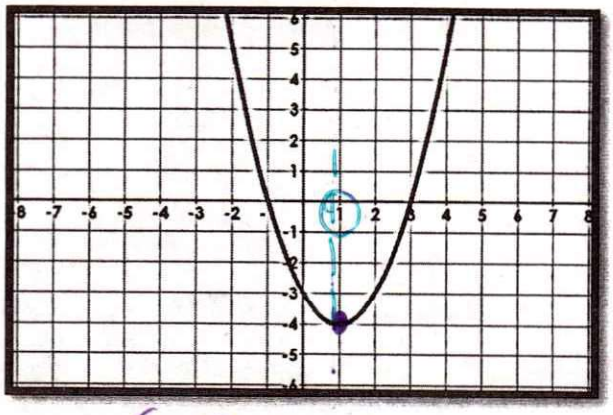
Vertex & Axis of Symmetry

Vertex		
Define: Highest or lowest point or peak of a parabola	**Think:** What is my highest or lowest point on my graph?	**Write:** Name the point (h, k)
Axis of Symmetry * x value of vertex		
Define: The vertical line that divides the parabola into mirror images and runs through the vertex	**Think:** What imaginary, vertical line would make the parabola symmetrical?	**Write:** x = h (x value of the vertex)

Graph 1

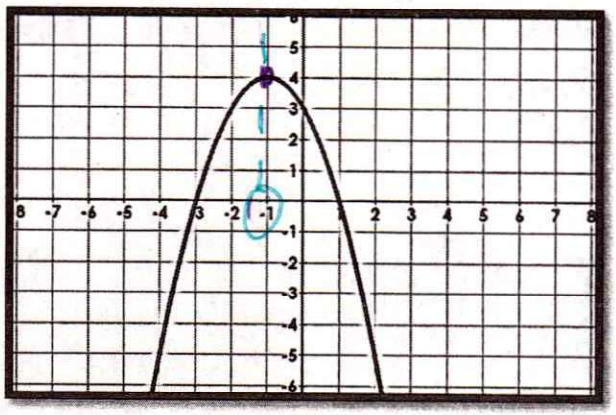


Vertex: (1,-4)

Axis of Symmetry:

X=1

Graph 2

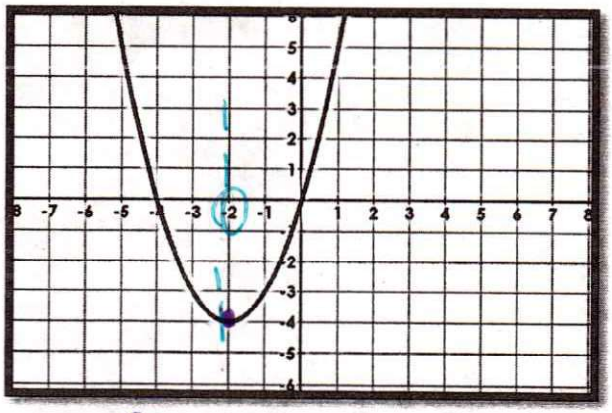


Vertex: (-1,4)

Axis of Symmetry:

X = -1

Graph 3

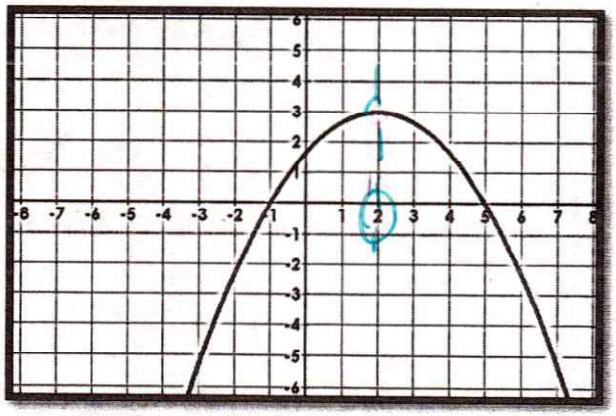


Vertex: (-2,-4)

Axis of Symmetry:

X = -2

Graph 4



Vertex: (2,3)

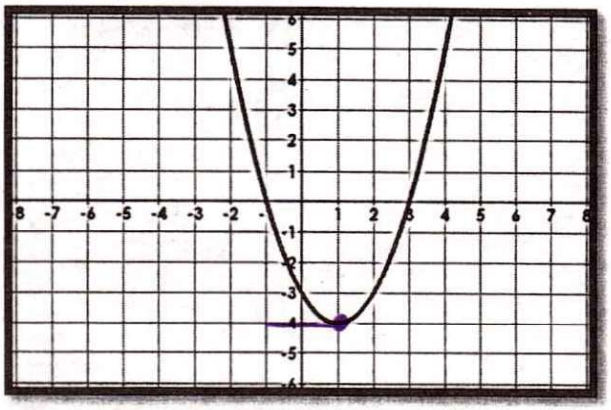
Axis of Symmetry:

X=2

Extrema

Maximum a = neg #		
Define: Highest point or peak of a function.	**Think:** What is my highest point on my graph?	**Write:** y = k (y-value of the vertex)
Minimum a = pos #		
Define: Lowest point or valley of a function.	**Think:** What is the lowest point on my graph?	**Write:** y = k (y-value of the vertex)

