Acc Alg I/Geo A    **Unit 3 Review: Modeling and Analyzing Quadratic Functions**    Name Key

**PART 1**

**I. Solve each quadratic function by the specified method.**

By factoring

1. $3x^2 - 16x - 7 = 5$

$3x^2 - 16x - 12 = 0$

$(3x+2)(x-6) = 0$

$\boxed{x = -\frac{2}{3} \quad x = 6}$

2. $7x^2 - 14x = -7$

$7x^2 - 14x + 7 = 0$

$7(x^2 - 2x + 1) = 0$

$7(x-1)^2 = 0$

$\boxed{x = 1 \text{ Double Root}}$

3. $x^2 - 121 = 0$

$(x-11)(x+11) = 0$

$\boxed{x = 11 \quad x = -11}$

4. $9x^2 + 21x = 0$

$3x(3x+7) = 0$

$\boxed{x = 0 \quad x = -\frac{7}{3}}$

By square roots

5. $-9x^2 + 25 = 0$

$-9x^2 = -25$

$x^2 = \frac{25}{9}$

$\sqrt{x^2} = \sqrt{\frac{25}{9}}$

$\boxed{x = \pm \frac{5}{3}}$

By completing the square

6. $x^2 - 10x - 4 = 0$

$x^2 - 10x = 4$

$x^2 - 10x + 25 = 4 + 25$

$5$

$(x-5)^2 = 29$

$\sqrt{(x-5)^2} = \sqrt{29}$

$x - 5 = \pm\sqrt{29}$

$\boxed{x = 5 \pm \sqrt{29}}$

7. $2x^2 + 4x = 12$

$2(x^2 + 2x + 1) = 12 + 2$

$2(x+1)^2 = 14$

$(x+1)^2 = 7$

$\sqrt{(x+1)^2} = \sqrt{7}$

$x + 1 = \pm\sqrt{7}$

$\boxed{x = -1 \pm \sqrt{7}}$

By quadratic formula

8. $6x^2 - 13x + 3 = -3$

$a = 6$
$b = -13$
$c = 6$

$6x^2 - 13x + 6 = 0$

$x = \frac{13 \pm \sqrt{(13)^2 - 4(6)(6)}}{2(6)}$

$= \frac{13 \pm \sqrt{25}}{12}$

$= \frac{13 \pm 5}{12} = \frac{18}{12} \text{ or } \frac{8}{12}$

$\boxed{x = 3/2 \text{ or } 2/3}$

9. $-x^2 + 8x + 22 = 0$

$a = -1$
$b = 8$
$c = 22$

$x = \frac{-8 \pm \sqrt{(8)^2 - 4(-1)(22)}}{-2}$

$= \frac{-8 \pm \sqrt{152}}{-2}$

$= \frac{-8 \pm 2\sqrt{38}}{-2}$

$\boxed{x = 4 \pm \sqrt{38}}$

10. $3x^2 - 22 = 0$

$a = 3$
$b = 0$
$c = -22$

$x = \frac{\pm\sqrt{-4(3)(-22)}}{6}$

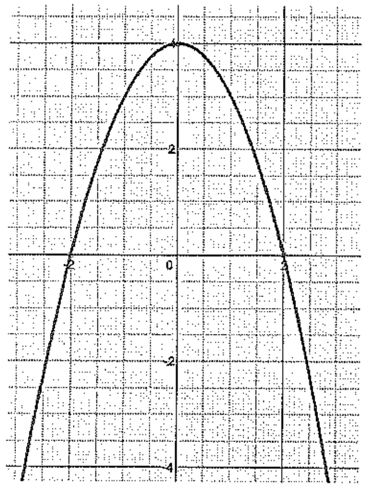
$= \frac{\pm\sqrt{264}}{6}$

$= \frac{\pm 2\sqrt{66}}{6}$

$\boxed{x = \frac{\pm\sqrt{66}}{3}}$

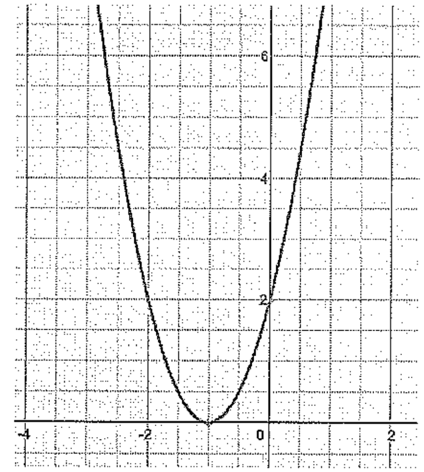
## II. Characteristics of Quadratic Functions

