Section 6.2: Properties of Graphs of Quadratic Functions

- determine the vertex of a quadratic in standard form
- sketch the graph
- determine the y-intercept, x-intercept(s), the equation of the axis of symmetry, domain and range

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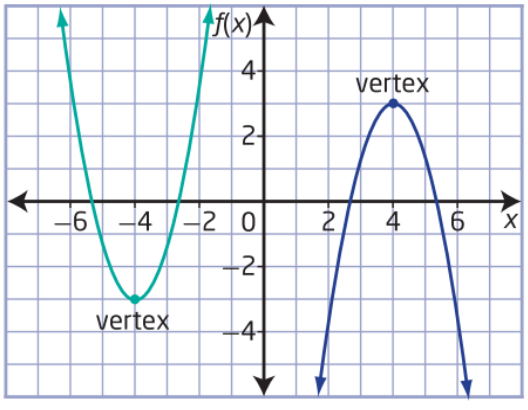
Remember

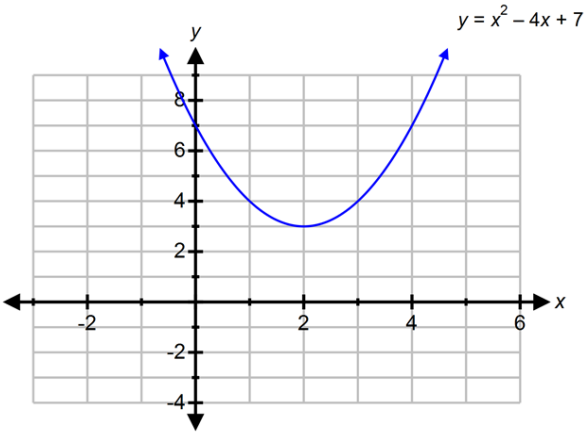


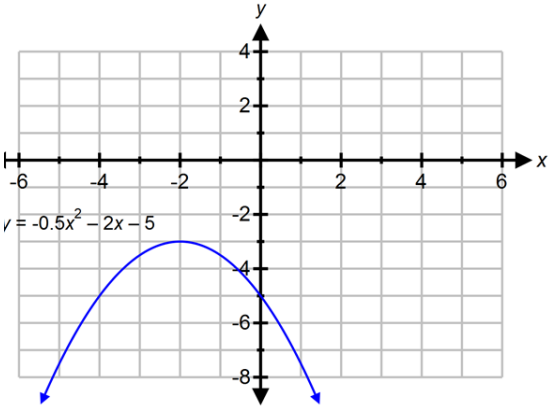
Vertex: The point at which the quadratic function reaches its maximum or minimum value.

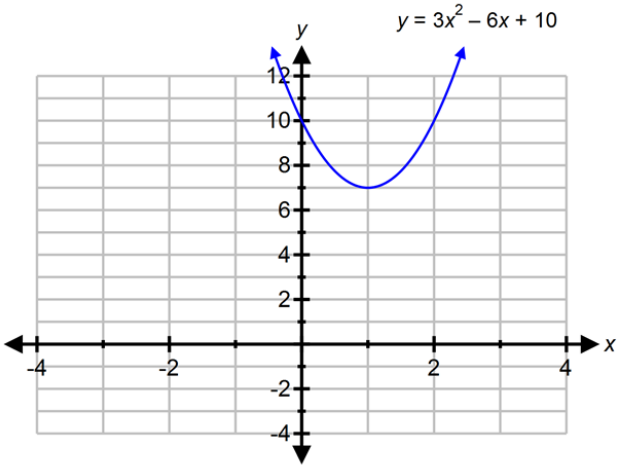
Vertex of a Quadratic Function

Complete the table.