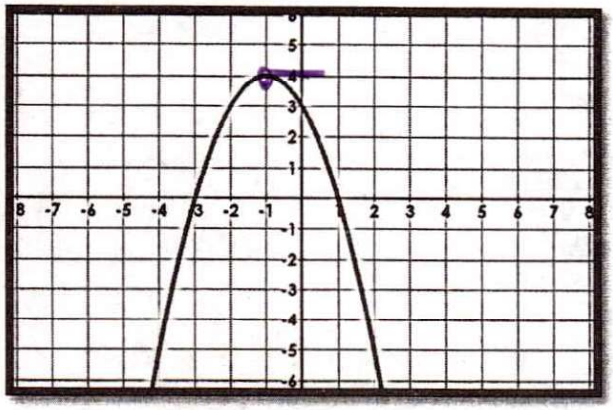
Graph 1



Extrema: min

Min/Max Value: y = -4

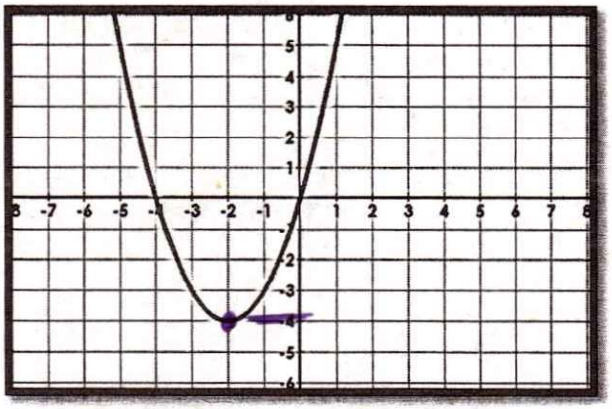
Graph 2



Extrema: max

Min/Max Value: y = 4

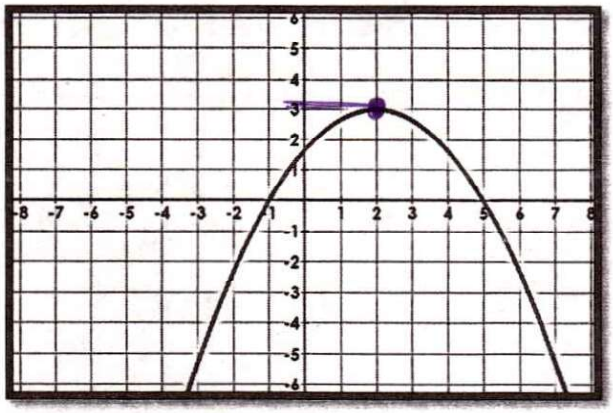
Graph 3



Extrema: min

Min/Max Value: y = -4

Graph 4



Extrema: max

Min/Max Value: y = 3

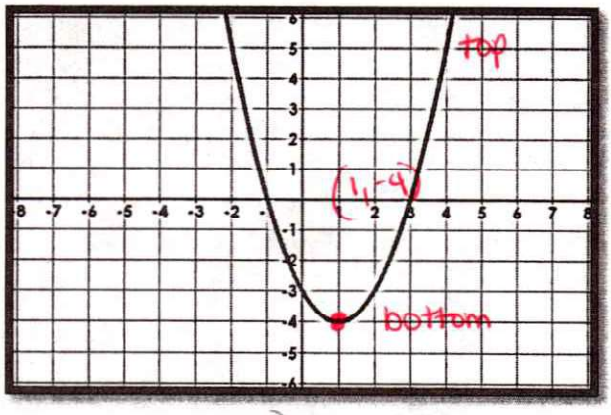
Day 3 - Characteristics of Quadratics

One key component to fully understanding quadratic functions is to be able to describe characteristics of the graph and its equation.

Domain and Range

$-\infty$ ∞ read L→R **Domain** * if arrows on ends always $(-\infty, \infty)$		
Define: All possible values of x	**Think:** How far left to right does the graph go?	**Write:** Smallest x ≤ x ≤ Biggest x *use < if the circles are open*
***(min, ∞) or (-∞, max) **Range** Bottom to top		
Define: All possible values of y	**Think:** How far down to how far up does the graph go?	**Write:** y ≤ highest y value (opens down) y ≥ lowest y value (opens up)

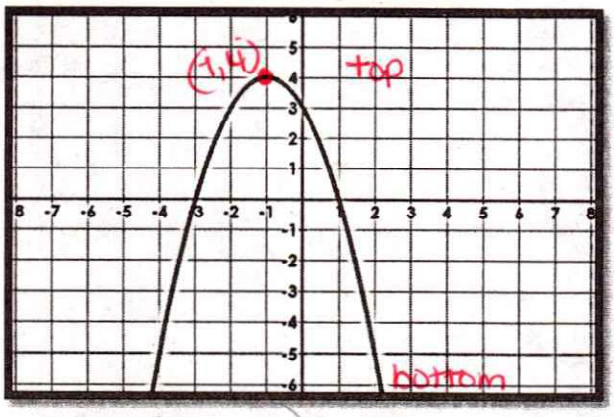
Graph 1



Domain: $(-\infty, \infty)$

Range: $(-4, \infty)$ or $y \geq -4$
(Bottom, top)

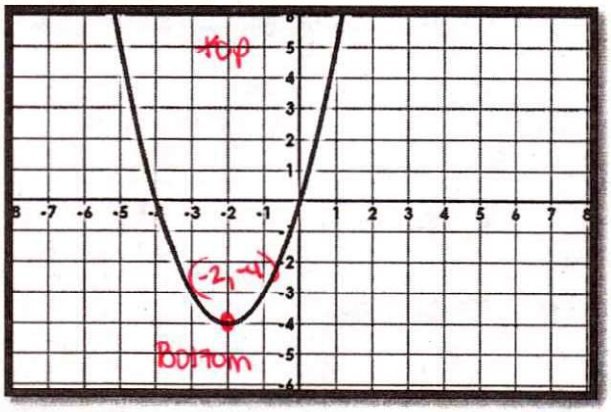
Graph 2



Domain: $(-\infty, \infty)$

Range: $(-\infty, 4)$ or $y \leq 4$
(Bottom, top)