11.



y-int: (0, 4)
x-int: (2, 0) (−2, 0)
AOS: $x = 0$
Vertex: (0, 4)
Domain: $(-\infty, \infty)$
Range: $(-\infty, 4]$
Max/Min value: 4
Intervals
Inc: $(-\infty, 0)$
Dec: $(0, \infty)$

12.



y-int: (0, 2)
x-int: (−2, 0)
AOS: $x = -2$
Vertex: (−1, 0)
Domain: $(-\infty, \infty)$
Range: $[0, \infty)$
Max/Min value: 0
Intervals
Inc: $(-1, \infty)$
Dec: $(-\infty, -1)$

**For each of the following quadratic functions, find the axis of symmetry, vertex and convert the function to the other form (if in standard convert to vertex and vice versa).**

13. $f(x) = 3x^2 - 18x + 2$

AOS: $x = 3$

Vertex: $(3, -25)$

Vertex: $\left(\frac{-b}{2a}, f\left(\frac{-b}{2a}\right)\right)$

$\left(\frac{18}{6}, \_\right)$

$(3, -25)$

$3(x^2 - 6x) = -2$
$3(x^2 - 6x + 9) = -2 + 27$
$3(x-3)^2 = 25$
$\boxed{y = 3(x-3)^2 - 25}$

14. $f(x) = -x^2 + 3x$

AOS: $\left(x = \frac{3}{2}\right)$
Vertex: $\left(\frac{3}{2}, \frac{9}{4}\right)$

Vertex: $\frac{-3}{-2} = \left(\frac{3}{2}, \frac{9}{4}\right)$

$-(x^2 - 3x) = 0$
$-(x^2 - 3x + \frac{9}{4}) = 0 + \frac{-9}{4}$
$\frac{3}{2}$
$-(x - 3/2)^2 = -\frac{9}{4} \rightarrow \boxed{y = -(x-\frac{3}{2})^2 + \frac{9}{4}}$

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

AOS: $x = -2$
Vertex: $(-2, 7)$

$-4(x^2 + 4x + 4) + 7$
$= -4x^2 - 16x - 16 + 7$
$\boxed{y = -4x^2 - 16x - 9}$

16. $f(x) = 6(x-1)^2 - 8$

AOS: $x = 1$
Vertex: $(1, -8)$

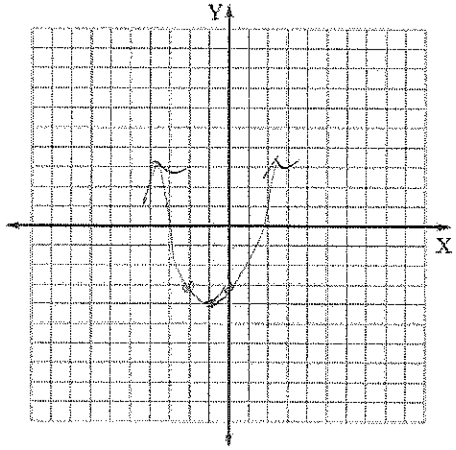
$6(x^2 - 2x + 1) - 8$
$= \cancel{6x}$
$= 6x^2 - 12x + 6 - 8$
$\boxed{y = 6x^2 - 12x - 2}$

