5.2 Graphing Basics

1) For the equations below, fill out the table and graph the points.

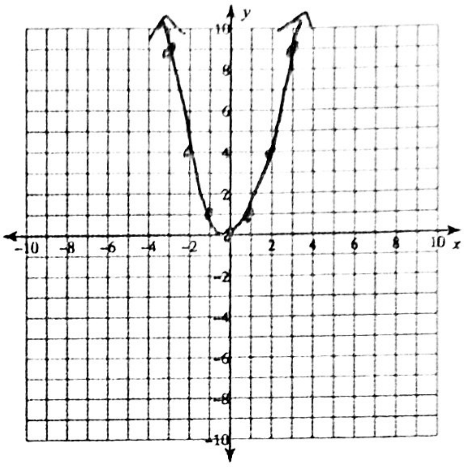
a. $y = x^2$

x	y
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

$\to -5$, $\to -3$, $\to -1$, $\to +1$, $\to +3$, $\to +5$

Decreasing side

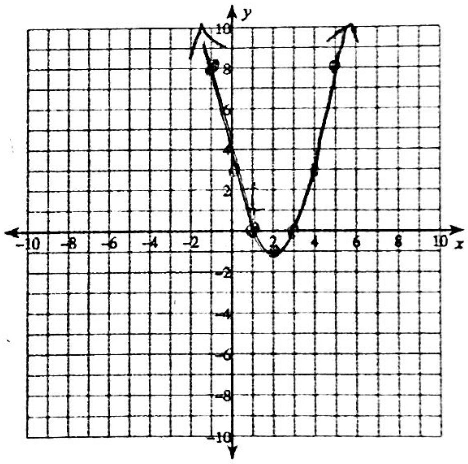
Increasing side



b. $y = x^2 - 4x + 3$

x	y
-1	8
0	3
1	0
2	-1
3	0
4	3
5	8

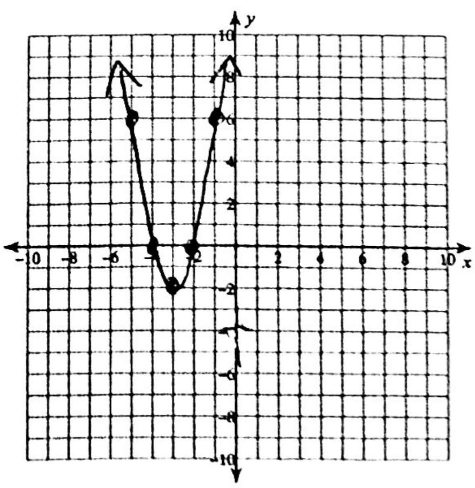
$\to -5$, $\to -3$, $\to -1$, $\to +1$, $\to +3$, $\to +5$



c. $y = 2x^2 + 12x + 16$

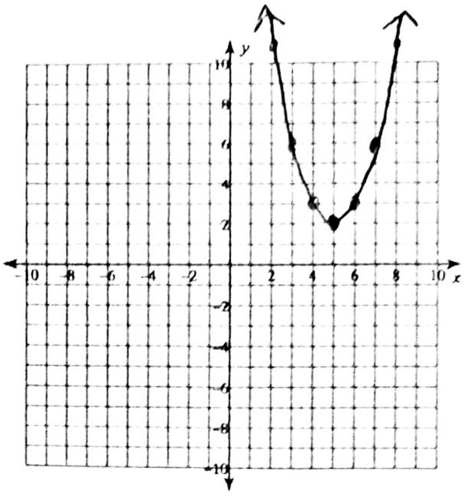
x	y
-6	16
-5	6
-4	0
-3	-2
-2	0
-1	6
0	16