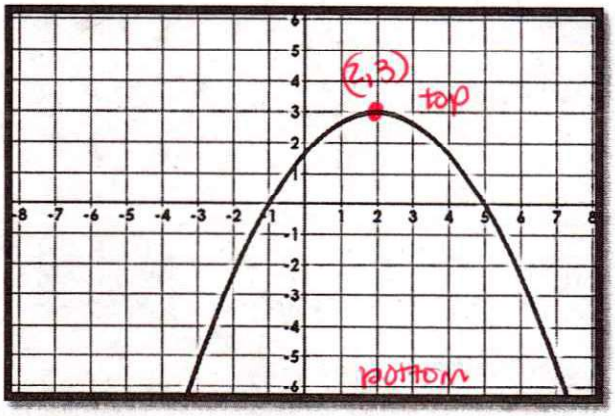
Graph 3



Domain: $(-\infty, \infty)$

Range: $(-4, \infty)$ or $y \geq -4$

Graph 4



Domain: $(-\infty, \infty)$

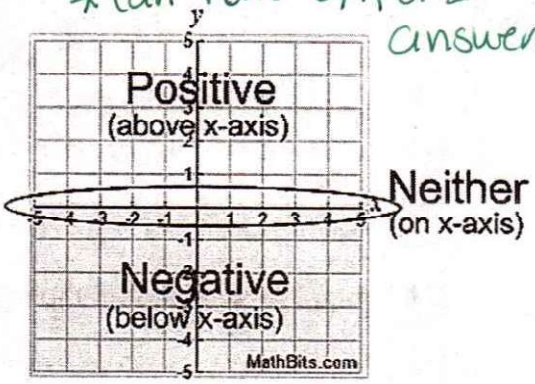
Range: $(-\infty, 3)$ or $y \leq 3$

Positive & Negative Parts of the Graph

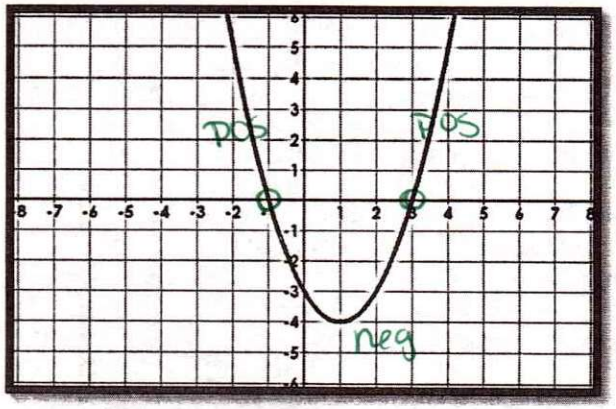
*based off of x-intercepts

Positive		
Define: The part of the function that is above the x-axis.	**Think:** Which part of the function is in the positive region and where?	**Write:** Inequality using the zeros value (x)
Negative		
Define: The part of the function that is below the x-axis.	**Think:** Which part of the function is in the negative region and where?	**Write:** Inequality using the zero values (x)

*can have 0, 1, or 2 answers



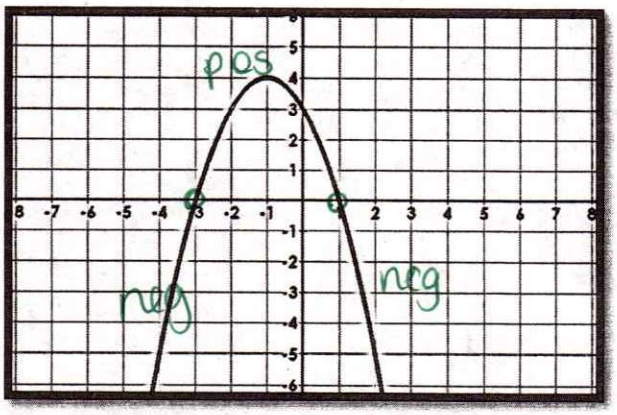
Graph 1



Positive: $(-\infty,-1)$ & $(3,\infty)$

Negative: $(-1,3)$

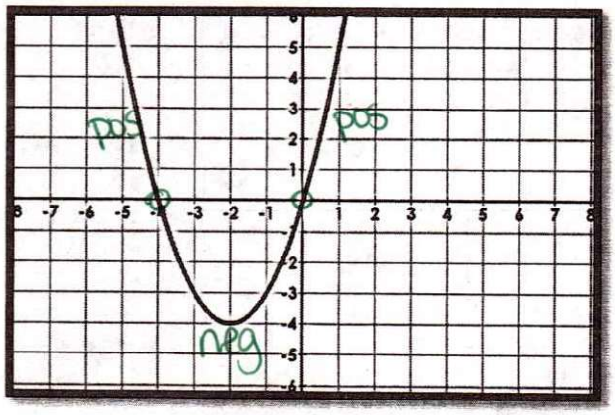
Graph 2



Positive: $(-3,1)$

Negative: $(-\infty,-3),(1,\infty)$

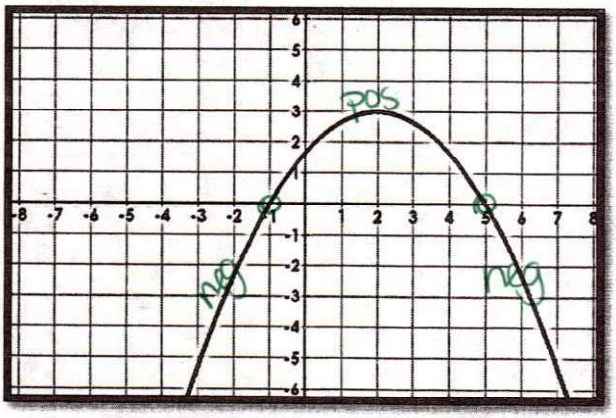
Graph 3



Positive:

