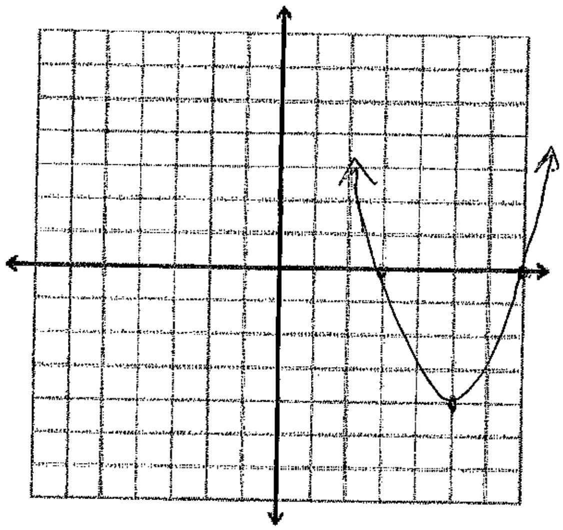
Key

GRAPHING QUADRATICS IN INTERCEPT FORM

EXAMPLE 1:

$f(x) = (x-7)(x-3)$



STEPS:

1) Identify the x-intercepts (set each factor equal to zero and solve for x) and plot them (y=0)

• x-intercepts are $(7,0)$ $(3,0)$

$x-7=0$ $x-3=0$

$x=7$ $x=3$

2) Find the vertex and axis of symmetry

• $x = \frac{p+q}{2}$ $x = \frac{7+3}{2} = 5$ AOS: $x=5$

$x=5$ $y=(5-7)(5-3)$

3) Find the y-value of the vertex by plugging x-value of vertex back into equation and simplify

$x=5$

vertex: $(5,-4)$

$y=(5-7)(5-3)$

$y=(-2)(2)=-4$

4) plot the x-intercepts and vertex, sketch graph

WS Quadratic Intercept Graphing

Sketch the parabolas using the intercepts method. 2(2)(-2)

a) $f(x) = (x + 2)(x - 4)$

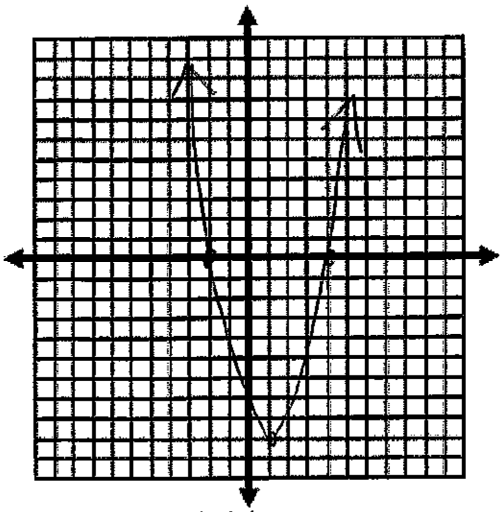
x-intercepts: (-2,0) (4,0)

vertex: (1,-9)

axis of symmetry: X = 1

y-intercept: (0,-8)

other points: ______



b) $f(x) = 2(x + 3)(x - 1)$

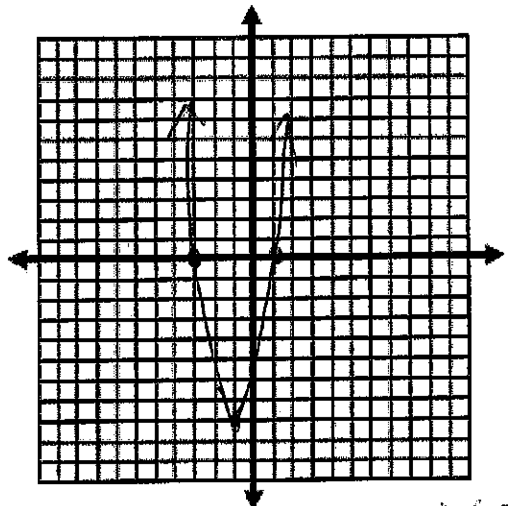
x-intercepts: (-3,0) (1,0)

vertex: (-1,-8)

axis of symmetry: X = -1

y-intercept: (0,-6)

other points: ______



-1(-3)(3)

c) $f(x) = -(x - 2)(x + 4)$

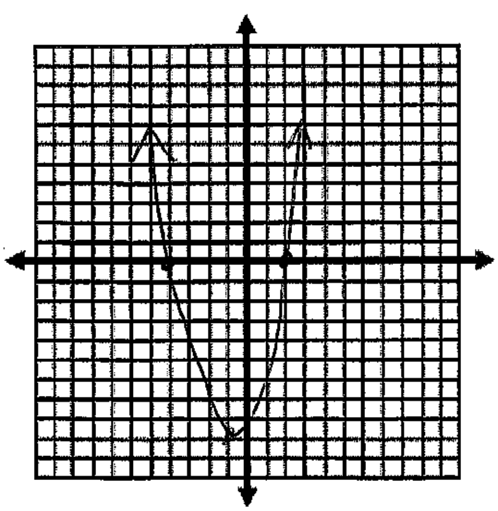
x-intercepts: (2,0) (-4,0)

vertex: (-1, 9)

axis of symmetry: X = -1

y-intercept: (0, 8)

other points: ______



-½(3)(-3)

d) $f(x) = -\frac{1}{2}(x + 2)(x - 4)$

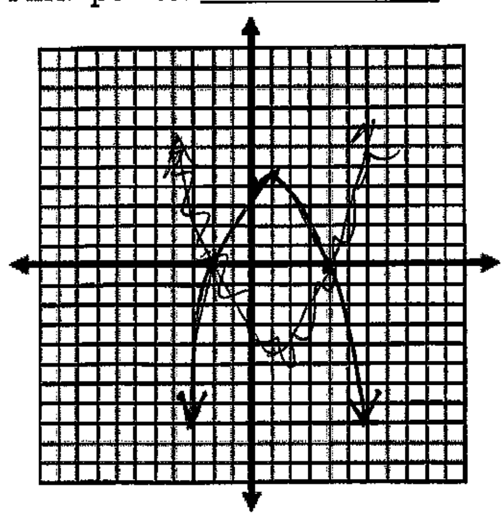
x-intercepts: (-2,0) (4,0)

vertex: (1, 4.5)

axis of symmetry: X = 1

y-intercept: (0, 4)

other points: ______



17

 Name: Key

I CAN GRAPH QUADRATIC FUNCTIONS IN INTERCEPT FORM.

