrt{(39)^2 - 4(3)(108)}}{2(3)} = \frac{\sqrt{1521 -}}{1296}$$

$$x = \frac{-39 \pm \sqrt{225}}{6}$$

$$x = \frac{-39 \pm 15}{6}$$

$\frac{-24}{6} = -4$

$\frac{-54}{6} = -9$

$x = \underline{-4}$ and $x = \underline{-9}$

$3x^2 + 40x - 128 = 0$

7.) $a = \underline{3}$ $b = \underline{40}$ $c = \underline{-128}$

$$x = \frac{-40 \pm \sqrt{(40)^2 - 4(3)(-128)}}{2(3)} \quad \sqrt{1600 + 1536}$$

$$x = \frac{-40 \pm \sqrt{3136}}{6}$$

$$x = \frac{-40 \pm 56}{6}$$

$\frac{16}{6} = 2.6$

$\frac{-96}{6}$

$x = \underline{2.6}$ and $x = \underline{-16}$

$2x^2 - 9x - 221 = 0$

8.) $a = \underline{2}$ $b = \underline{-9}$ $c = \underline{-221}$

$$x = \frac{-(-9) \pm \sqrt{(-9)^2 - 4(2)(-221)}}{2(2)} \quad \sqrt{81 + 1768}$$

$$x = \frac{+9 \pm \sqrt{1849}}{4}$$

$$x = \frac{+9 \pm 43}{4}$$

$\frac{52}{4} = 13$

$\frac{-34}{4} = -8.5$

$x = \underline{13}$ and $x = \underline{-8.5}$

9.) $a = \underline{5}$ $b = \underline{-68}$ $c = \underline{-192}$

$x^2 - 68x = 192$

$x^2 - 68x - 192 = 0$

$$x = \frac{+68 \pm \sqrt{(68)^2 - 4(5)(-92)}}{2(5)} \quad \sqrt{4624 + 3840}$$

$$x = \frac{+68 \pm \sqrt{8464}}{10}$$

$$x = \frac{+68 \pm 92}{10}$$

$\frac{160}{10} = 16$

$\frac{24}{10} = 2.4$

$x = \underline{16}$ and $x = \underline{-2.4}$

10.) $a = \underline{5}$ $b = \underline{13}$ $c = \underline{-1}$

$5x^2 + 13x - 1 = 0$

$$x = \frac{-13 \pm \sqrt{13^2 - 4(5)(-1)}}{2(5)} \quad \sqrt{169 + 20}$$

$$x = \frac{-13 \pm \sqrt{189}}{10}$$

$$x = \frac{-13 \pm 13.75}{10}$$

$\frac{0.75}{10} = 0.075$

$\frac{-26.75}{10} = -2.675$

$x = \underline{0.075}$ and $x = \underline{-2.675}$

$$2x^2 - 24x + 33 = 0$$

11.) a= _2_ b= _-24_ c= _33_

$$x = \frac{-(-24) \pm \sqrt{24^2 - 4 \cdot 2 \cdot 33}}{2 \cdot 2} \quad \sqrt{576 - 264}$$

$$\frac{24 \pm \sqrt{312}}{4}$$

$$x = \frac{+24 \pm \boxed{17.66}}{\boxed{4}}$$

$\frac{41.66}{4} = 10.4$

$\frac{6.34}{4} = 1.6$

x= _10.4_ and x= _1.6_

$$7x^2 + 100x - 4 = 0$$

12.) a= _7_ b= _102_ c= _-4_

$$x = \frac{-100 \pm \sqrt{100^2 - 4 \cdot 7 \cdot (-4)}}{2 \cdot 7} \quad \sqrt{10000 + 11}$$

$$x = \frac{-100 \pm \sqrt{10112}}{14}$$

$$x = \frac{-100 \pm \boxed{100.56}}{\boxed{14}}$$

$\frac{0.56}{14} = 0.0$

$\frac{-200.56}{14} = -14.3$

x= _0.04_ and x= _-14.33_

13.) a= _8_ b= _-3_ c= _-7_

$$2x^2 - 3x - 7 = 0$$

$$x = \frac{-(-3) \pm \sqrt{3^2 - 4 \cdot 8 \cdot (-7)}}{2 \cdot 8}$$

$$\frac{3 \pm \sqrt{9 + 224}}{16} = \frac{3 \pm \sqrt{233}}{16}$$

$$x = \frac{+3 \pm \boxed{15.26}}{\boxed{16}}$$

$\frac{18.26}{16} = 1.14$

$\frac{-12.26}{16} = -0.77$

x= _1.14_ and x= _-0.77_

14.) a= _6_ b= _5_ c= _-40_

$$6x^2 + 5x - 40 = 0$$

$$x = \frac{-5 \pm \sqrt{5^2 - 4 \cdot 6 \cdot (-40)}}{2 \cdot 6} \quad \sqrt{25 + 960}$$