Negative: $(-4,0)$ or $-4<x<0$

Graph 4



Positive: $(-1,5)$

Negative: $(-\infty,-1)$ $(5,\infty)$

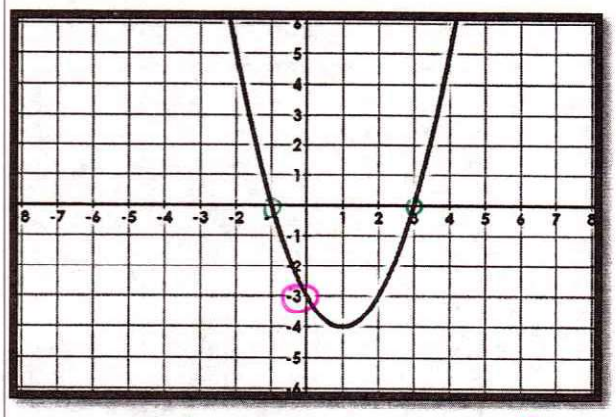
Zeros and Intercepts

will have exactly one

can have 0, 1, 2

Y-Intercept		
Define: Point where the graph crosses the y-axis	**Think:** At what coordinate point does the graph cross the y-axis?	**Write:** (0, b)
X-Intercept		
Define: Point where the graph crosses the x-axis	**Think:** At what coordinate point does the graph cross the x-axis?	**Write:** (a, 0)
Zero		
Define: Where the function (y-value) equals 0	**Think:** At what x-value does the graph cross the x-axis?	**Write:** x = ____

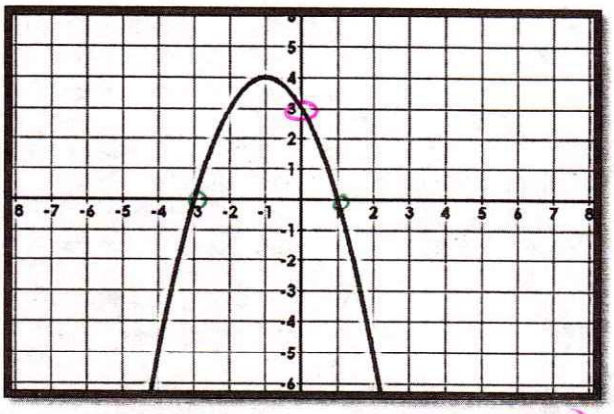
Graph 1



X-intercepts: (-1,0) (3,0) Y-intercept: (0,-3)

Zeros: x=-1 & x=3

Graph 2



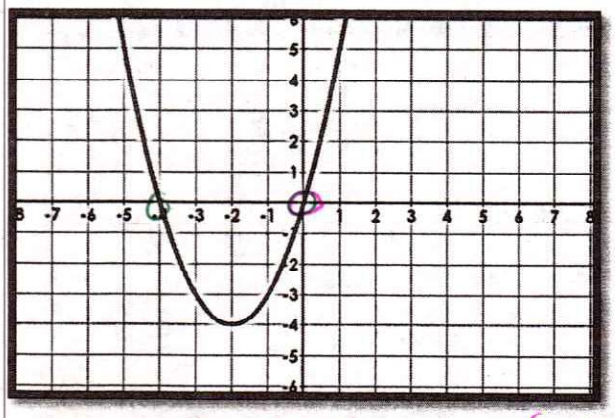
X-intercepts: (-3,0) (1,0) Y-intercept: (0,3)

Zeros:

x=-3

x=1

Graph 3

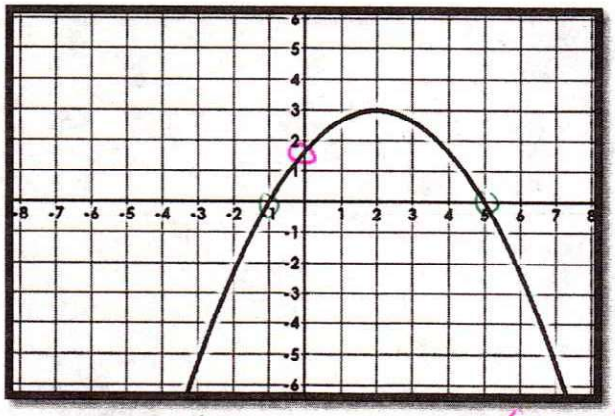


X-intercepts: (-4,0) (0,0) Y-intercept: (0,0)

Zeros: x=-4

x=0

Graph 4



X-intercepts: (-1,0) (5,0) Y-intercept: (0,1.5)

Zeros:

x=-1 x=5

Day 4 - Characteristics of Quadratics (Cont'd)

*use Axis of Sym

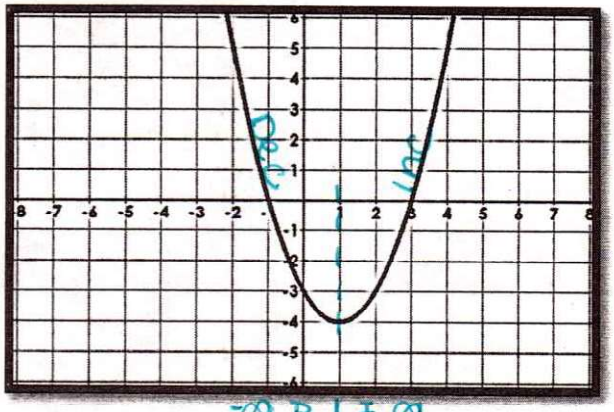
Intervals of Increase and Decrease

Interval of Increase		
Define: The part of the graph that is rising as you read left to right.	**Think:** From left to right, is my graph going up?	**Write:** An inequality using the x-value of the vertex