Directions: Show all nevessary work to graph the following quadratics in the most efficient way.

1. $f(x) = (x+1)(x+5)$

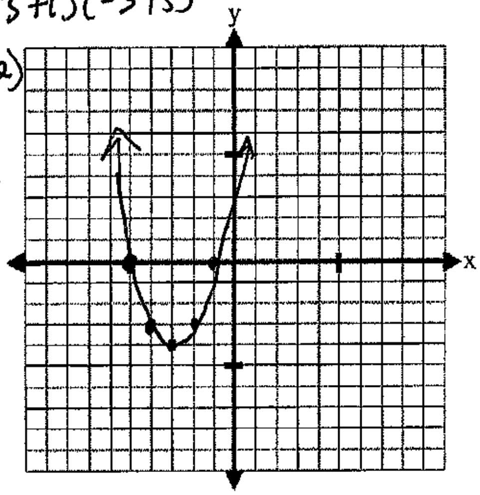
x-intercepts $(-1,0)$ $(-5,0)$

vertex: $(-3,-4)$ $x = \frac{-1+-5}{2}$

$y=(-3+1)(-3+5)$

$y=-2(2)$

x	y
-5	0
-4	-3
-3	-4
-2	-3
-1	0



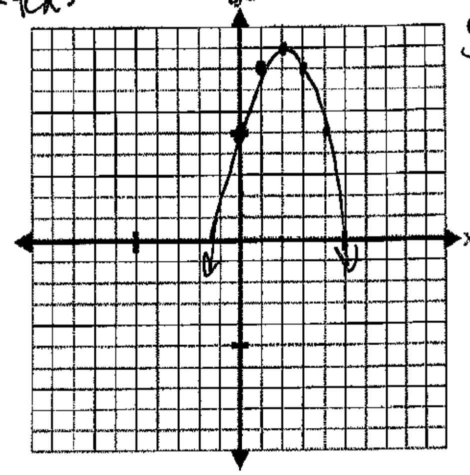
2. $g(x) = -(x+1)(x-5)$

x-inter: $(-1,0)$ $(5,0)$

vertex: $x = \frac{-1+5}{2} = 2$ $y=-(2+1)(2-5)$

$y=+9$

x	y
0	5
1	8
2	+9
3	8
4	5



3. $h(x) = 2(x-1)(x-3)$

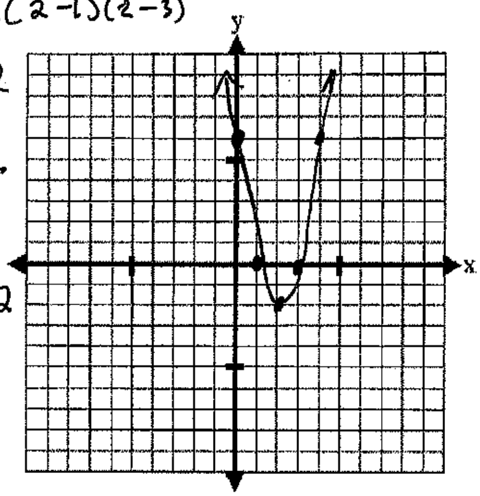
x-int: $(1,0)$ $(3,0)$

vertex: $x = \frac{1+3}{2} = 2$ $V(2,-2)$

$y=2(2-1)(2-3)$

$y=-2$

x	y
0	6
1	0
2	-2
3	0
4	6



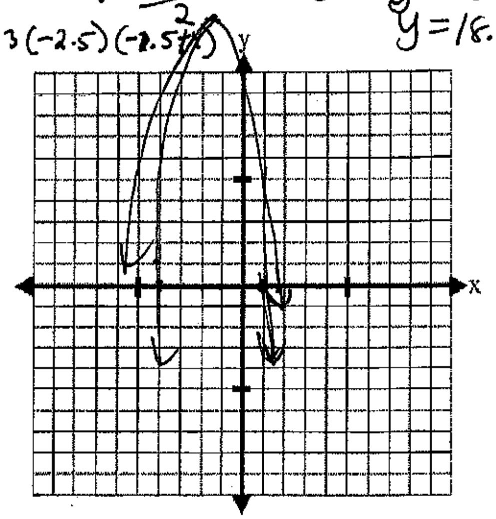
4. $y = -3(x-1)(x+4)$

x-inter: $(1,0)$ $(-4,0)$

vertex: $x = \frac{1+-4}{2} = -1.5$ $y=\cancel{18.5}$

$y=-3(-2.5)(-1.5+4)$ $y=18.75$

x	y
-3	12
-2.5	
-2	18
-1.5	~~18.5~~ 18.75
0	12
1	0



5. $f(x) = -(x+2)(x-4)$

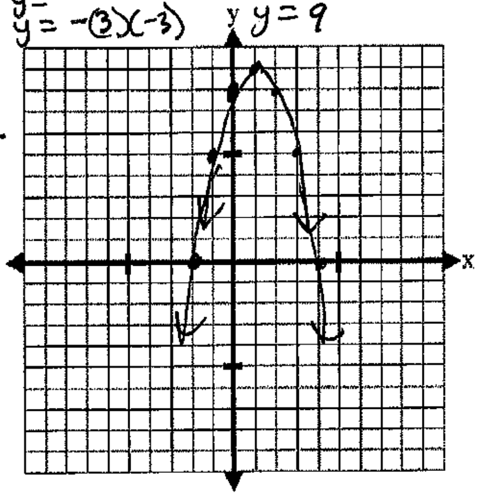
x-vertex ~~X-inter~~: $\frac{(-2+4)}{2} = 1$

