Name ______________________ Date ________

8.3 Notetaking with Vocabulary

I can graph quadratics using characteristics. ← works for ALL quadratics

I can find the maximum or minimum value of a quadratic function.

Write the meaning of each vocabulary term.

maximum value – y-coordinate of vertex if parabola opens ↓

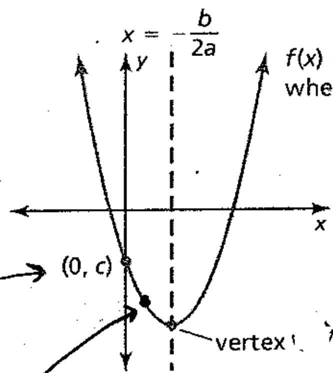
X coordinate is when

minimum value " " " " " " y-coordinate opens ↑

Core Concepts

Graphing $f(x) = ax^2 + bx + c$

Id a, b and c



- ① The graph opens up ① when $a > 0$, and the graph opens down when $a < 0$.
- ④ The y-intercept is $(0, c)$
- ③ The x-coordinate of the vertex is $x = \frac{-b}{2a}$
- ② The axis of symmetry is ② $x = \frac{-b}{2a}$

③ Vertex $\left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)$

plug in to find y

$y = ax^2 + bx + c$

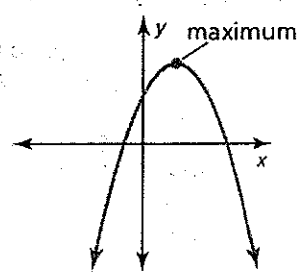
⑤ plot one more point on the same of the axis of symmetry

Notes:

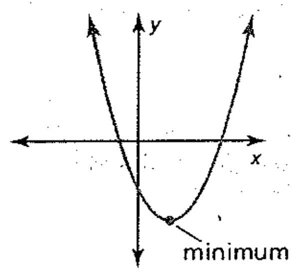
Maximum and Minimum Values

The y-coordinate of the vertex of the graph of $f(x) = ax^2 + bx + c$ is the maximum value of the function when $a < 0$ or the minimum value of the function when $a > 0$.

$f(x) = ax^2 + bx + c, a < 0$



$f(x) = ax^2 + bx + c, a > 0$



Notes:

Practice

AoS $X = \frac{-b}{2a}$

In Exercises 1–4, find (a) the axis of symmetry and (b) the vertex of the graph of the function.

1. $f(x) = x^2 - 10x + 2$

$a = 1 \quad b = -10 \quad c = 2$

AoS $x = \frac{-b}{2a} = \frac{10}{2(1)} = \frac{10}{2} = 5$

AoS $\boxed{x = 5}$ $\boxed{(5, -23)}$ Vertex

$f(5) = 5^2 - 10(5) + 2$

$f(5) = 25 - 50 + 2 = -25 + 2 = -23$

~~2. $y = 4x^2 + 16x$~~

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

4. $f(x) = -3x^2 + 6x + 1$

$a = -3 \quad b = 6 \quad c = 1$

$x = \frac{-b}{2a} = \frac{-6}{2(-3)} = \frac{-6}{-6} = 1$

AoS $\boxed{X = 1}$

$f(1) = -3(1)^2 + 6(1) + 1$

$f(1) = -3 + 6 + 1 = 4$

$\boxed{(1, 4)}$ Vertex

① ↑ $a = 3$ $b = 6$ $c = 2$

② AoS $x = \frac{-b}{2a} = \frac{-6}{2(3)} = \frac{-6}{6} = -1$ AoS $\boxed{x = -1}$