Function	Vertex (max/min)	a	b	c	$-\frac{b}{2a}$	Eqn. Axis of Sym.	y-int
$y = x^2 - 4x + 7$							
$y = -0.5x^2 - 2x - 5$							
$y = 3x^2 - 6x + 10$							







Summary:

(a) Given a quadratic in standard form $y = ax^2 + bx + c$ the $x-$ coordinate of the vertex can be determined using

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

(b) Substitute the x-value back into the equation $y = ax^2 + bx + c$ and solve for the y-coordinate

(c) The x-coordinate of the vertex = axis of symmetry

(d) The y-intercept is the c value or solve for y by setting $x = 0$

Example: Identify the vertex, # of x-intercepts, the y-intercept and equation of the axis of symmetry for each quadratic function.

a) $y = 2x^2 - 12x + 5$

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

c) $y = -3x^2 + 2x + 1$

d) $y = 3x^2 + 12$

e) $y = 3x^2 + 18x$

Example:

A golf ball is struck and its height with respect to time is represented by the function $h(t) = -3t^2 + 12t$ where $h(t)$ represents height and t is the time in seconds.

(a) What is the direction of opening?_____

(b) Will the ball attain a maximum or minimum height?_____

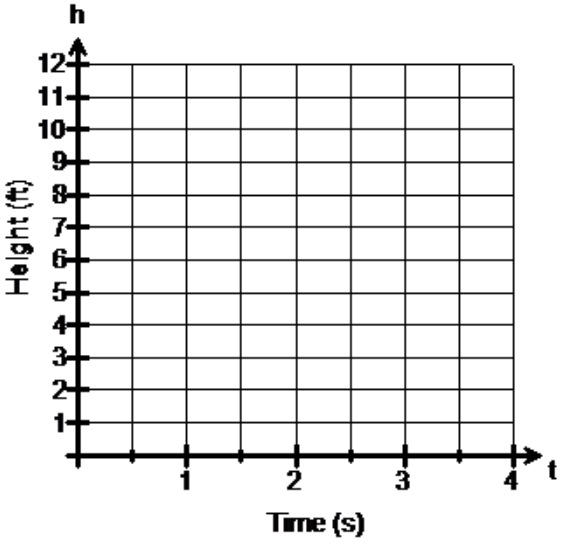
(c) What is the maximum or minimum height?

(d) When does the ball reach its maximum or minimum height?

(e) What is the y – intercept?

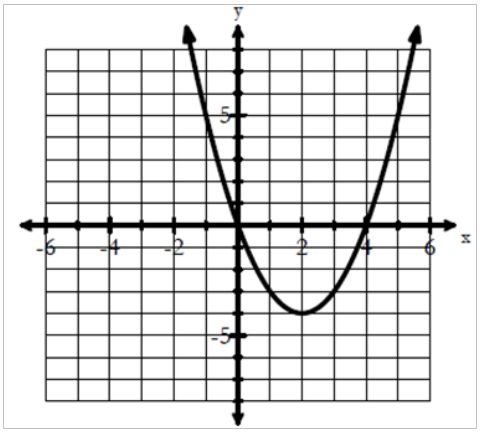
(f) Create a table of values and graph the function.

t	$h(t)$



Your Turn

1) State the vertex and equation of the axis of symmetry.



Vertex:_____

Equation of axis of symmetry:_____

2. Given the table of values, state the vertex, the y-intercept and the equation of axis of symmetry.

x	-1	0	1	2	3
y	10	1	-2	1	10

Vertex:_____

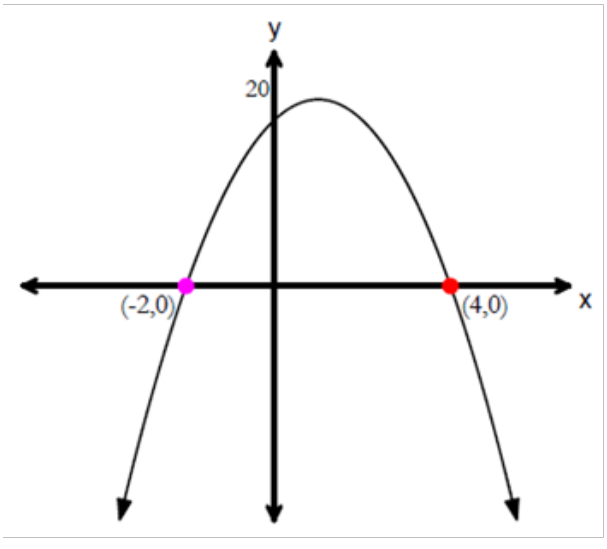
Equation of axis of symmetry:_____

3. Determine the vertex, the y-intercept, and the equation of axis of symmetry for the quadratic function $y = 2x^2 - 8x + 7$.