x-inter: $(-2,0)$ $(4,0)$

y-inter: $y = -(1+2)(1-4)$

$y = -(3)(-3)$ $y = 9$

x	y
-1	5
0	8
1	9
2	8
3	5

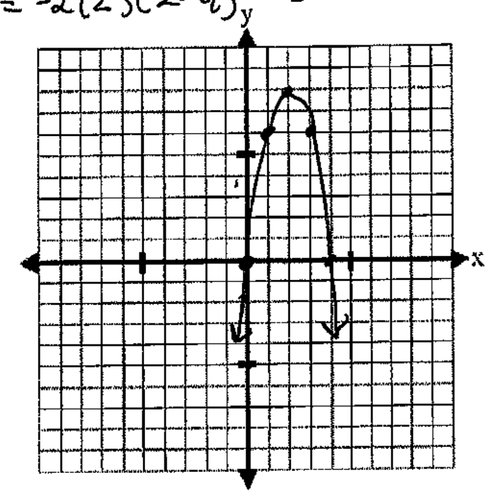


6. $y = -2x(x-4)$

x-inter: $(4,0)$

vertex: $\frac{4}{2} = 2$

$y = -2(2)(2-4) = 8$



x	y
0	0
1	6
2	8
3	6
4	0

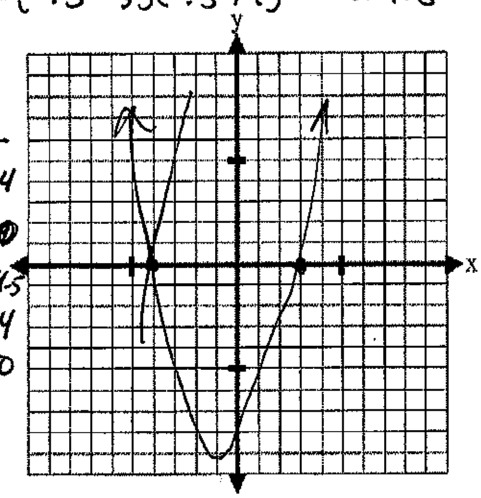
7. $y = 2(x-3)(x+4)$

x-inter: $(3,0)$ $(-4,0)$

vertex: $x = \frac{3+-4}{2} = -.5$

$y = 2(-.5-3)(-.5+4) = -24.5$

x	y
-1	-24
-2	-20
-.5	-24.5
0	-24
1	-20



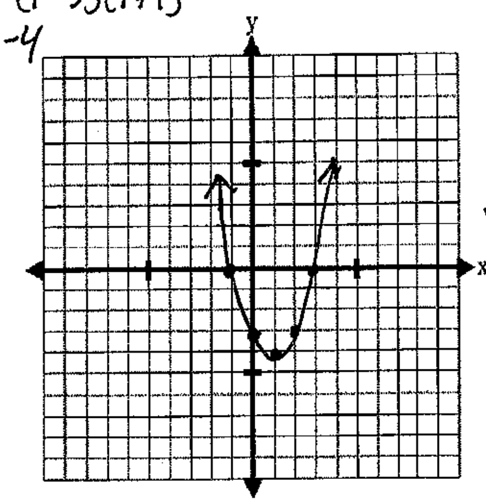
8. $y = (x-3)(x+1)$

x-inter: $(3,0)$ $(-1,0)$

vertex: $x = \frac{3+-1}{2} = 1$ $(1,-4)$

$y = (1-3)(1+1)$

$y = -4$



x	y
-1	0
0	-3
v 1	-4
2	-3
3	0

Converting Quadratic Equations

A step-by-step guide with practice

Intercept Form to Standard Form

- Write the equation in standard form:
- $y = -2(x + 3)(x - 2)$
- $y = -2(x^2 + x - 6)$ multiply binomials
- $y = -2x^2 - 2x + 12$ distribute

Intercept Form to Standard Form

- Write the equation in standard form:
- $y = -2(x + 3)(x - 2)$

Vertex Form to Standard Form

- Write this equation in standard form:
- $y = 2(x - 3)^2 + 4$

Intercept Form to Standard Form

- Write the equation in standard form:
- $y = -2(x + 3)(x - 2)$
- $y = -2(x^2 + x - 6)$ multiply binomials

Vertex Form to Standard Form

- Write this equation in standard form:
- $y = 2(x - 3)^2 + 4$
- $y = 2(x^2 - 6x + 9) + 4$ square the binomial by using foil

Standard Form to Vertex Form

- Write the equation in vertex form:
- y = 3x2 – 6x + 8
- y = 3(x2 – 2x) + 8 factor out "a"

Vertex Form to Intercept Form

- Write the equation in intercept form:
- $y = (x + 4)^2 - 1$

Standard Form to Vertex Form

- Write the equation in vertex form:
- $y = 3x^2 - 6x + 8$
- $y = 3(x^2 - 2x \quad) + 8$ factor out "a"
- $y = 3(x^2 - 2x + 1) + 8 - 3$ complete the square

Vertex Form to Intercept Form

- Write the equation in intercept form:
- $y = (x + 4)^2 - 1$
- $y = x^2 + 8x + 16 - 1$ square the binomial by using foil

Standard Form to Vertex Form

- Write the equation in vertex form:
- $y = 3x^2 - 6x + 8$
- $y = 3(x^2 - 2x \quad) + 8$ factor out "a"
- $y = 3(x^2 - 2x + 1) + 8 - 3$ complete the square
- $y = 3(x - 1)^2 + 5$ factor and combine

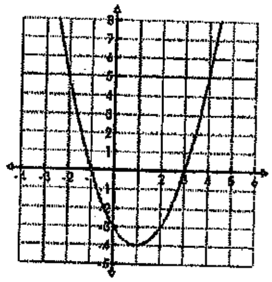
Vertex Form to Intercept Form

- Write the equation in intercept form:
- $y = (x + 4)^2 - 1$
- $y = x^2 + 8x + 16 - 1$ square the binomial by using foil
- $y = x^2 + 8x + 15$ combine terms