$$x = \frac{-5 \pm \sqrt{985}}{12}$$

$$x = \frac{-5 \pm \boxed{31.38}}{\boxed{12}}$$

$\frac{26.38}{12} = 2.$

$\frac{-36.38}{12} = -3.$

x= _2.20_ and x= _-3.03_

15.) a= _3_ b= _-11_ c= _-2_

$$3x^2 - 11x - 2 = 0$$

$$x = \frac{-(-11) \pm \sqrt{11^2 - 4 \cdot 3 \cdot 2}}{2 \cdot 3}$$

$$x = \frac{11 \pm \sqrt{121 + 24}}{6} = \frac{11 \pm \sqrt{145}}{6}$$

$$\frac{11 \pm 12.04}{6}$$

$\frac{23.04}{6} = 3.84$

$\frac{-1.04}{6} = -0.173$

x= _3.84_ and x= _-0.17_

Quadratic Formula:

For $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

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Name: **KEY**

Lesson 10.7

$b^2-4ac > 0$ (2) 2 root
$b^2-4ac = 0$ (1) 1 root
$b^2-4ac < 0$ (0) 0 roots

Axis of Symmetry/Vertex/**Discriminant: b^2-4ac**

Evaluating the discriminant tells us ... What type of root to expect

Functions	Axis of Sym.	Vertex	Discriminant	# of Roots	Sketch
$y=-x^2-6x+8$ (smile/frown)	$x=\dfrac{-(-6)}{2(-1)}=\dfrac{6}{-2}=-3$ $x=-3$	$V(-3, 17)$ $y=-(-3)^2-6(-3)+8$ $=-9+18+8$ $y=17$	b^2-4ac $(-6)^2-4(-1)(8)$ $36+32=68$ $+\sqrt{68}$	2	
$y=x^2+6x+9$ (smile/frown)	$x=\dfrac{-6}{2(1)}=\dfrac{-6}{2}=-3$ $x=-3$	$V(-3, 0)$ $y=(-3)^2+6(-3)+9$ $=9-18+9$ $y=0$	b^2-4ac $6^2-4(1)(9)$ $36-36=0$ $=0$	1 not double root	
$y=x^2+2x+5$ (smile/frown)	$x=\dfrac{-2}{2(1)}=\dfrac{-2}{2}=-1$ $x=-1$	$V(-1, 4)$ $y=(-1)^2+2(-1)+5$ $=1-2+5$ $y=4$	$(2)^2-4(1)(5)$ $4-20=-16$ $+\sqrt{-16}$ no real	0	

Equation	AOS	Vertex	Discriminant	#eg Roots	Sketch
$y=2x^2+7x+3$	$x=\dfrac{-7}{2(2)}=\dfrac{-7}{4}$ $x=-1.75$	$V(-1.75, -3.125)$ $y=2(-1.75)^2+7(-1.75)+3$ $y=-3.125$	$(7)^2-4(2)(3)$ $49-24=25$ $\sqrt{25}=\pm 5$	2 roots	
$y=-x^2+4x-1$	$x=\dfrac{-4}{2(-1)}=2$ $x=2$	$V(2,3)$ $y=-(2)^2+4(2)-1$ $y=-4+8-1$ $y=3$	$(4)^2-4(-1)(-1)$ $16-4=12$ $\sqrt{12}$	2	
$y=x^2-8x+16$	$x=\dfrac{-(-8)}{2(1)}=\dfrac{8}{2}$ $x=4$	$V(4,0)$ $y=(4)^2-8(4)+16$ $=16-32+16$ $y=0$	$(-8)^2-4(1)(16)$ $64-64=0$ $\sqrt{0}=\pm 0$	1 root — DOUBLE ROOT	
$y=x^2+2x+2$	$x=\dfrac{-2}{2(1)}=-1$ $x=-1$	$V(-1,1)$ $y=(-1)^2+2(-1)+2$ $=1-2+2$ $y=1$	$(2)^2-4(1)(2)$ $4-8=-4$ $\sqrt{-4}$ = no solution	0	
$y=-2x^2-7x+3$	$x=\dfrac{-(-7)}{2(-2)}=\dfrac{7}{-4}$ $x=-1.75$	$V(-1.75, 9.125)$ $y=-2(-1.75)^2-7(-1.75)+3$ $=-(1.25+12.25)+3=9.125$	$(-7)^2-4(-2)(3)$ $49+24=73$ $\sqrt{73}$ $8.1, 9,-9$ $y=9.125$	2	