11.3 HW Solutions

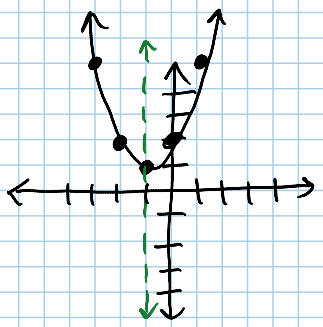
For Exercises 1–3, sketch the graph of the function.

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

① A.O.S $x = \frac{-b}{2a}$ $x = \frac{-2}{2(1)}$ $x = -1$

Vertex: $y = (-1)^2 + 2(-1) + 2$, $y = 1$, V: $(-1, 1)$

Y-int: $(0, 2)$

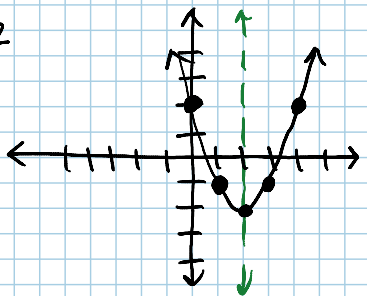


x	y
-3	5
-2	2
-1	1
0	2
1	5

② A.O.S. $x = \frac{4}{2(1)}$ $x = 2$

Vertex: $y = (2)^2 - 4(2) + 2$, $y = -2$, V: $(2, -2)$

Y-int: $(0, 2)$

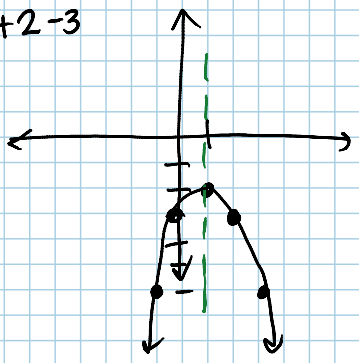


x	y
0	2
1	-1
2	-2
3	-1
4	2

③ A.O.S. $x = \frac{-2}{2(-1)}$ $x = 1$

Vertex: $y = -(1)^2 + 2 - 3$, $y = -2$, $(1, -2)$

Y-int: $(0, -3)$



For Exercises 4–6, find the vertex of the function and determine whether it is a maximum or minimum.

4. $y = -3x^2 + 6x - 1$
5. $y = x^2 - 5$
6. $y = 8x - 2x^2$

4. maximum – since "a" is negative, the parabola will face down

$x = \frac{-b}{2a} = \frac{-6}{2(-3)} = 1$ $y = -3(1)^2 + 6(1) - 1$, $y = 2$ Vertex $(1, 2)$

5. minimum – since "a" is positive, the parabola will face up

$x = \frac{-0}{2(1)}$, $x = 0$ Vertex $(0, -5)$

6. maximum – same as #4

$x = \frac{-8}{2(-2)}$, $x = 2$ Vertex $(2, 0)$

7. Consider the graph of $y = x^2 - 4x + 1$. *Before* graphing this function, use the observations you made about graphs of quadratic functions in the Investigation to answer the questions in Parts (a)–(d).
   a. Does the graph open upward or downward? Explain how you know.

a) upward since "a" is positive

b) $x = \frac{4}{\ }$ $y = (2)^2 - 4(2) + 1$ vertex $(2, -3)$

quadratic functions in the Investigation to answer the questions in Parts (a)–(d).

a. Does the graph open upward or downward? Explain how you know.

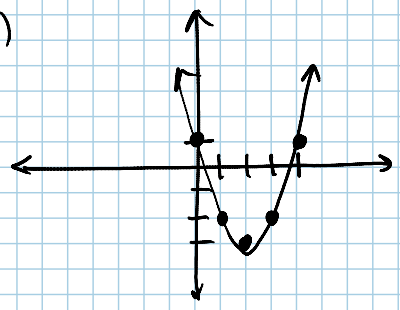
b. What are the coordinates of the vertex of the graph? Is it a maximum or minimum? Explain how you know.

c. What is the equation of the axis of symmetry of the graph?

d. What is the domain of the function? What is the range?

e. Graph the function.

e)



b) $x = \frac{4}{2(1)}$ $x = 2$ $y = (2)^2 - 4(2) + 1$ $y = -3$ Vertex $(2, -3)$

The vertex is a minimum since the "U" is facing upwards.

c) $x = 2$ d) Domain: $(-\infty, \infty)$ Range: $[1, \infty)$

8 **a.** Without graphing the functions $y = 2x^2 + 3x + 6$ and $y = -3x^2 + 12x + 6$, predict how they differ.

b. Graph each function to see if your prediction in Part (a) is correct.