Characteristics

Domain: ℝ

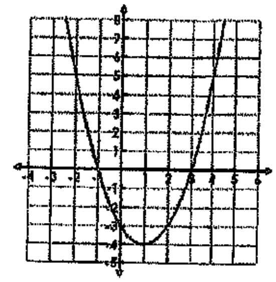
Range: $[-4, \infty)$



Characteristics

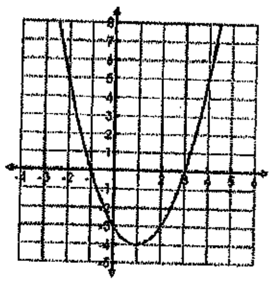
Zeros: $(-1,0)$ $(3,0)$

Y-intercept: $(0,-3)$



Characteristics

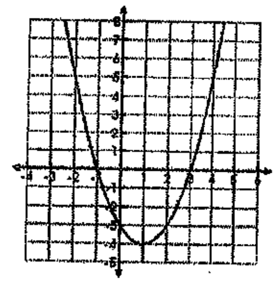
Extreme Value: $(1,-4)$



Characteristics

Interval of Increase: $(1, \infty)$

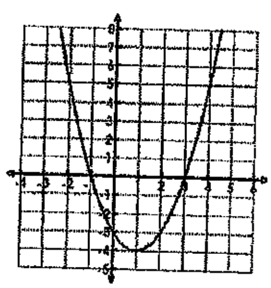
Interval of Decrease: $(-\infty, 1)$



Characteristics

Axis of Symmetry: $x = 1$

Vertex: $(1,-4)$

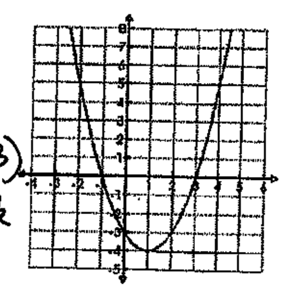


Characteristics

Rate of change from $-2 \le x \le 0$

$(-2, 5)$ $(0,-3)$

x_1 y_1 x_2 y_2



$m = \frac{-3-5}{0-2} = \frac{-8}{2} = \boxed{-4}$

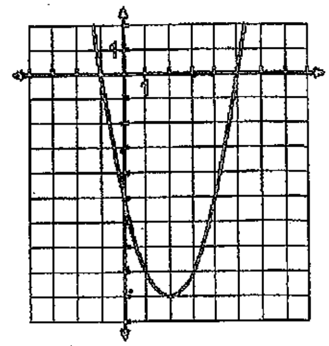
1. Domain: R Range: [9,∞)

Vertex: (2,-9) Extrema: ______

X intercept(s): (-1,0) (5,0) Y Intercept: (0,-5)

Increasing: (2,∞) Decreasing: (-∞,2)

Axis of Symmetry: X=2



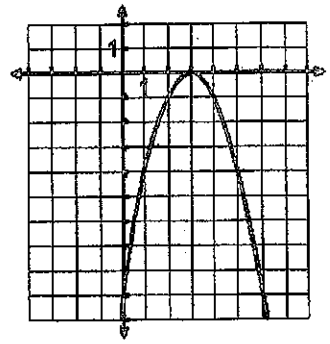
2. Domain: R Range: (-∞,1]

Vertex: (3,0) Extrema: ______

X intercept(s): (3,0) Y Intercept: (0,-9)

Increasing: (-∞,3) Decreasing: (3,∞)

Axis of Symmetry: X=3



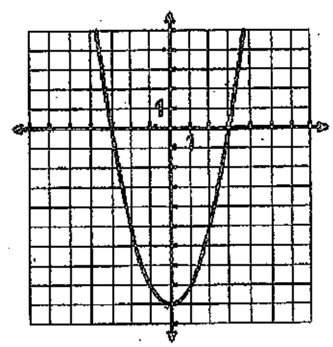
3. Domain: R Range: [-9,∞)

Vertex: (0,-9) Extrema: ______

X intercept(s): (-3,0) (3,0) Y Intercept: (0,-9)

Increasing: (0,∞) Decreasing: (-∞,0)

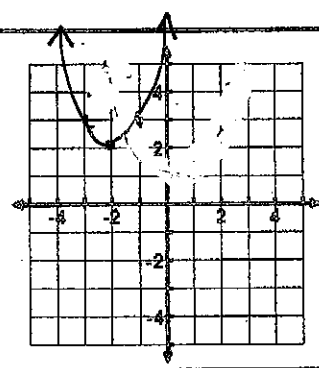
Axis of Symmetry: X=0



Use the information to sketch a quadratic.

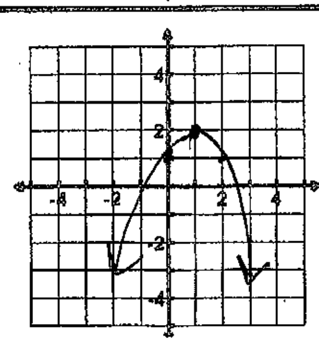
4. Domain: all real numbers
Range: $y \geq 1$

Increasing: $-2 < x < \infty$
Decreasing: $-\infty < x < -2$
There is no stretch or shrink ($a = 1$)



5. Domain: all real numbers
Vertex: (1,2)

Increasing: $-\infty < x < 1$
Decreasing: $1 < x < \infty$
There is no stretch or shrink ($a = 1$)

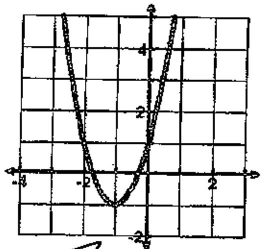


21

Name: ______________________ Date: __________

Characteristics of Functions

1. $f(x) = 2x^2 + 4x + 1$



a. Domain: R b. Range: $[-1, \infty)$

c. Extrema: Min d. Axis of Sym: $x = -1$

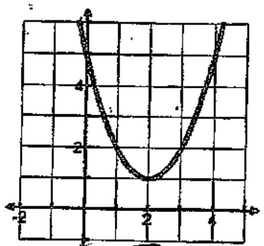
e. Increasing: $(-1, \infty)$ f. Decreasing: $(-\infty, -1)$

g. End Behavior: $x \to \infty, y \to \infty$ & $x \to -\infty, y \to \infty$

h. Average rate of change $0 \le x \le 2$

(0,1) (2,17) $m = \frac{17-1}{2-0} = \frac{16}{2} = \boxed{8}$

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



a. Domain: R b. Range: $[1, \infty)$

c. Extrema: Min d. Axis of Sym: $x = 2$

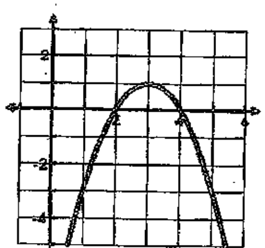
e. Increasing: $(2, \infty)$ f. Decreasing: $(-\infty, 2)$