Interval of Decrease		
Define: The part of the graph that is falling as you read from left to right.	**Think:** From left to right, is my graph going down?	**Write:** An inequality using the x-value of the vertex

** label $-\infty$, AOS, ∞ **

Graph 1

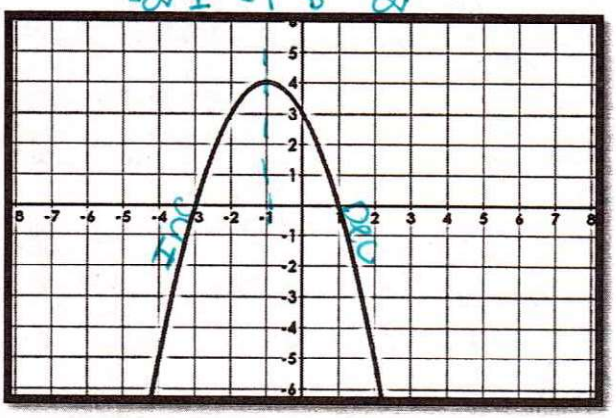


Interval of Increase:
$(1, \infty)$ or $1 \le x < \infty$ or $x \ge 1$

Interval of Decrease:
$(-\infty, 1)$ or $-\infty < x \le 1$ or $x \le 1$

Graph 2

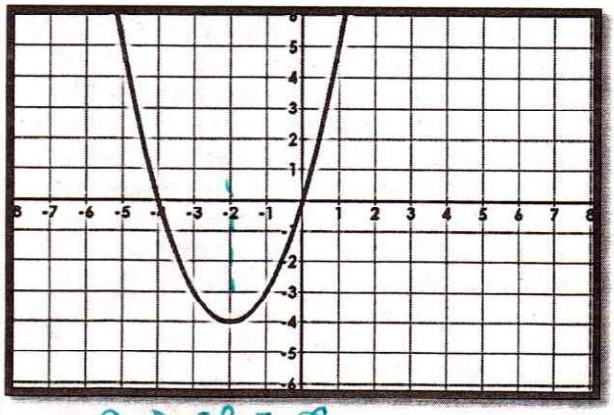
$-\infty$ I -1 D ∞



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

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

Graph 3



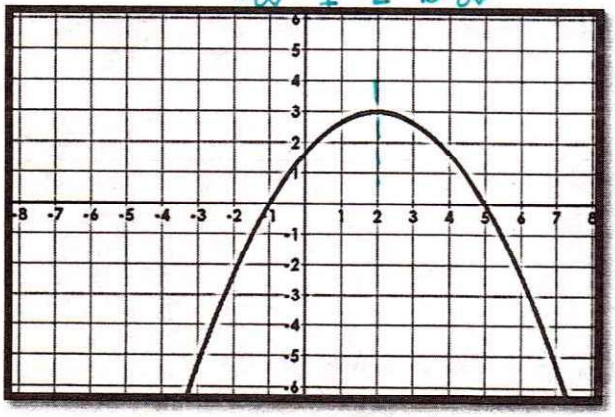
$-\infty$ D -2 I ∞

Interval of Increase:
$(-2, \infty)$

Interval of Decrease:
$(-\infty, -2)$

Graph 4

$-\infty$ I 2 D ∞



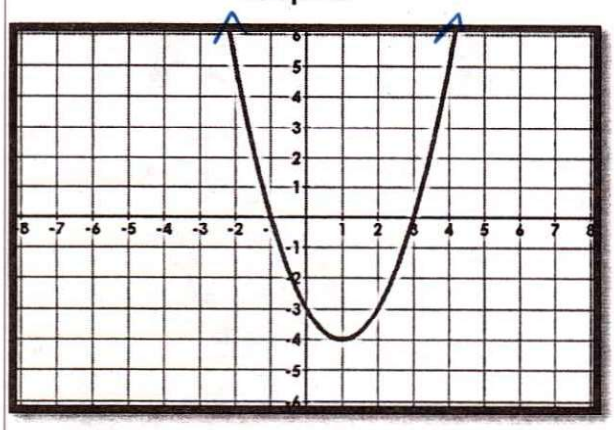
Interval of Increase:
$(-\infty, 2)$

Interval of Decrease:
$(2, \infty)$

End Behavior

End Behavior	
Define: Behavior of the ends of the function (what happens to the y-values or f(x)) as x approaches positive or negative infinity. The arrows indicate the function goes on forever so we want to know where those ends go.	
Think: As x goes to the left (negative infinity), what direction does the left arrow go?	**Write:** As x → -∞, f(x) → _____
Think: As x goes to the right (positive infinity), what direction does the right arrow go?	**Write:** As x → ∞, f(x) → _____

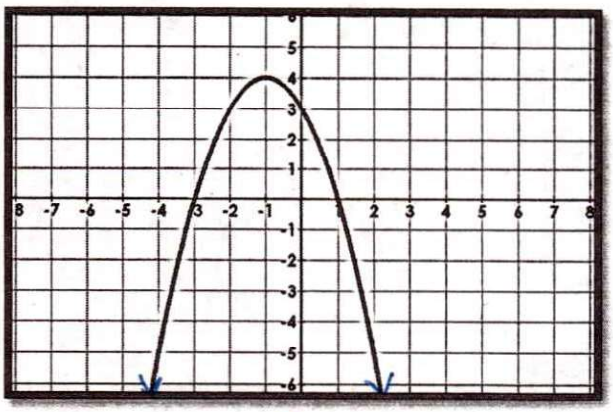
Graph 1



As x → -∞, f(x) → ∞.

As x → ∞, f(x) → ∞.

