4.1 Quadratic Functions and Parabolas

Quadratic function can be written in the standard form or the vertex form

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

where a, b, c are real numbers and $a \neq 0$

Vertex form $f(x) = a(x - h)^2 + k$

where a, h, k are real numbers and $a \neq 0$

4.1 Continued

Identifying a Quadratic Function

Is the function linear, quadratic or other?

1. $V(t) = 2t$

2. $f(t) = 3.5t - 7$

3. $r(t) = 5t^2$

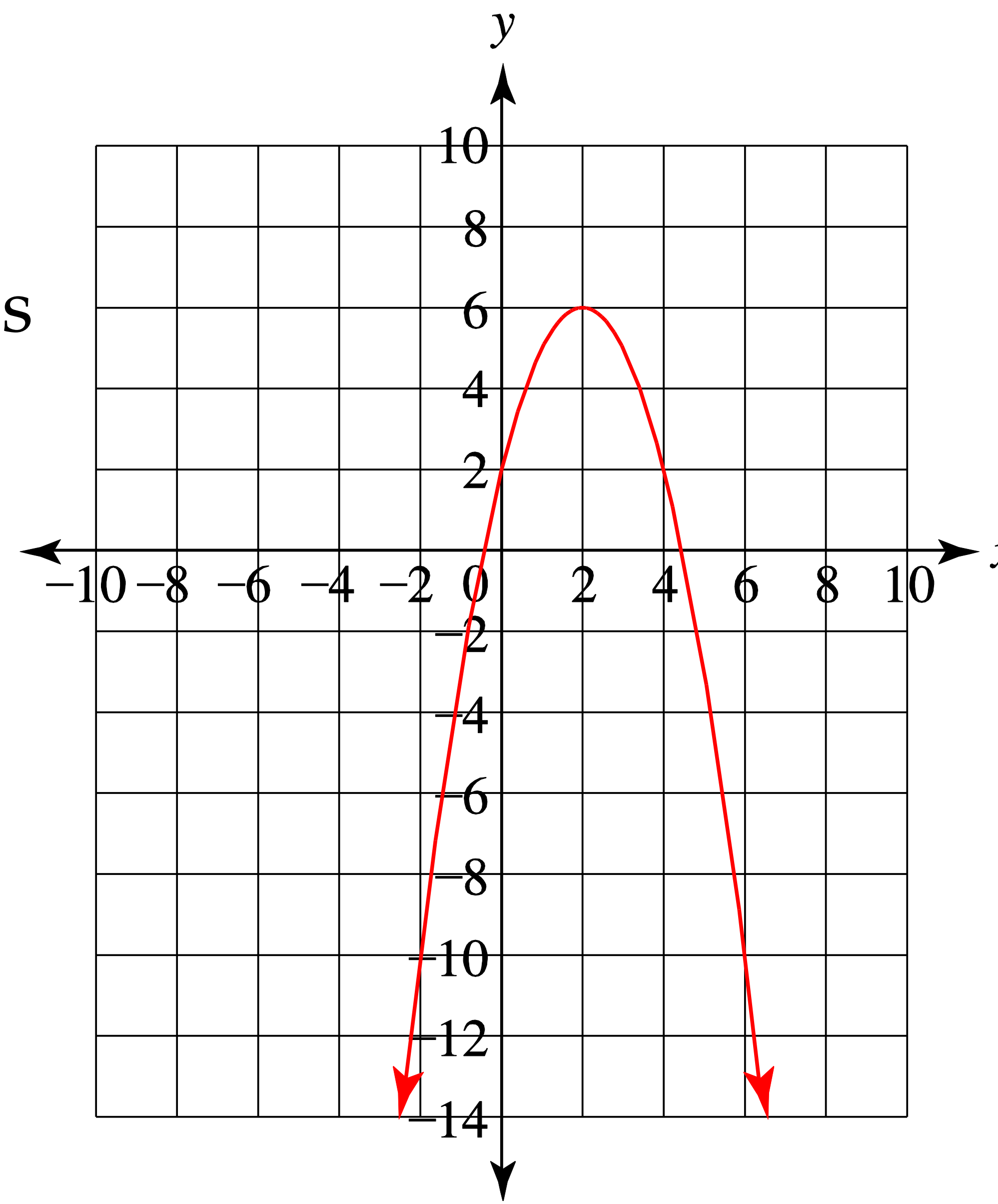
4. $p(u) = 4u^2 + 5u$

5. $E(w) = (w + 4)^2$

6. $P(n) = 2n^3 - 5n^2 + n - 10$

Use the graph of $f(x)$ to estimate the following:

a. For what x values is this curve increasing? Decreasing? Write your answer using inequalities.