g. End Behavior: $x \to \infty, y \to \infty$ & $x \to -\infty, y \to \infty$

h. Average rate of change $0 \le x \le 2$

(0,5) (2,1) $m = \frac{1-5}{2-0} = \frac{-4}{2} = \boxed{-2}$

3. $f(x) = -(x-2)(x-4)$



a. Domain: R b. Range: $(-\infty, 1]$

c. Extrema: Max d. Axis of Sym: $x = 3$

e. Increasing: $(-\infty, 3)$ f. Decreasing: $(3, \infty)$

g. End Behavior: $x \to \infty, y \to -\infty$ & $x \to -\infty, y \to -\infty$

h. Average rate of change $0 \le x \le 2$

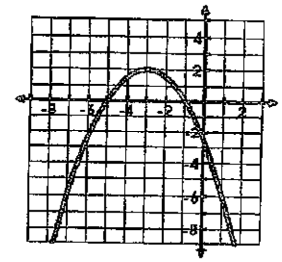
(0,−8) (2,0) $m = \frac{0 - -8}{2-0}$

$m = \frac{8}{2} = \boxed{4}$

22

CCGPS Geometry   Unit 2c – Graphing Quadratics   Homework

4. This graph represents a quadratic function.



a. Extrema: Max b. Axis of Sym: $x = -3$

c. Zeros: (−5,0) (−1,0) d. y-intercept: (0,−2)

e. Domain: R f. Range: $(-\infty, 2]$

g. Increasing: $(-\infty, -3)$ h. Decreasing: $(-3, \infty)$

i. For the increasing interval, is the rate of change increasing or decreasing?

increasing

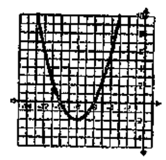
j. For the decreasing interval, is the rate of change increasing or decreasing?

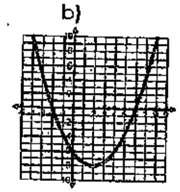
decreasing

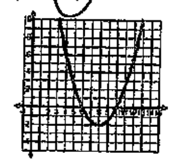
5. The quadratic function $f(x)$ has these characteristics:

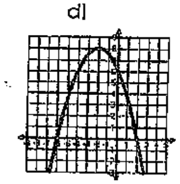
- The vertex is located at $(8, -2)$.
- The range is $-2 \le f(x) < \infty$.

Which graph could be $f(x)$?

a) 

b) 

c) 

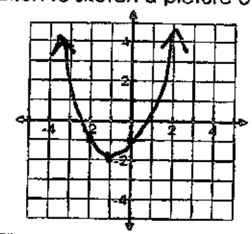
d) 

6. Use the information for a given quadratic function to sketch a picture of the function.

Domain: $-\infty < x < \infty$
Range: $y \ge -2$

Increasing: $-1 < x < \infty$
Decreasing: $-\infty < x < -1$

There is no stretch or shrink ($a = 1$)



Characteristics of Quadratics WS   Name ____________

Graph each function, then give the characteristics.

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

Domain R
Range $(-\infty, 4]$
Vertex $(3,4)$
Maximum $(3,4)$
Minimum none
Zero(s) $(1,0)$ $(5,0)$
x-intercept(s)
y-intercept $(0,-5)$
End Behavior $x \to -\infty, f(x) \to -\infty$, $x \to \infty, f(x) \to -\infty$
Interval of Increase $(-\infty, 3)$
Interval of Decrease $(3, \infty)$

2. $h(x) = 2(x-2)^2$

Domain R
Range $[0, \infty)$
Vertex $(2,0)$
Maximum none
Minimum $(2,0)$
Zero(s) $x=2$
x-intercept(s) $(2,0)$
y-intercept $(0,8)$
End Behavior $x \to -\infty, f(x) \to \infty$, $x \to \infty, f(x) \to \infty$
Interval of Increase $(2, \infty)$
Interval of Decrease $(-\infty, 2)$

3. $g(x) = 2x^2 + 8x + 6$

Domain R
Range $[-2, \infty)$
Vertex $(-2,-2)$
Maximum none
Minimum $(-2,-2)$
Zero(s) $x=-1$ $x=-3$
x-intercept(s) $(-1,0)(-3,0)$
y-intercept $(0,6)$
End Behavior $x \to -\infty, f(x) \to \infty$, $x \to \infty, f(x) \to \infty$
Interval of Increase $(-2, \infty)$
Interval of Decrease $(-\infty, -2)$

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

Domain R
Range $[2, \infty)$
Vertex $(3,2)$
Maximum none
Minimum $(3,2)$
Zero(s) none
x-intercept(s) none
y-intercept $(0,11)$
End Behavior $x \to -\infty, f(x) \to \infty$ $x \to \infty, f(x) \to \infty$
Interval of Increase $(3, \infty)$
Interval of Decrease $(-\infty, 3)$

5. $f(x) = -\frac{1}{2}(x-1)(x+3)$

Domain R
Range $(-\infty, +2]$
Vertex $(-1,2)$
Maximum $(-1,2)$
Minimum none
Zero(s) $x=1$ $x=-3$
x-intercept(s) $(1,0)$ $(-3,0)$
y-intercept $(0, \frac{3}{2})$
End Behavior $x \to -\infty, f(x) \to -\infty$ $x \to \infty$ $f(x) \to -\infty$
Interval of Increase $(-\infty, -1)$
Interval of Decrease $(-1, \infty)$

6. $g(x) = -x^2 + 10x - 24$

$x = \frac{-b}{2a} = \frac{-10}{-2} = 5$

$y = -(5)^2 + 10(5) - 24$

$y = -25 + 50 - 24$

$y = 25 - 24$

$y = 1$

Domain R
Range $(-\infty, 1]$
Vertex $(5,1)$
Maximum $(5,1)$
Minimum none
Zero(s) $x=4$ $x=6$
x-intercept(s) $(4,0)(6,0)$
y-intercept $(0,-24)$
End Behavior $x \to -\infty, f(x) \to -\infty$ $x \to \infty, f(x) \to -\infty$
Interval of Increase $(-\infty, 5)$
Interval of Decrease $(5, \infty)$