Determine the Axis of Symmetry using Points on a Graph

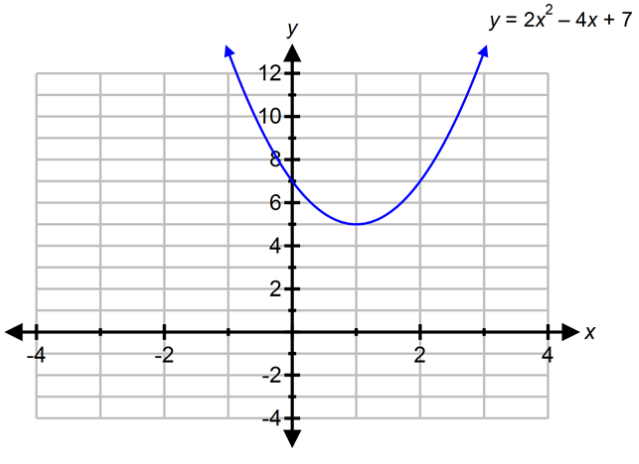
↳ points having same y-coordinates

Example: Determine the equation of axis of symmetry from the parabola.



Where is the axis of symmetry positioned compared to the location of the two given points?

Your Turn: Determine the equation of axis of symmetry from the parabola.



Summary: Axis of symmetry

(i) A vertical reflection line that passes through the vertex

(ii) Can be attained by the formula $x = -\frac{b}{2a}$ when the quadratic function $y = ax^2 + bx + c$ is given.

(iii) Can be attained from two points with the same y–coordinate by **AVERAGING THE X-COORDINATES**.

Example: Determine the equation of axis of symmetry for each parabola that contains the points:

(a) (–2, 4) and (6, 4)

(b) (5, 0) and (11, 0)

Domain and Range of a Quadratic Function

Domain: is the set of all input values (or x–values)

Range: is the set of all output values (or y–values)

The domain and range can be determined:

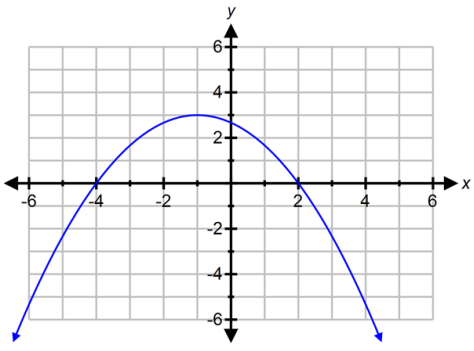
(i) Graphically

(ii) Using a Table (or set of points)

(iii) Function

1. State the domain and range for:

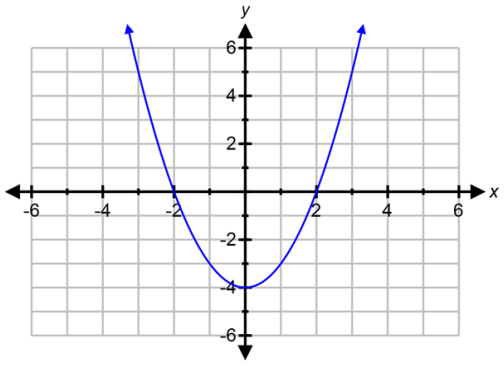
(a)