$\to -10$, $\to -6$, $\to -2$, $\to +2$, $\to +6$, $\to +10$



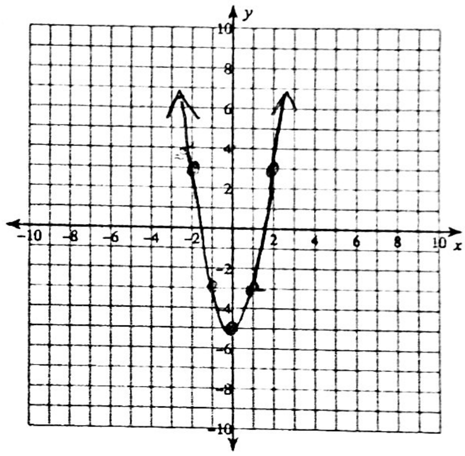
d. $y = x^2 - 10x + 27$

x	y	
2	11	
3	6	-5
4	3	-3
5	2	-1
6	3	$+1$
7	6	$+3$
8	11	$+5$



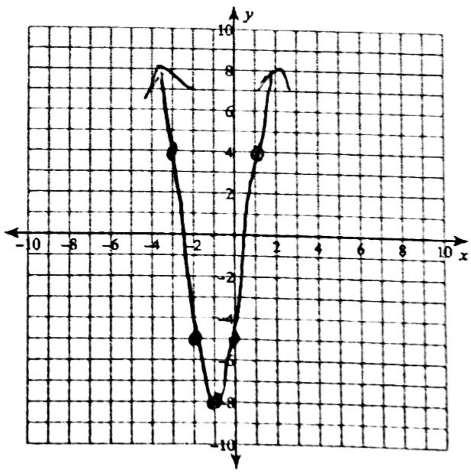
e. $y = 2x^2 - 5$

x	y	
-3	13	
-2	3	-10
-1	-3	-6
0	-5	-2
1	-3	$+2$
2	3	$+6$
3	13	$+10$



f. $y = 3x^2 + 6x - 5$

x	y	
-4	19	
-3	4	-15
-2	-5	-9
-1	-8	-3
0	-5	$+3$
1	4	$+9$
2	19	$+15$



2) For the tables that you filled out, make an additional column for the rate of change. Pick out the rate of change for each table.

3) Which equations had the same rate of change? What in the equation do you think determines what the rate of change will be?

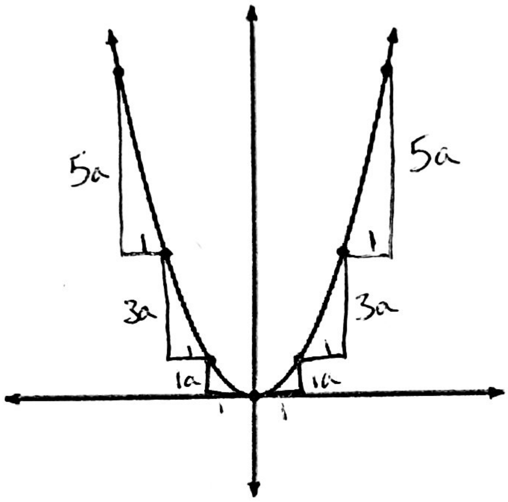
a, b, d   c, e

The a-value is the same for the equations with the same rate of change

4) What point do you feel is the "center" of the rate of change?

The vertex

We are going to use this exploration as a guide to graphing:



In order to graph a parabola, you only need two things:
- vertex
- growth rate (a-value)

The a-value is always the first number you see

$y=ax^2+bx+c$ $y=a(x-h)^2+k$

$y=a(x-p)(x-q)$

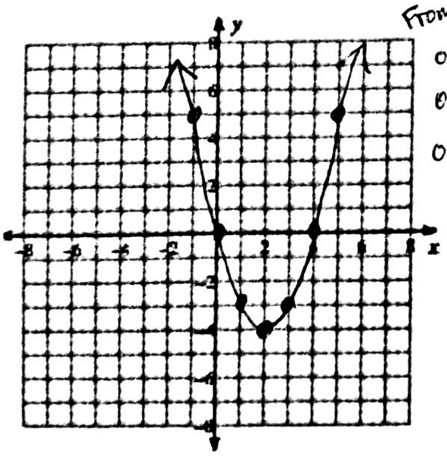
8) Given the equation and the vertex, graph each quadratic. Then identify each key feature.

$a=1$

a. $y = x^2 - 4x$
Vertex: $(2, -4)$

$1a = 1(1) = 1$
$3a = 3(1) = 3$
$5a = 5(1) = 5$

From vertex:
over 1 up 1
over 1 up 3
over 1 up 5



x-intercept(s): $(0,0)$, $(4,0)$

y-intercept: $(0,0)$

Axis of Symmetry: $x=2$

Vertex: $(2,-4)$

Max/min value: -4

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

Range: $[-4, \infty)$ $x \geq -4$

Increasing: $(2, \infty)$ $x > 2$

Decreasing: $(-\infty, 2)$ $x < 2$

Positive: $(-\infty, 0) \cup (4, \infty)$ $x < 0$ and $x > 4$

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

End behavior: As $x \to -\infty$, $y \to \infty$
As $x \to \infty$, $y \to \infty$