③ $f(-1) = 3(-1)^2 + 6(-1) + 2 = 3 - 6 + 2 = -1$ Vertex $\boxed{(-1, -1)}$

$a = -\frac{1}{5}$ $b = -1$ $c = 5$ $\frac{2}{1}(-\frac{1}{5})$

① ↓ ② AoS $x = \frac{-b}{2a} = \frac{1}{-\frac{2}{5}} = -\frac{5}{2}$

$\boxed{x = -2.5}$ AoS

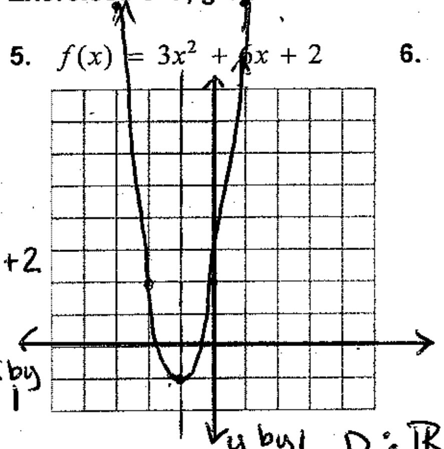
In Exercises 5–7, graph the function. Describe the domain and range.

④ y-int. $(0, c)$ $(0, 2)$

⑤ $x = 1$

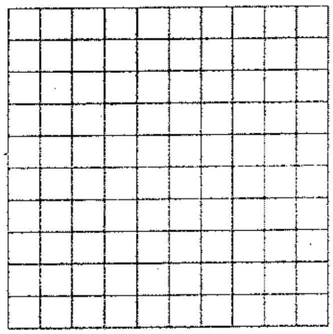
$y = 3(1)^2 + 6(1) + 2$
$= 3 + 6 + 2$
$= 11$

5. $f(x) = 3x^2 + 6x + 2$

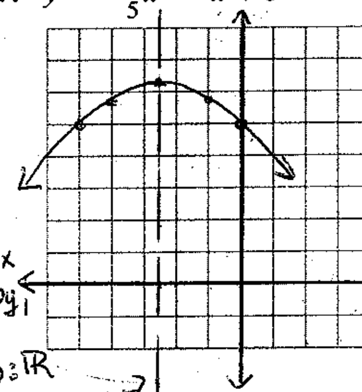


x by 1 y by 1 $x = -1$ D: ℝ $R: \{y \geq -1\}$

6. $y = 2x^2 - 8x - 1$



7. $y = -\frac{1}{5}x^2 - x + 5$



x by 1 $x = -2.5$ y axis by 1 D: ℝ $R: \{y \leq 6.25\}$

③ Vertex

$y = -\frac{1}{5}(-2.5)^2 - (-2.5) + 5$

$y = 6.25$

$\boxed{(-2.5, 6.25)}$ Vertex

④ $(0, c)$ $(0, 5)$

⑤ $(-1, 5.8)$

$y = -\frac{1}{5}(-1)^2 - (-1) + 5$

$y = (-.2)(1) + 1 + 5$

$y = -.2 + 6 = 5.8$

In Exercises 8–13, tell whether the function has a minimum value or a maximum value. Then find the value.

8. $y = -\frac{1}{2}x^2 - 5x + 2$

9. $y = 8x^2 + 16x - 2$

↑ b/c $a > 0$

$a = 8$ $b = 16$ $c = -2$ $\boxed{\text{Minimum} = -10}$

$x = \frac{-16}{2(8)} = \frac{-16}{16} = -1$

$y = 8(-1)^2 + 16(-1) - 2$

$y = 8 - 16 - 2 = -10$

11. $y = -7x^2 + 7x + 5$ **12.** $y = 9x^2 + 6x + 4$ **13.** $y = -\frac{1}{4}x^2 + x - 6$

vertical motion model

$h(t) = at^2 + bt + c$
$= at^2 + bt + s_0$ ← starting height

14. The function $h = -16t^2 + 250t$ represents the height h (in feet) of a rocket t seconds after it is launched. The rocket explodes at its highest point.

a. When does the rocket explode? x – when $a = -16$ $b = 250$ $s_0 = c = 0$

$x = \frac{-b}{2a} = \frac{-250}{2(-16)} = \frac{-250}{-32} = 7.8125$ The rocket explodes at about 7.8 seconds.

b. At what height does the rocket explode? y – maximum

$h = -16(7.8125)^2 + 250(7.8125)$

$h = 976.5625$

The rocket explodes at approximately 976.6 feet.