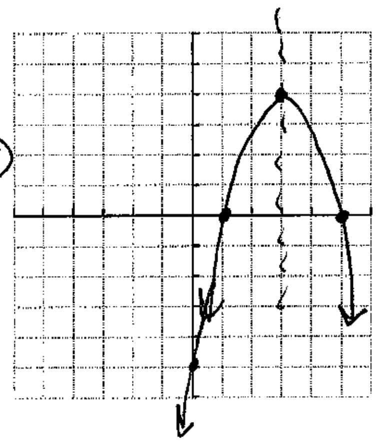
1) $y = -(x-1)(x-5)$

$x = \frac{1+5}{2} = 3$

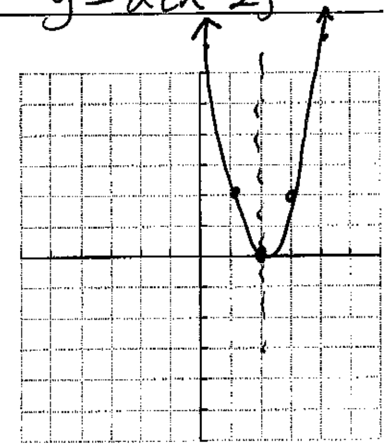
$y = -(3-1)(3-5)$

$y = 4$

$V(3,4)$



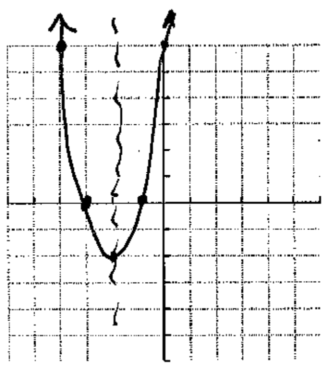
2) $y = 2(x-2)^2$



3) $y = 2x^2 + 8x + 6$

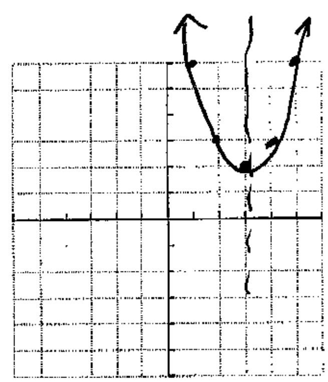
$x = -\frac{b}{2a}$

$x = \frac{-8}{4} = -2$



x	y
-4	6
-3	0
-2	-2
-1	0
0	6

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



5) $y = -\frac{1}{2}(x-1)(x+3)$

$x = \frac{1-3}{2} = -1$

$x = -1$

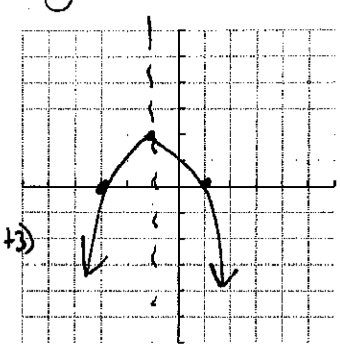
$y = -\frac{1}{2}(-1-1)(-1+3)$

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

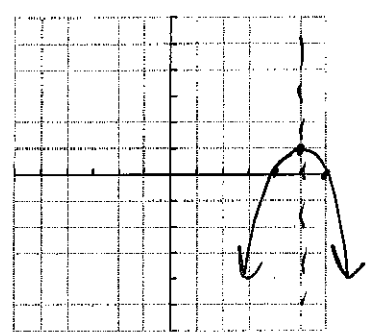
$y = 2$

vertex: $(-1, 2)$

y-inter: $(0, \frac{3}{2})$



6) $y = -x^2 + 10x - 24$



Name: ______________________ Date: ______________

Graphing Quadratics – Standard Form

$$f(x) = ax^2 + bx + c$$

Most common way to see a quadratic written.

Axis of Symmetry: $x = \frac{-b}{2a}$

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

Plug your axis of symmetry in to the function to find the y-value

Steps to Graphing in STANDARD form:

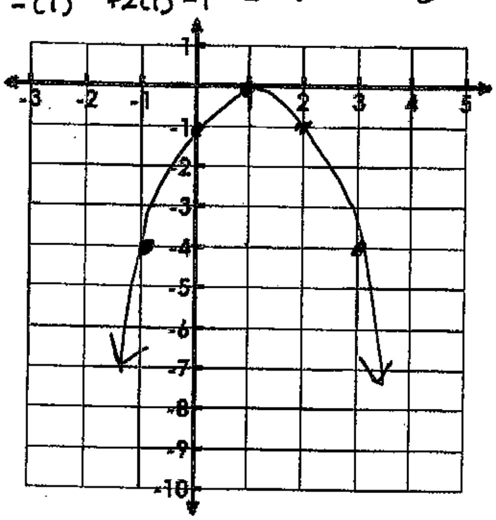
1. Identify a, b, and c.
2. Find the axis of symmetry. $x = \frac{-b}{2a}$ Graph this lightly as a dashed vertical line.
3. Table, Edit Function, start = A.O.S. This is your vertex. Plot it.
4. Scroll up and down to get other ordered pairs.
5. Connect in a u-shape with arrows at each end.

Graph.

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

$x = -\frac{b}{2a} = \frac{-2}{-2} = 1$

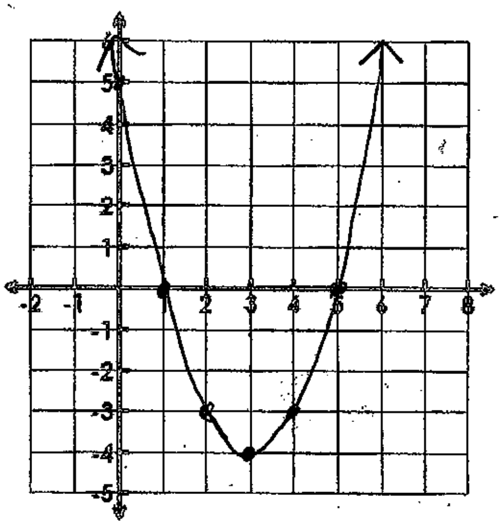
$y = -(1)^2 + 2(1) - 1 = -1 + 2 - 1 = 0$