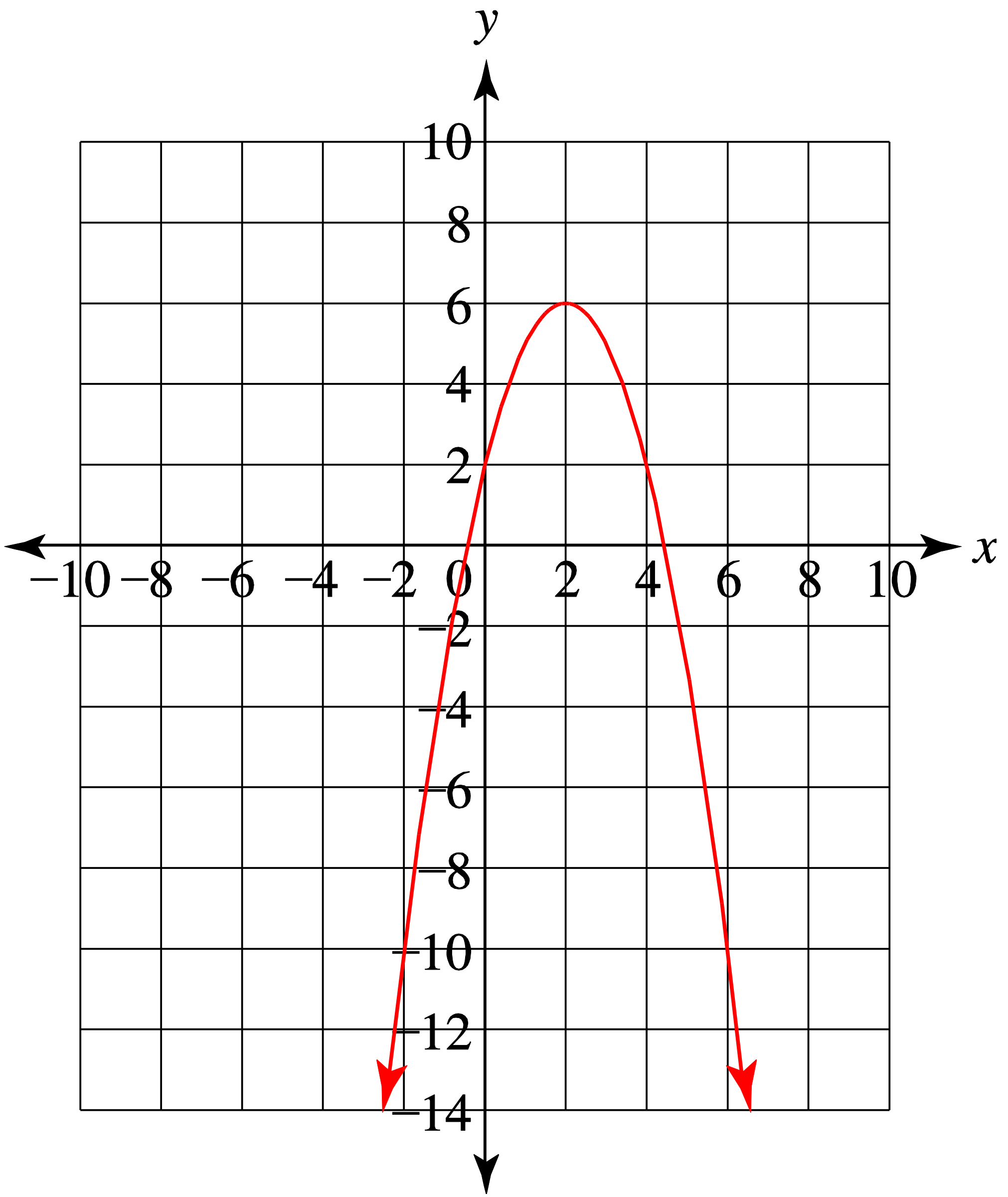
b. Vertex

c. x-intercept(s)

d. y-intercept

e. $f(3) = ?$

f. What x value(s) will make $f(x) = -10$



4.2 Graphing Quadratic Equations in Vertex Form: $f(x) = a(x - h)^2 + k$

- The vertex of the parabola is (h,k)
- The value of "a" will determine whether the parabola faces upward or downward, and how wide or narrow the graph is.

$a > 0$	faces UP	$0 < a < 1$	wider
$a < 0$	faces DOWN	$a > 1$	narrower

- The value of h will determine how far the vertex moves to the left or right.

  $h > 0$ (positive but will appear negative) shifts ________

  $h < 0$ (negative but will appear positive) shifts ________

4.2 continuted

In vertex form: $f(x) = a(x - h)^2 + k$

- The value of k will determine how far the vertex moves up or down.
  - $k > 0$ shifts ________
  - $k < 0$ shifts ________
- The axis of symmetry is the vertical line through the vertex and has the equation $x = h$

Describe how the graphs of the following parabolas have changed from the graph of the standard parabola $y = x^2$.