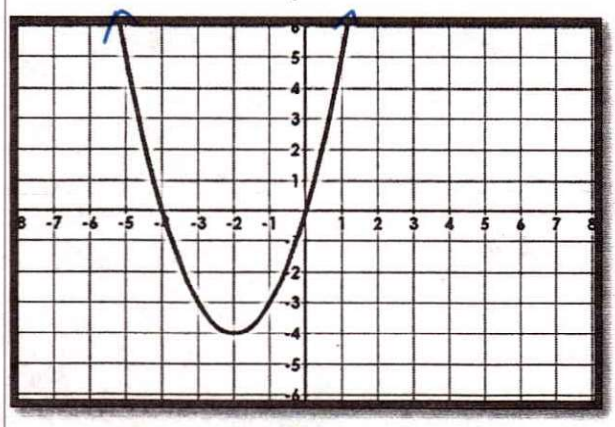
Graph 2



As x → -∞, f(x) → $-\infty$.

As x → ∞, f(x) → $-\infty$.

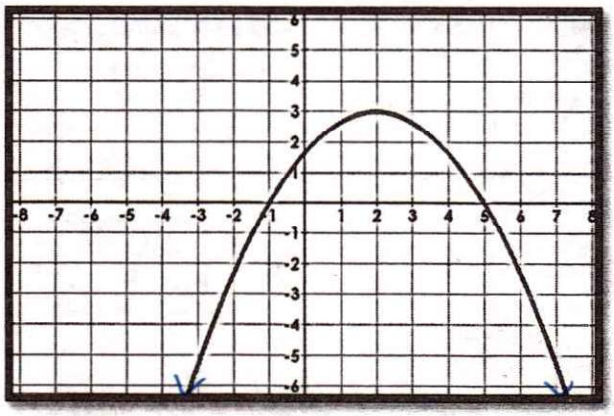
Graph 3



As x → -∞, f(x) → ∞.

As x → ∞, f(x) → ∞.

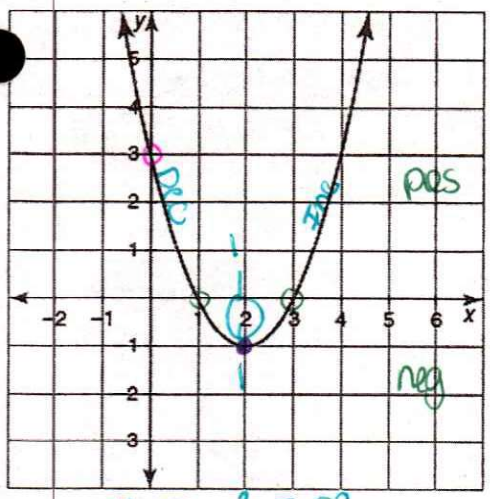
Graph 4



As x → -∞, f(x) → $-\infty$.

As x → ∞, f(x) → $-\infty$.

Practice: Describe the characteristics of the following graphs:



Domain: (-∞ ∞) **Range:** (-1, ∞) or y ≥ -1

Vertex: (2, -1) **Axis of Sym.** x = 2

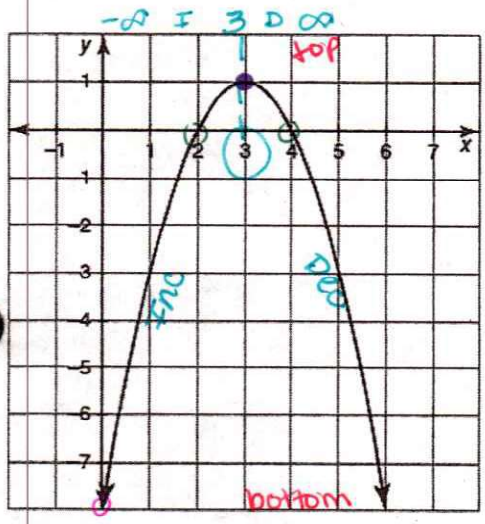
Y-Intercept: (0, 3) **Zeroes:** x = 1, x = 3

Extrema: min **Max/Min Value:** y = -1

Int of Inc: (2, ∞) **Int of Dec:** (-∞, 2)

Positive: (-∞, 1) (3, ∞) **Negative:** (1, 3)

End Behavior: As x → -∞, f(x) → ∞. As x → ∞, f(x) → ∞



Domain: (-∞ ∞) **Range:** (-∞, 1) or y ≤ 1

Vertex: (3, 1) **Axis of Sym.** x = 3

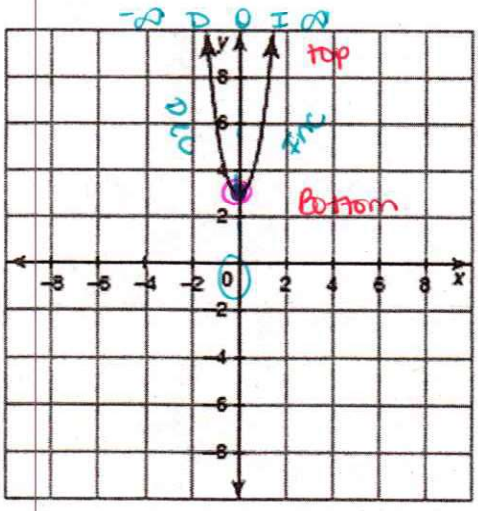
Y-Intercept: (0, 8) **Zeroes:** x = 2, x = 4

Extrema: max **Max/Min Value:** y = 1

Int of Inc: (-∞, 3) **Int of Dec:** (3, ∞)

Positive: (2, 4) **Negative:** (-∞, 2), (4, ∞)