Characteristics	
A.O.S.	$x = 1$
Vertex:	$(1, 0)$
Domain:	$\mathbb{R}$
Range:	$(-\infty, 0)$
x-intercept(s):	$(1, 0)$
y-intercept:	$(0, -1)$
Interval of Increase:	$(-\infty, 1)$
Interval of Decrease:	$(1, \infty)$
Rate of change from $0 \le x \le 2$:	$(0, -1)$ $(2, -1)$ $m = \frac{-1+1}{2-0} = \boxed{0}$
Rate of change from $1 \le x \le 3$:	$(1, 0)$ $(3, -4)$ $m = \frac{-4-0}{3-1} = \frac{-4}{2} = \boxed{-2}$

2. $f(x) = x^2 - 6x + 5$

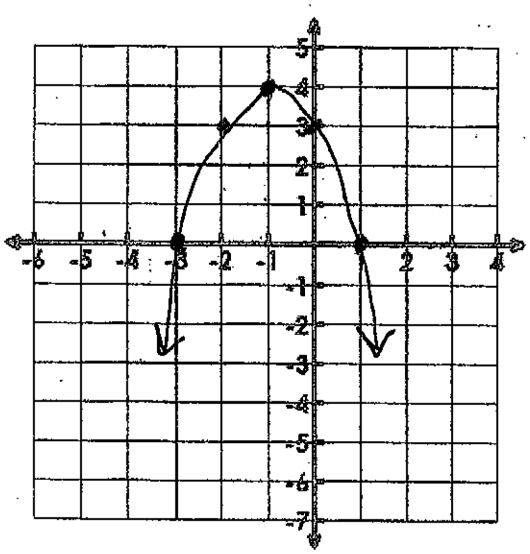
$x = \frac{6}{2} = 3$ $y = 9 - 18 + 5$
$y = -4$



Characteristics	
A.O.S.:	$x = 3$
Vertex:	$(3, -4)$
Domain:	$\mathbb{R}$
Range:	$[-4, \infty)$
Zeros:	$(1,0)$ $(5,0)$
y-intercept:	$(0, 5)$
Interval of Increase:	$(3, \infty)$
Interval of Decrease:	$(-\infty, 3)$
Rate of change from $0 \le x \le 2$:	$(0,5)$ $(2,-3)$ $m = \frac{-3-5}{2-0} = \frac{-8}{2} = \boxed{-4}$
Rate of change from $4 \le x \le 5$:	$(4,-3)$ $(5,0)$ $m = \frac{0--3}{5-4} = \boxed{\frac{3}{1}}$

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

$x = \frac{2}{-2} = -1$ $y = -1 + 2 + 3$



Characteristics	
A.O.S.:	$x = -1$
Vertex:	$(-1, 4)$
Domain:	$\mathbb{R}$
Range:	$(-\infty, 4]$
Roots:	$x = -3$ $x = 1$
y-intercept:	$(0, 3)$
Interval of Increase:	$(-\infty, -1)$
Interval of Decrease:	$(-1, \infty)$
Rate of change from $0 \le x \le 2$:	$(0,3)$ $(2,-5)$ $m = \frac{-5-3}{2-0} = \frac{-8}{2} = \boxed{-4}$
Rate of change from $-3 \le x \le 1$:	$(-3,0)$ $(1,0)$ $m = \frac{0-0}{1+3} = \boxed{0}$

$-4 -4 +3$

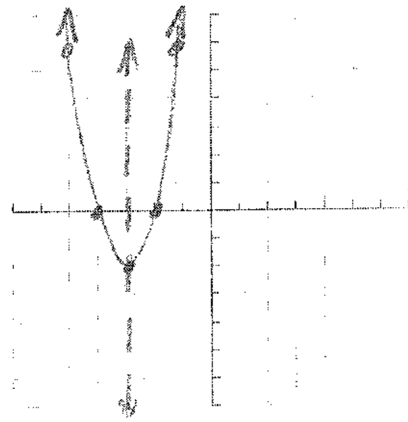
AC Math 1 Name Teresa Scor

Graphing Quadratic Equations WS 1

Graph each of the following quadratic functions. Identify the appropriate characteristics.

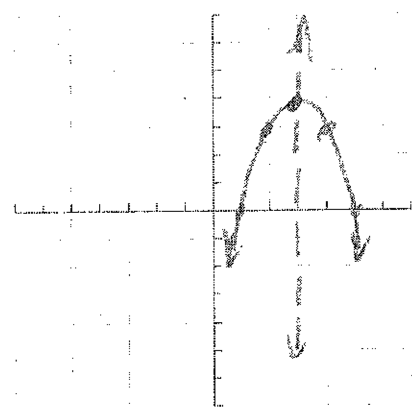
1. $f(x) = 2(x+2)(x+4)$

x-Intercept(s): (-2,0) (-4,0)
Vertex: (-3,-2)
Axis of Symmetry: $x = -3$
y-intercept: (0,16)



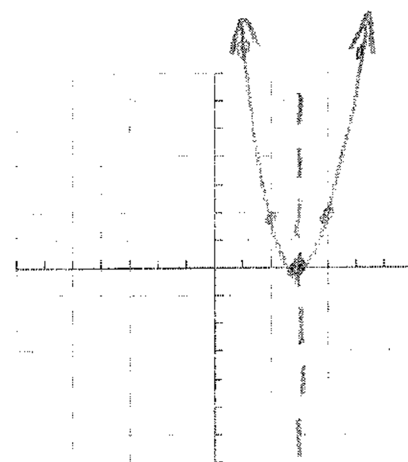
2. $g(x) = -(x-3)^2 + 4$

x-Intercept(s): (1,0) (5,0)
Vertex: (3,4)
Axis of Symmetry: $x = 3$
y-intercept: (0,-5)



3. $f(x) = 2x^2 - 12x + 18$

x-Intercept(s): (3,0) n/a
Vertex: (3,0)
Axis of Symmetry: $x = 3$
y-intercept: (0,18)

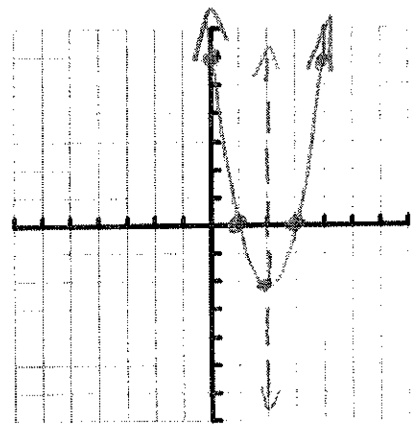


AC Math 1 Name: answer key

Graphing Quadratic Equations WS 2

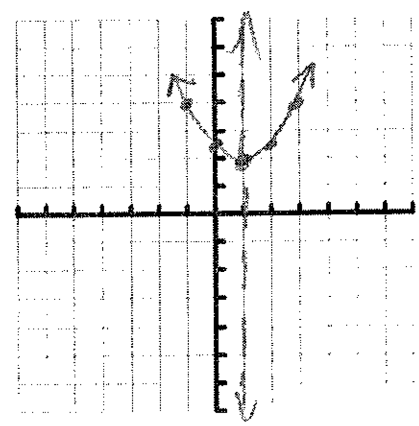
Graph each of the following quadratic functions. Identify the appropriate characteristics.