## III. Graphing Transformations of Parabolas

**Graph** the following on separate graph paper and fill in the chart for each parabola. Solve plug in 0 for x

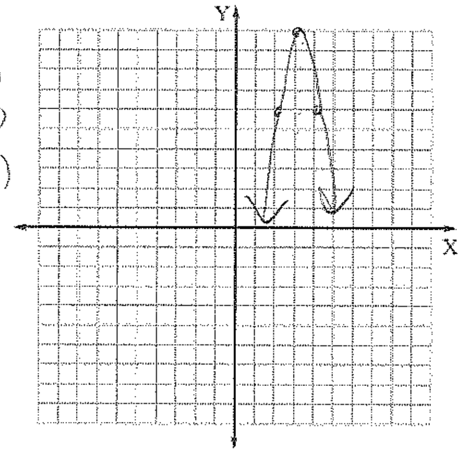
| | Direction of Opening | Equation of Axis of Symmetry | Vertex | Max or Min | Max or Min Value | x-intercept(s) (EXACT) | y-intercept | Interval of Increase | - Decrease |
|---|---|---|---|---|---|---|---|---|---|
| a) $y=(x+1)^2-4$ | up | $x=-1$ | $(-1,-4)$ | min | $-4$ | $\{1,-3\}$ | $(0,-3)$ | $(-1,\infty)$ | $(-\infty,-1)$ |
| b) $y=-4(x-3)^2+10$ | down | $x=3$ | $(3,10)$ | max | 10 | $\{\frac{1}{2},\frac{11}{2}\}$ | $(0,-26)$ | $(-\infty,3)$ | $(3,\infty)$ |
| c) $y=2x^2+1$ | up | $x=0$ | $(0,1)$ | min | 1 | none | $(0,1)$ | $(0,\infty)$ | $(-\infty,0)$ |
| d) $y=\frac{1}{2}(x+4)^2-2$ | up | $x=-4$ | $(-4,-2)$ | min | $-2$ | $\{-2,-6\}$ | $(0,6)$ | $(-4,\infty)$ | $(-\infty,-4)$ |
| e) $y=-3x^2-4$ | down | $x=0$ | $(0,-4)$ | max | $-4$ | none | $(0,-4)$ | $(-\infty,0)$ | $(0,\infty)$ |
| f) $y=-(x-4)^2+4$ | down | $x=4$ | $(4,4)$ | max | 4 | $\{2,6\}$ | $(0,-12)$ | $(-\infty,4)$ | $(4,\infty)$ |
| g) $y=\frac{1}{4}(x+6)^2+5$ | up | $x=-6$ | $(-6,5)$ | min | 5 | none | $(0,14)$ | $(-6,\infty)$ | $(-\infty,-6)$ |
| h) $y=-\frac{1}{2}(x-2)^2$ | down | $x=2$ | $(2,0)$ | max | 0 | Double Root $\{2\}$ | $(0,-2)$ | $(-\infty,2)$ | $(2,\infty)$ |
| i) $y=-2(x-1)^2+7$ | down | $x=1$ | $(1,7)$ | max | 7 | $1\pm\sqrt{\frac{7}{2}}$ | $(0,5)$ | $(-\infty,1)$ | $(1,\infty)$ |

a)



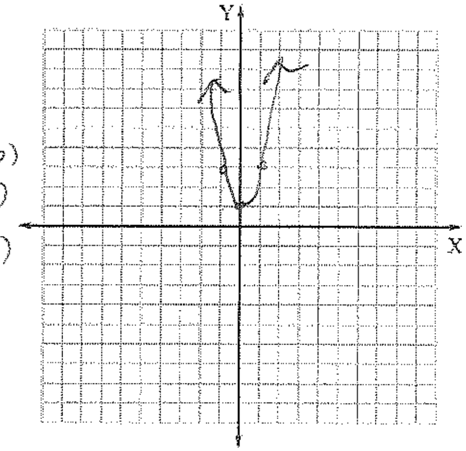
b)

(2, 6)
(3, 10)
(4, 6)

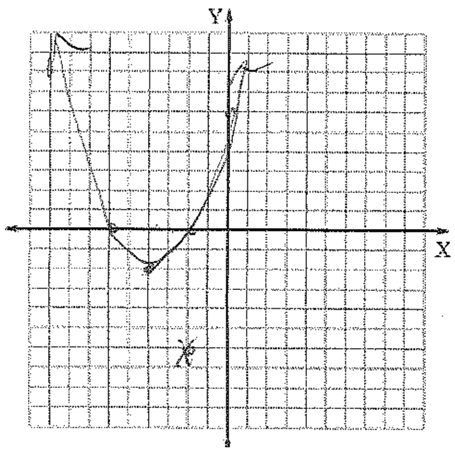


c)

