Characteristic	$y=-4x^2$ $y=-4(x-0)^2+0$	$y=-\frac{1}{2}x^2$ $y=-\frac{1}{2}(x-0)^2+0$	$y=2x^2-5$ $y=2(x-0)^2-5$	$y=-2(x-1)^2+3$	$y=2x^2-x-3$
1. Value of “a”	-4	-1/2	2	-2	2
2. Value of “p” or “h”	0	0	0	1	1/4
3. Value of “q” or “k”	0	0	-5	3	-25/8
4. Curve wider, normal narrower than $y=x^2$	Narrow	wide	narrow	narrow	narrow
5. Direction of opening	Down	down	up	down	up
6. Coordinates of the vertex	(0, 0)	(0, 0)	(0, -5)	(1, 3)	(1/4, -25/8)
7. Equation of axis of symmetry	X = 0	X = 0	X = 0	X = 1	X = 1/4
8. Domain of the function	$x \in \Re$	$x \in \Re$	$x \in \Re$	$x \in \Re$	$x \in \Re$
9. Range of the function	$y \le 0$	$y \le 0$	$y \ge -5$	$y \le 3$	$y \ge -25/8$
10. Does the curve have a maximum or minimum value?	max	max	min	max	min
11. What is the maximum or minimum value?	Y = 0	Y = 0	Y = -5	Y = 3	Y = -25/8
12. Table of Values	X: -2, -1, 0, 1, 2 Y: -16, -4, 0, -4, -16	X: -2, -1, 0, 1, 2 Y: -2, -1/2, 0, -1/2, -2	X: -2, -1, 0, 1, 2 Y: 3, -3, -5, -3, 3	X: -1, 0, 1, 2, 3 Y: -5, 1, 3, 1, -5	X: -1, 0, 1/4, 2/4, 6/4 Y: 0, -3, -25/8, -3, 0
13. Sketch the graph					

$$p = -\frac{b}{2a} = -\frac{(-1)}{2(2)} = \frac{1}{4}$$

$$q = \frac{4ac - b^2}{4a} = \frac{4(2)(-3) - (-1)^2}{4(2)} = \frac{-24 - 1}{8} = \frac{-25}{8}$$

Applications:

1. The height *"h"* in feet of an object above the ground is given by $h(t) = -16t^2 + 60t + 200$ where *"t"* is the time in seconds. Find the maximum height of the object and at what time it reaches the maximum height.

$$y = \frac{4ac - b^2}{4a} = \frac{4(-16)(200) - (60)^2}{4(-16)} = \frac{-12800 - 3600}{-64} = \frac{-16400}{-64} = 256.25$$

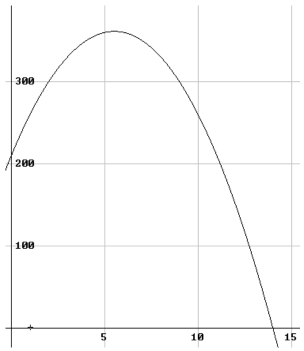
2. A electronics manufacturer has daily production costs of $C(x) = 8{,}000 - 80x + 0.04x^2$, where *"C"* is the total cost (in dollars) and *"x"* is the number of units produced. How many units should be produced each day to yield a minimum cost?

$$y = \frac{4ac - b^2}{4a} = \frac{4(.04)(8000) - (80)^2}{4(.04)} = \frac{1280 - 6400}{.16} = \frac{-5120}{.16} = -32{,}000$$

3. The value of Sara's stock portfolio is given by the function $v(t) = 80 + 95t - 3t^2$ where *"v"* is the value of the portfolio in hundreds of dollars and *"t"* is the time in months. When will the value of Sara's portfolio be at a maximum?

$$y = \frac{4ac - b^2}{4a} = \frac{4(-3)(80) - (95)^2}{4(-3)} = \frac{-960 - 9025}{-12} = \frac{-9985}{-12} = 832.08$$

4. A ball is tossed upwards from the top of a cliff 180 meters in height. The height of the ball above the ground is given by the quadratic function $h = -5t^2 + 55t + 210$ where "h" is the height of the ball in meters and "t" is the number of seconds that the ball is in the air. The graph of the function appears below.



Based on the graph and using the appropriate formulas answer the following:

a) What is the initial height of the ball? 210

b) How high is the ball above the ground after 1 second?

$$h = -5t^2 + 55t + 210$$

$$h = -5(1)^2 + 55(1) + 210 = 260$$

c) How high is the ball above the ground after 6 seconds?

$$h = -5t^2 + 55t + 210$$

$$h = -5(6)^2 + 55(6) + 210 = -180 + 330 + 210 = 360$$

d) When does the ball reach its maximum height?

$$x = -\frac{b}{2a} = -\frac{55}{2(-5)} = \frac{-55}{-10} = 5.5$$

e) What was the maximum height that the ball reached?

$$y = \frac{4ac - b^2}{4a} = \frac{4(-5)(210) - (55)^2}{4(-5)} = \frac{-4200 - 3025}{-20} = \frac{-7225}{-20} = 361.25$$

f) When does the ball hit the ground? Approx. 14 seconds

g) In the context of the problem, what is the domain of this function? Explain. The domain is "x" values from "0" to "14" because the ball can not start in a negative value and it stops when it hits the ground when x = 14.

h) In the context of this problem, what is the range of this function? Explain. The range is "y" values from "0" to "361.25" – from the highest point to the lowest which is at the ground where y = 0.