End Behavior: As x → -∞, f(x) → -∞. As x → ∞, f(x) → ∞



Domain: (-∞, ∞) **Range:** (3, ∞) or y ≥ 3

Vertex: (0, 3) **Axis of Sym.** x = 0

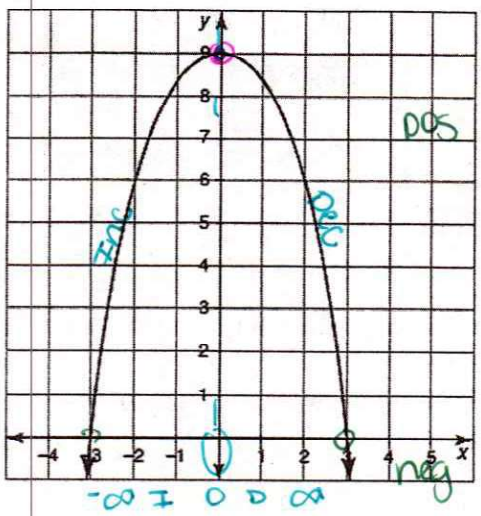
Y-Intercept: (0, 3) **Zeroes:** none

Extrema: min **Max/Min Value:** y = 3

Int of Inc: (0, ∞) **Int of Dec:** (-∞, 0)

Positive: (-∞, ∞) **Negative:** none

End Behavior: As x → -∞, f(x) → ∞. As x → ∞, f(x) → ∞



Domain: (-∞,∞) **Range:** (-∞, 9)

Vertex: (0,9) **Axis of Sym.** x=0

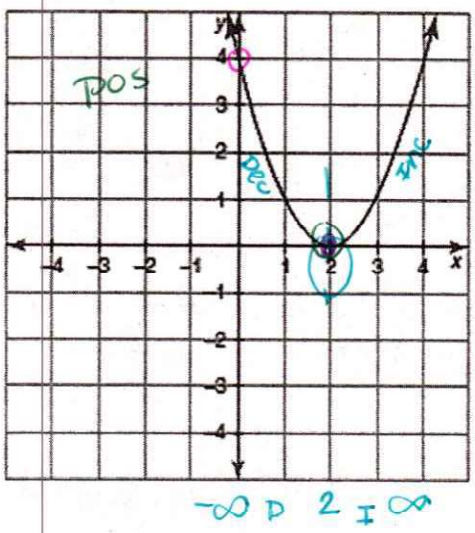
Y-Intercept: (0,9) **Zeroes:** x=-3, x=3

Extrema: max **Max/Min Value:** y=9

Int of Inc: (-∞, 0) **Int of Dec:** (0, ∞)

Positive: (-3, 3) **Negative:** (-∞,-3) (3,∞)

End Behavior: As x → -∞, f(x) → -∞. As x → ∞, f(x) → -∞



Domain: (-∞,∞) **Range:** (0,∞)

Vertex: (2,0) **Axis of Sym.** x=2

Y-Intercept: (0,4) **Zeroes:** x=2

Extrema: min **Max/Min Value:** y=0

Int of Inc: (2,∞) **Int of Dec:** (-∞,2)

Positive: (-∞,∞) **Negative:** none

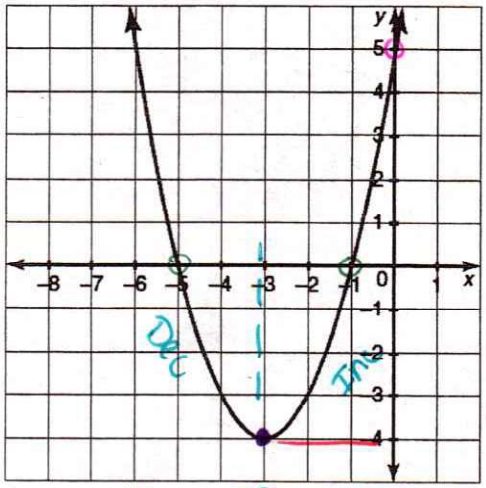
End Behavior: As x → -∞, f(x) → ∞. As x → ∞, f(x) → ∞

Day 3 - Characteristics of Quadratic Functions Name:_____

Practice Assignment Date:_____ Block:_____

Identify all of the characteristics listed for the following graphs.

1.



$-\infty$ D -3 I ∞

Domain: $(-\infty, \infty)$ **Range:** $(-4, \infty)$

Vertex: $(-3, -4)$ **Axis of Sym.** $x = -3$

Y-Intercept: $(0, 5)$ **Zeroes:** $x = -5$, $x = -1$

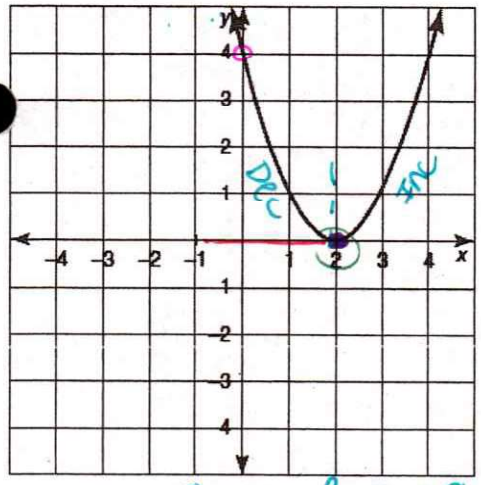
Extrema: min **Max/Min Value:** $y = -4$

Int of Inc: $(-3, \infty)$ **Int of Dec:** $(-\infty, -3)$

Positive: $(-\infty, -5), (-1, \infty)$ **Negative:** $(-5, -1)$

End Behavior: As x → -∞, f(x) → ∞. As x → ∞, f(x) → ∞

2.