(-1, 3)
(0, 1)
(1, 3)

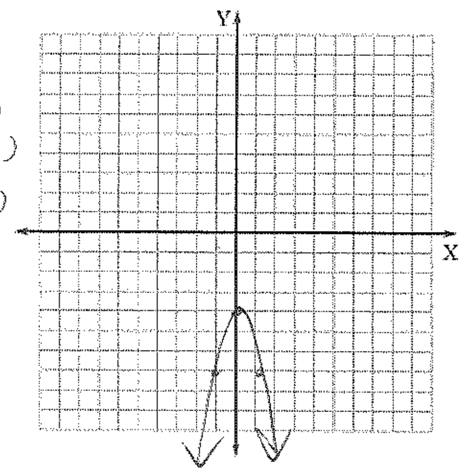


d)

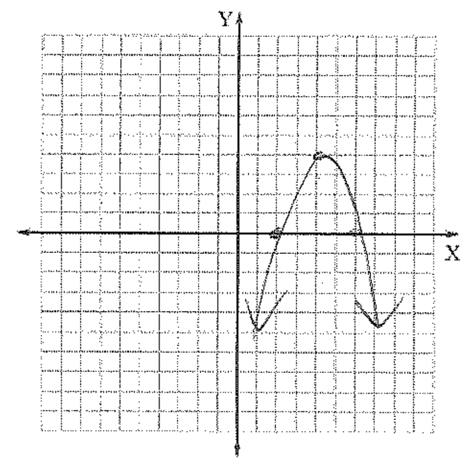


e)

(-1, -7)
(0, -4)
(1, -7)

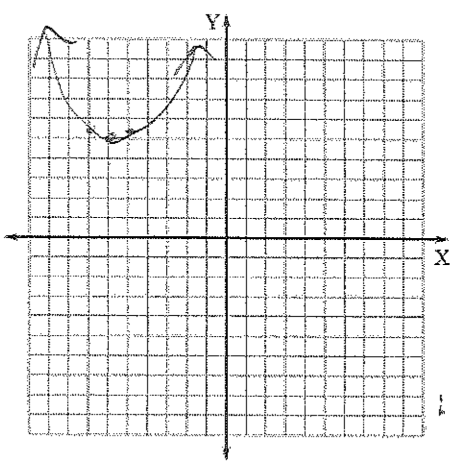


f)



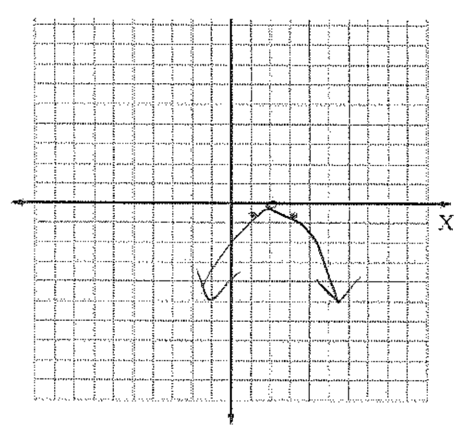
g)

(-5, 5.25)
(-6, 5)
(-7, 5.25)

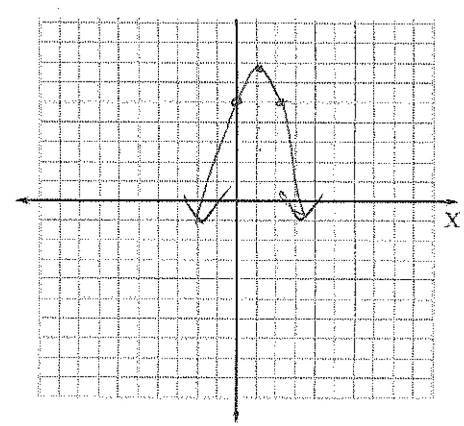


h)

