MPM2D
Ms. Kueh

Properties of Quadratic Relations

The relation $ax^2 + bx + c$ is called a Quadratic Relation,
where a, b, and c are real numbers and $a \neq 0$.

Investigation: How can you compare relations of the form $y = ax^2 + bx + c$?
Make a table of values for each relation from **−3 to +3**.

a) $y = x^2$

x	y
−3	9
−2	4
−1	1
0	0
1	1
2	4
3	9

$(-3)^2 = 9$
$(-2)^2 = 4$

b) $y = 2x^2$

x	y
−3	$2(-3)^2 = 18$
−2	$2(-2)^2 = 8$
−1	$2(-1)^2 = 2$
0	0
1	2
2	8
3	18

c) $y = x^2 + 2x + 3$

x	y
−3	$(-3)^2 + 2(-3) + 3 = 6$
−2	$(-2)^2 + 2(-2) + 3 = 3$
−1	2
0	3
1	6
2	11
3	18

d) $y = -x^2$

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

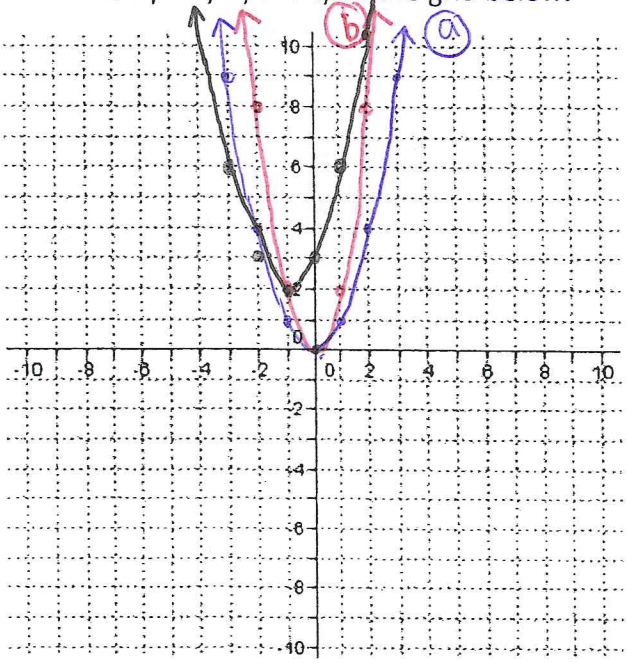
$-(-3)^2 = -(9) = -9$
$-(-2)^2 = -(4) = -4$

e) $y = -0.5x^2 + 3$

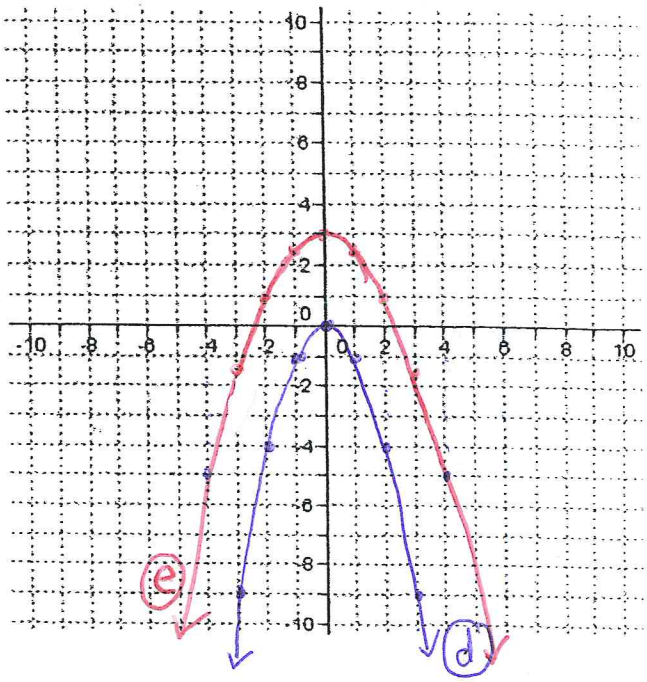
x	y
−3	$-0.5(9) + 3 = -1.5$
−2	$-0.5(-2)^2 + 3 = 1$
−1	$-0.5(-1)^2 + 3 = 2.5$
0	3
1	2.5
2	1
3	−1.5

4 −5

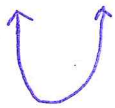
Graph a) b) and c) on the grid below.



Graph d) and e) on the grid below.

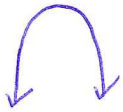


What do you notice about the a value in $ax^2 + bx + c$ and how it affects the graphs?



When "a" is positive — the parabola opens up.

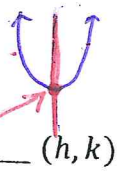
When "a" is negative — the parabola opens down.



* a = # in front of x

Properties of Quadratic Relations

The graph (shape) of a quadratic relation is called a parabola.