Domain:_____

Range:_____

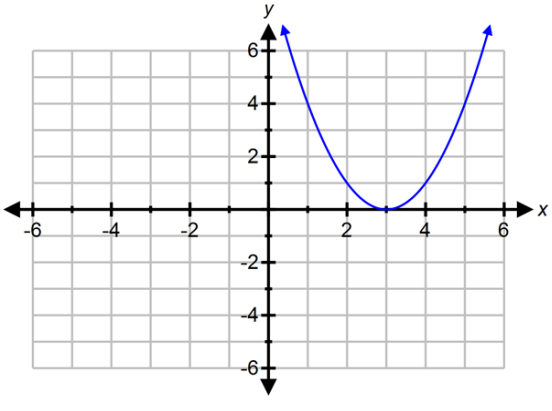
(b)



Domain:_____

Range:_____

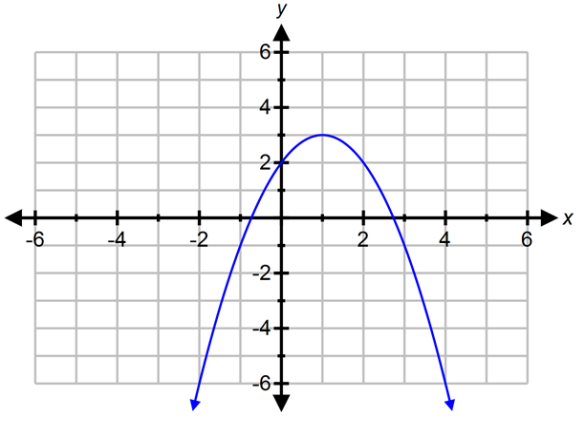
(c)



Domain:_____

Range:_____

(d)



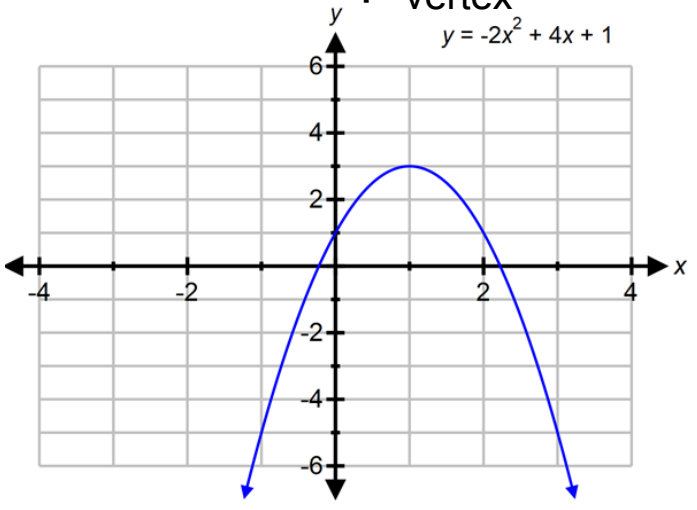
Domain:_____

Range:_____

Determining Domain & Range from a Quadratic Function

How do we attain the domain of a quadratic function such as $y = -2x^2 + 4x + 1$ without the aid of a graph?

- direction of the opening
- vertex



(a) What is the direction of opening for the given function?

(b) Will the function have a maximum or minimum value?

(c) How can we algebraically attain the maximum/minimum value?

(d) How does the above information enable us to express the range?

Summary:

To attain the domain and range from $y = ax^2 + bx + c$

Domain: For any unrestricted quadratic function is $x \in \Re$

Range: (i) determine the direction of opening

(ii) determine the ***x* - coordinate** of vertex by $x = -\dfrac{b}{2a}$

(iii) Substitute the result from (ii) into the function $y = ax^2 + bx + c$ to get the maximum/minimum value

(iv) State the range.

If $a > 0$, then $y \geq$ y - coordinate of vertex

If $a < 0$, then $y \leq$ y - coordinate of vertex

Example: Determine the domain and range for:

(a) $y = 3x^2 - 2$

(b) $y = x^2 + 4x + 4$

(c) $y = -x^2 + 6x - 8$

(d) $y = -2x^2 + 4x - 1$

Work Sample: **6.2: pg.333 #s 3a-b, 4a-d, 6a-c, 9a)c), 11a-c i)iv), 13a-c, 15**