(1, $-\frac{1}{2}$)
(2, 0)
(3, $-\frac{1}{2}$)



i)



**Acc Alg I/Geo A** **Unit 3 Test Review** **Name**____________________

**Part II**

**Topics:**

- Solve a quadratic equation by factoring, square roots, completing the square and quadratic formula.
- Write a quadratic function in standard and vertex form and find the axis of symmetry and vertex for each.
- Graph a quadratic function and transformations of quadratic functions
- Describe the transformations of a quadratic function from its parent function.
- Identify the characteristics of a quadratic function (AOS, vertex, x and y intercepts, domain, range, maximum and minimum values, intervals of increase and decrease).
- Solve application problems involving quadratic functions (such as height and time problems).

## Application of the Quadratic Function

The Acme Fireworks Company has been engaged to provide the fireworks for the annual 4th of July fireworks show for the town of Madison, GA. The City Manager of Madison selected Acme Fireworks because they have four different kinds of fireworks. Each firework is designed to explode when the rocket reaches its highest point in the air. Once the rocket explodes, the sparkles of different colors fly out of the rocket and stay in the air for the same number of seconds as it took for the rocket to reach the highest point. All fireworks are launched from the ground. The time from $x = 0$ to the first $x$–intercept is the time it takes the wick to burn until the rocket is launched. The City Manager has visited your classroom to ask your class to confirm the figures that Acme Fireworks Company has given him. Specifically, he wants to know the height at which the rockets will explode and how long the sparkles for each type of firework will be in the air. Your teacher is interested in the method that you choose to solve each equation.

Below, you are given the equation for the flight of each firework. For each brand, tell the height of the rocket when it explodes, how many seconds it took to reach this height, and how long the sparkles will remain in the air. Lastly, explain why you chose the method you did to solve the given equation. In each equation, x stands for the number of seconds the rocket is in the air, and $f(x)$ models the flight of the rocket in feet.

1. Blue Bombers: $f(x) = 81 - x^2$

   i. How high is the rocket when it explodes? 81 ft.

   ii. How many seconds was the rocket in the air before it exploded? 9 sec.

   iii. How many seconds did the sparkles stay in the air? 9 sec.

   iv. What method did you use to solve the given equation? factoring

2. Red Rockets: $g(x) = -2x^2 + 29x - 90$ $\frac{-29}{-4} = \frac{29}{4} = (7.25, 15.1)$

   i. How high is the rocket when it explodes? 15.1 feet

   ii. How many seconds was the rocket in the air before it exploded? 7.25 sec.

   iii. How many seconds did the sparkles stay in the air? $x = 4.5$ and $10$ $10 - 4.5 = \boxed{5.5 \text{ sec.}}$

   iv. What method did you use to solve the given equation? quadratic formula

3. Green Gammas: $-x^2 + 12x = 15$ $y = -x^2 + 12x - 15$ $\frac{-12}{-2} = (6, 21)$

i. How high is the rocket when it explodes? 21 ft.

ii. How many seconds was the rocket in the air before it exploded? 6 sec.

iii. How many seconds did the sparkles stay in the air? $x = 1.4$ or $10.6$ so 8.8 sec.

iv. What method did you use to solve the given equation? QF

4. Orange Orthogonals: $h(x) = -6x^2 + 53x - 91$ $\frac{-53}{-12} = \left(\frac{53}{12}, 26.04\right)$

i. How high is the rocket when it explodes? 26.04 ft.

ii. How many seconds was the rocket in the air before it exploded? 4.4 sec.

iii. How many seconds did the sparkles stay in the air? $x = 2.3$ + $6.5$ so 4.2 sec.

iv. What method did you use to solve the given equation? QF

**Write your equations for the following transformed graphs of the parent function $f(x) = x^2$**

5. reflected over x-axis, stretched by a factor of 4 and shifted left 7 units

$g(x) = -4(x+7)^2$

6. stretched by a factor of ½, shifted right 2 units and up 4 units

$h(x) = \frac{1}{2}(x-2)^2 + 4$