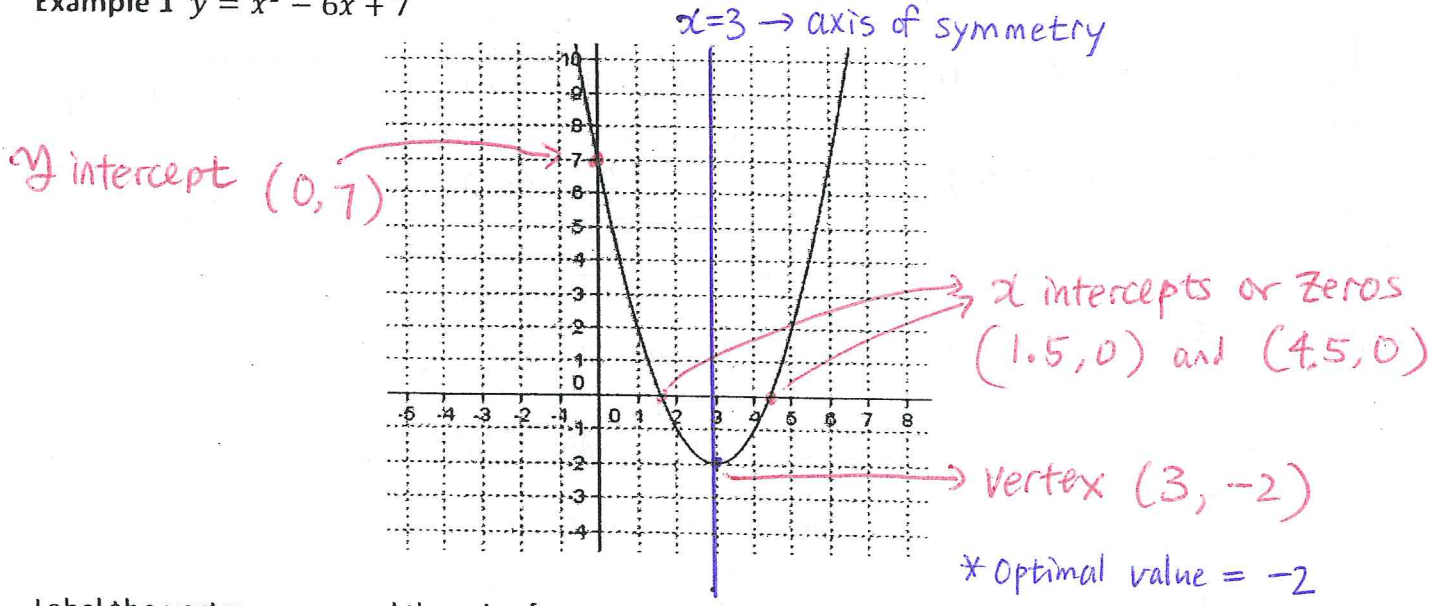
A parabola has a minimum or maximum point called the vertex

The y-value of the vertex is called the optimum value.

A parabola is symmetrical about a vertical line drawn through the vertex, called the axis of symmetry.

If the parabola crosses the x-axis, the x-coordinates of these points are called the zeros, or x intercepts of the relation. (because $y=0$ at these points)

Example 1 $y = x^2 - 6x + 7$

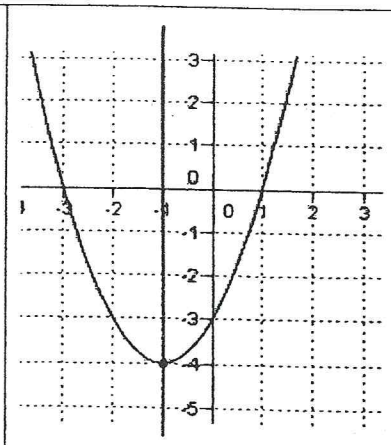
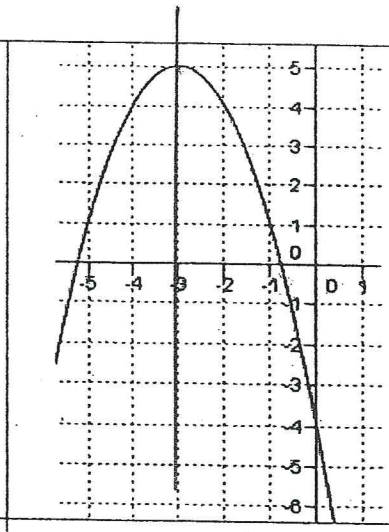
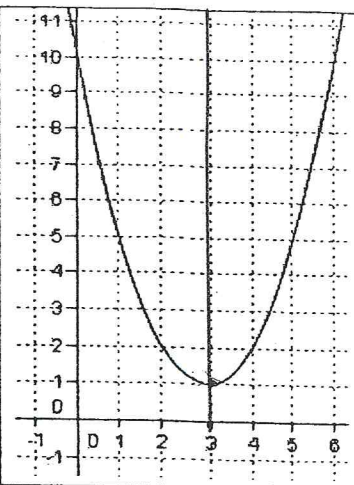


Label the vertex, zeros, and the axis of symmetry. What is the optimal value?

Is it a maximum or a minimum? Minimum point (because all other points are higher than this point.)

What do you notice about the c value in $y = ax^2 + bx + c$?

c = y intercept.

Parabola Graph			
Vertex	$(-1, -4)$	$(-3, 5)$	$(3, 1)$
Optimal Value	-4	5	1
Axis of Symmetry	$x = -1$	$x = -3$	$x = 3$
Zeroes a.k.a. x-intercepts (if any)	$(-3, 0)$ and $(1, 0)$	$(-5.2, 0)$ and $(-0.8, 0)$	none
Direction of Opening	Open up	Open down	Open up
y–intercept	$(0, -3)$	$(0, -4)$	$(0, 10)$

True or False?

F — The axis of symmetry and the y-intercept are the same.

T — The axis of symmetry is always located halfway between the zeroes (if there are zeros).

T — The y-coordinate of the vertex is always the same as the optimal value.

T — The x-coordinate of the vertex is always the same as the axis of symmetry.

F — All parabolas have 2 zeros (x-intercepts)

F — The y-intercept is always positive.

F — Some parabolas have no y-intercepts →