$y = 2x^2 + 3x + 6$ vs $y = -3x^2 + 12x + 6$

Faces up — Faces down

has a minimum — has a maximum

wider — narrower

$x = \frac{-b}{2a} = \frac{-3}{2(2)} = -\frac{3}{4}$ $x = \frac{-12}{2(-3)} = 2$

different vertices

$y = 2\left(-\frac{3}{4}\right)^2 + 3\left(-\frac{3}{4}\right) + 6$

$y = 2\left(\frac{9}{16}\right) - \frac{9}{4} + 6$

$y = \frac{18}{8} - \frac{9}{4} + \frac{6}{1}$

$y = \frac{9}{8} - \frac{18}{8} + \frac{48}{8}$

$y = \frac{39}{8}$

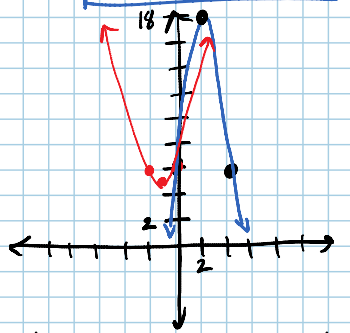
Vertex $\left(-\frac{3}{4}, \frac{39}{8}\right)$

$y = -3(2)^2 + 12(2) + 6$

$y = -3(4) + 24 + 6$

$y = 18$

vertex $(2, 18)$



9. A model rocket rises vertically so that its height h above the ground (in feet) is given by $h = -16t^2 + 300t$, with time t measured in seconds.

a. In how many seconds after the rocket is launched will it reach its maximum height?

b. What is the maximum height that the rocket will reach before it begins its descent?

a) $x = \frac{-b}{2a}$ $x = \frac{-300}{2(-16)}$ $x \approx 9.4$

Maximum height is reached after approx 9.4 sec

b) $h = -16(9.4)^2 + 300(9.4)$ $h \approx 1,406$ ft.

Maximum height is approx 1,406 ft

10. Many functions have graphs that are transformations of graphs of simpler functions. For example, the graph of $y = x^2 + 3$ is a vertical shift of $y = x^2$ upward by three units. For Parts (a)–(d), compare the graph of the given function to the graph of $y = x^2$.

a. $y = x^2 - 2$ **b.** $y = -x^2$

a) the graph of $y = x^2$ shifted down 2 units

b) the graph of $y = x^2$ reflected over the x-axis

simpler functions. For example, the graph of $y = x^2 + 3$ is a vertical shift of $y = x^2$ upward by three units. For Parts (a)–(d), compare the graph of the given function to the graph of $y = x^2$.

a. $y = x^2 - 2$ **b.** $y = -x^2$

c. $y = (x - 3)^2$ **d.** $y = (x + 5)^2 + 4$

11. Compare the graph of the given function to the graph of $y = x^2$. Let c be a positive real number.

a. $y = (x - c)^2$ **b.** $y = (x + c)^2$

c. $y = x^2 + c$ **d.** $y = x^2 - c$

a) the graph of $y=x$ shifted down 2 units

b) the graph of $y=x$ reflected over the x-axis

c) the graph of $y=x^2$ shifted right 3 units

d) the graph of $y=x^2$ shifted left 5 units and up 4 units

a) the graph of $y=x^2$ shifted c units to the right

b) the graph of $y=x^2$ shifted c units to the left

c) the graph of $y=x^2$ shifted c units up

d) the graph of $y=x^2$ shifted c units down