1. $f(x)=2(x-1)(x-3)$ $f(2)=2(1)(-1)$



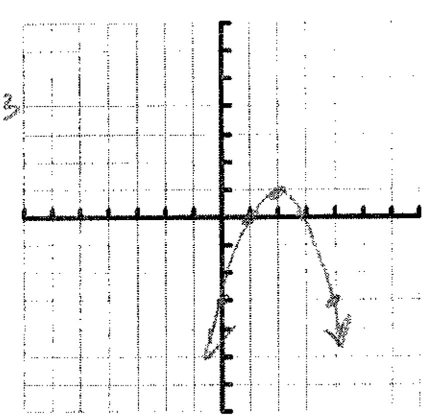
1st → x-Intercept(s): (1,0) (3,0)
Vertex: (2,-2)
Axis of Symmetry: $x=2$
y-intercept: (0,6)

2. $g(x)=\frac{1}{2}(x-1)^2+2$



x-Intercept(s): none
1st → Vertex: (1,2)
Axis of Symmetry: $x=1$
y-intercept: (0, 2½)

3. $f(x)=-x^2+4x-3$ $x=\frac{-4}{-2}=2$
$f(2)=-4+8-3$



x-Intercept(s): (1,0) (3,0)
Vertex: (2,1)
1st → Axis of Symmetry: $x=2$
y-intercept: (0,-3)

3. A baker has modeled the monthly operating costs for making wedding cakes by the function $y = 0.5x^2 - 12x + 150$ where y is the total cost in dollars and x is the number of cakes prepared.

   A. Find the **vertex** and **axis of symmetry**. *The vertex would represent (Cakes Prepared, $Cost).*

   $x = \frac{12}{1}$ $y = .5(12)^2 - 12(12) + 150$ $\boxed{(12, 78)}$

   $y = 72 - 144 + 150$

   B. What is the **minimum** monthly operating **cost**?

   $78

   C. How many **cakes** should be prepared each month to yield the minimum operating cost?

   12 cakes

   D. What are the baker's costs if he/she makes **no cakes (zero)**?

   $\boxed{\$150}$ $y = .5(0)^2 - 12(0) + 150$

4. The path of a soccer ball is modeled by the function $h(x) = -0.005x^2 + 0.25x$, where h is the height in meters and x is the horizontal distance that the ball travels in meters. What is the **maximum height** that the ball reaches? *Hint: start by finding the vertex.*

   $x = \frac{-.25}{2(-.005)} = 25$ $y = -.005(25)^2 + .25(25)$

   $y = \boxed{3.125m}$

5. The function $A(x) = x(10 - x)$ describes the area A of a rectangular flower garden, where x is its width in yards. What is the maximum area of the garden? *Hint: get your equation in standard form 1st and then start finding the vertex.*

   $10x - x^2 = A(x)$

   $x = \frac{-10}{2(-1)} = 5$ $A(5) = 10(5) - (5)^2$

   $= 50 - 25 = \boxed{25 \text{ yd}^2}$

6. A record label uses the following function to model the sales of a new release.

   $$a(t) = -90t^2 + 8100t$$

   The number of albums sold is a function of time, t, in days. On which **day** were the **most** albums sold? What is the **maximum** number of **albums** sold on that day?

   $x = t =$ days

   $x = \frac{-8100}{2(-90)} = 45$ days $a(45) = -90(45)^2 + 8100(45)$

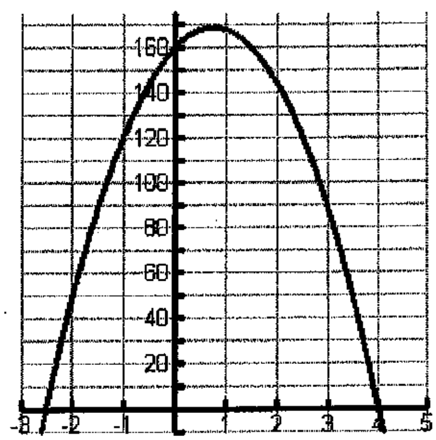
   $= \boxed{182250}$

Name: ________________________ Date: ______________

Characteristics of Quadratic Equations

Wil E. Coyote is catapulting a boulder off a cliff to hit the road runner. Let t represent the number of seconds that the boulder catapults off the cliff and h(t) denote the height of the boulder, in feet, above the base of the cliff. Ignoring air resistance, we can use the following formula to express the path of the boulder: $h(t) = -16t^2 + 24t + 160$

1. What does the x axis represent? seconds The y axis? height of boulder
2. What part of the graph is insignificant? Why?



sec.

3. What was the height of the boulder before it was launched? 160 ft ~~ft~~
   What special point on the graph is associated with this information? (y-intercept)
4. If Wil E. Coyote simply pushed a boulder off the cliff, how would the graph look different?
   There would not be an arc if the boulder was pushed off the cliff. It would be a straight line down.
5. How long will it take before the boulder reaches the bottom of the cliff? 4 sec.
   What special point on the graph is associated with this information? x-intercept
6. After how many seconds does the boulder change direction? about 3/4 of a sec (.75)
   $x = \frac{-24}{2(-16)} = \frac{-24}{-32} = (.75)$
   How high is the boulder when it changes direction? 169 ft
   What is this significant point called on the graph? vertex
7. How high above the starting point does the boulder begin to change direction?
   9 ft (169-160)
8. If Wil E. Coyote changes his mind, how many seconds does he have to stop the boulder from going over the cliff? .75 sec.