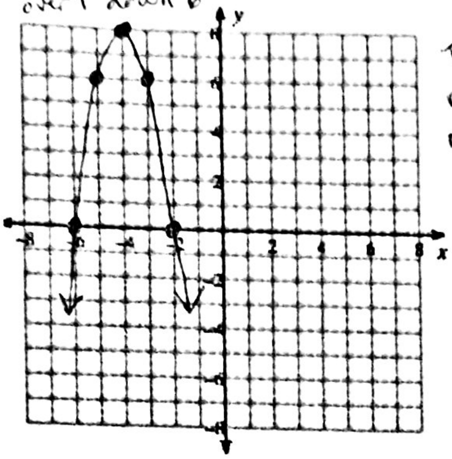
$y = -2(0+6)(0+2) = -24$

$a = -2$

b. $y = -2(x+6)(x+2)$
Vertex: $(-4, 8)$

$1a = 1(-2) = -2$
$3a = 3(-2) = -6$
$5a = 5(-2) = -10$

From vertex: over 1 down 2
over 1 down 6



The negative means you will move down

x-intercept(s): $(-6,0), (-2,0)$

y-intercept: $(0,-24)$

Axis of Symmetry: $x = -4$

Vertex: $(-4,8)$

Max/min value: 8

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

Range: $(-\infty, 8]$

Increasing: $(-\infty, -4)$

Decreasing: $(-4, \infty)$

Positive: $(-6, -2)$

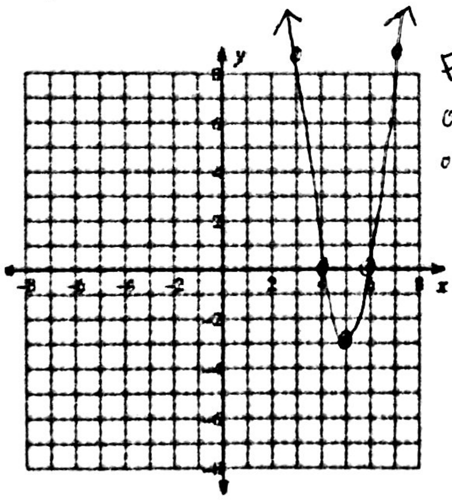
Negative: $(-\infty, -6) \cup (-2, \infty)$

End behavior: As $x \to -\infty$, $y \to -\infty$
As $x \to \infty$, $y \to -\infty$

* If you can't see the y-intercept on the graph, plug in $x=0$ into the equation to find it

c. $y = 3(x-5)^2 - 3$
Vertex: $(5, -3)$
$a = 3$

$1a = 1(3) = 3$
$3a = 3(3) = 9$
$5a = 5(3) = 15$



From vertex:
over 1 up 3
over 1 up 9

$x = 0$ $\quad y = 3(0-5)^2 - 3$
$= 3(-5)^2 - 3$
$= 75 - 3 = 72$

x-intercept(s): $(4,0), (6,0)$

y-intercept: $(0, 72)$

Axis of Symmetry: $x = 5$

Vertex: $(5,-3)$

Max/min value: -3

Domain: $-\infty < x < \infty$

Range: $x \geq -3$

Increasing: $x > 5$

Decreasing: $x < 5$

Positive: $x < 4$ and $x > 6$

Negative: $4 < x < 6$

End behavior: As $x \to -\infty$, $y \to \infty$
As $x \to \infty$, $y \to \infty$

d. $y = -x^2 + 8x - 12$

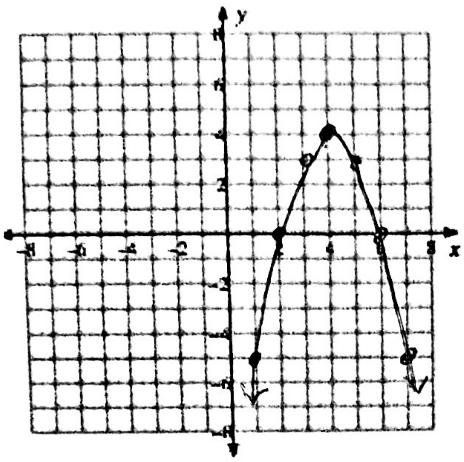
Vertex: (4,4)

$a = -1$

$1a = 1(-1) = -1$

$3a = 3(-1) = -3$

$5a = 5(-1) = -5$



x-intercept(s): $(2,0), (6,0)$

y-intercept: $(0, -12)$

Axis of Symmetry: $x = 4$

Vertex: $(4, 4)$

Max/min value: 4

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

Range: $(-\infty, 4]$

Increasing: $(-\infty, 4)$

Decreasing: $(4, \infty)$

Positive: $(2, 4)$

Negative: $(-\infty, 2) \cup (6, \infty)$

End behavior: As $x \to -\infty$, $y \to -\infty$

As $x \to \infty$, $y \to -\infty$