$-\infty$ D 2 I ∞

Domain: $(-\infty, \infty)$ **Range:** $(0, \infty)$

Vertex: $(2, 0)$ **Axis of Sym.** $x = 2$

Y-Intercept: $(0, 4)$ **Zeroes:** $x = 2$

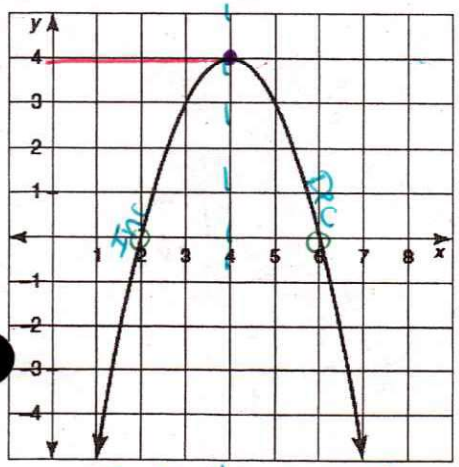
Extrema: min **Max/Min Value:** $y = 0$

Int of Inc: $(2, \infty)$ **Int of Dec:** $(-\infty, 2)$

Positive: $(-\infty, \infty)$ **Negative:** none

End Behavior: As x → -∞, f(x) → ∞. As x → ∞, f(x) → ∞

3.



$-\infty$ I 4 D ∞

Domain: $(-\infty, \infty)$ **Range:** $(-\infty, 4)$

Vertex: $(4, 4)$ **Axis of Sym.** $x = 4$

Y-Intercept: $(0, -12)$ **Zeroes:** $x = 2$, $x = 6$

Extrema: max **Max/Min Value:** $y = 4$

Int of Inc: $(-\infty, 4)$ **Int of Dec:** $(4, \infty)$

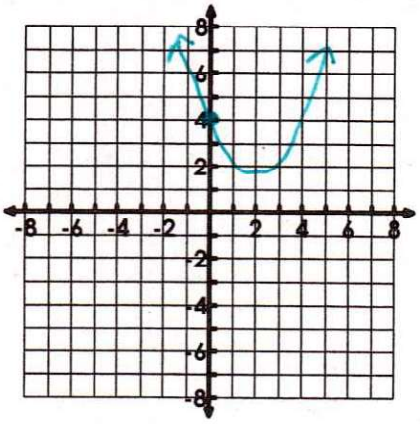
Positive: $(2, 6)$ **Negative:** $(-\infty, 2)(6, \infty)$

End Behavior: As x → -∞, f(x) → $-\infty$. As x → ∞, f(x) → $-\infty$

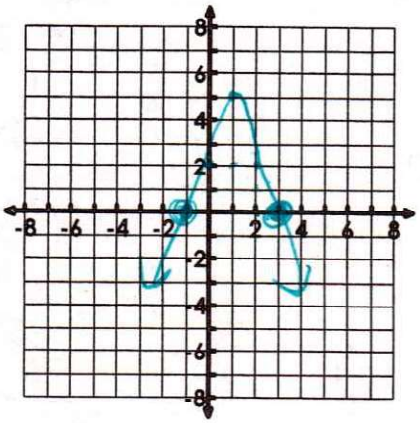
*Answers may vary

Problems 4 – 9: Use the given description to create a <u>rough sketch</u> of a quadratic function. Your graphs might look different than mine, but they must meet the characteristic described below. Start by placing your characteristics on the graph and create the sketch after that.

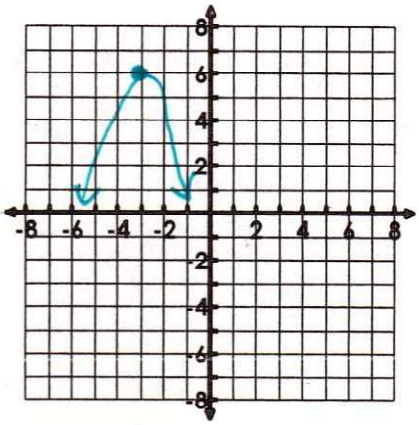
4. Parabola that opens up and has a y-intercept of (0, 5).



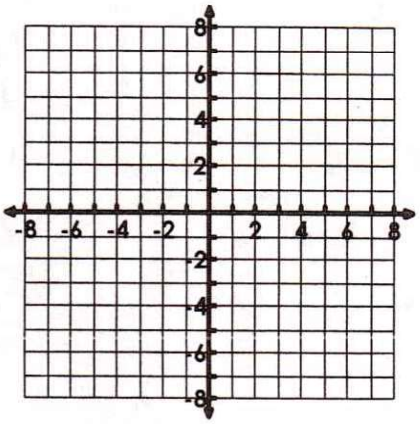
5. Parabola that opens down and has x-intercepts of 3 and -1.



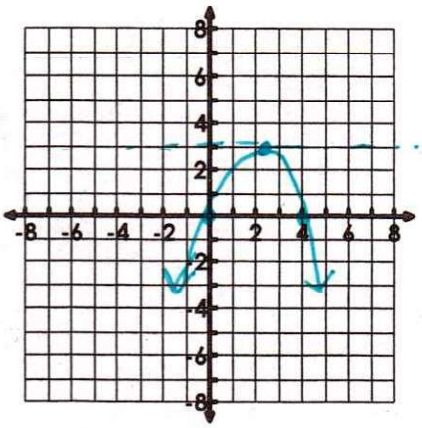
6. Parabola with end behavior that approaches $-\infty$ Points down and has a vertex of (-3, 6).



7. Parabola with a negative part of the graph between $-2 \le x \le 2$.



8. Parabola with a maximum of 3 and zeros of 0 and 4.



9. Parabola with an axis of symmetry of x = -1 and a range of $y \ge -5$.