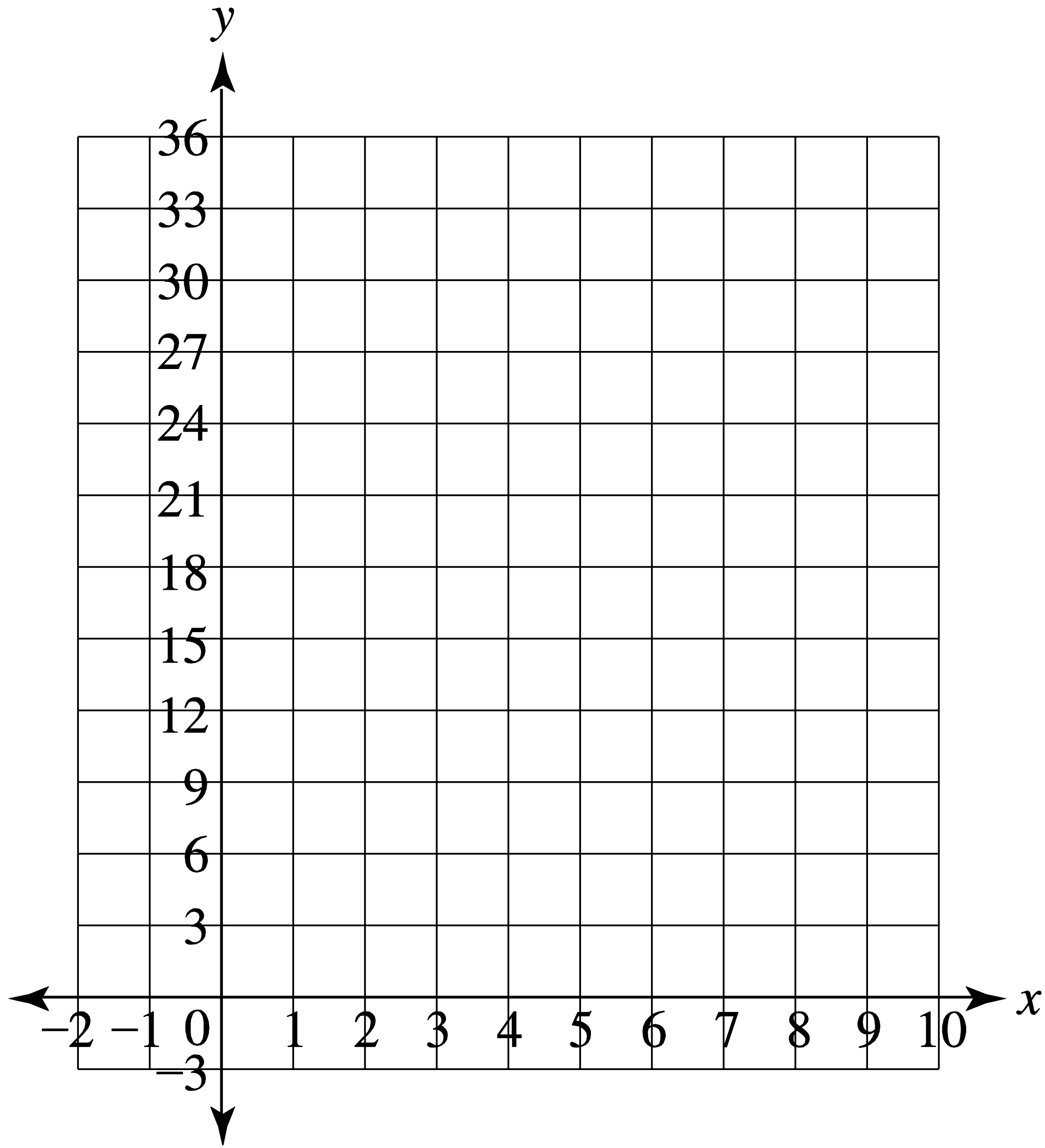
a. $y = \frac{2}{3}(x - 5)^2 - 1$

b. $y = -4(x + 7)^2 + 6$

Steps to graphing a Quadratic Equation from Vertex Form: $f(x) = a(x - h)^2 + k$

1. Determine whether the graph opens up or down.
2. Find the vertex and the equation of the axis of symmetry.
3. Find the y-intercept. You can solve for the y-intercept using x=0: $y = a(0 - h)^2 + k$
4. Find another point by choosing a value for x and calculating y. Use symmetry to plot other points.
5. Connect the points with a smooth curve.

Sketch the graph of $f(x) = 1.5(x-4)^2 + 3$



4.2 continued

- Domain of a quadratic model will be restricted only by the context of the problem.
- Range of a quadratic model is the output values that come from the domain.
- The domain for a quadratic function with no context will be all real numbers.
- The range for a quadratic function with no context will be either

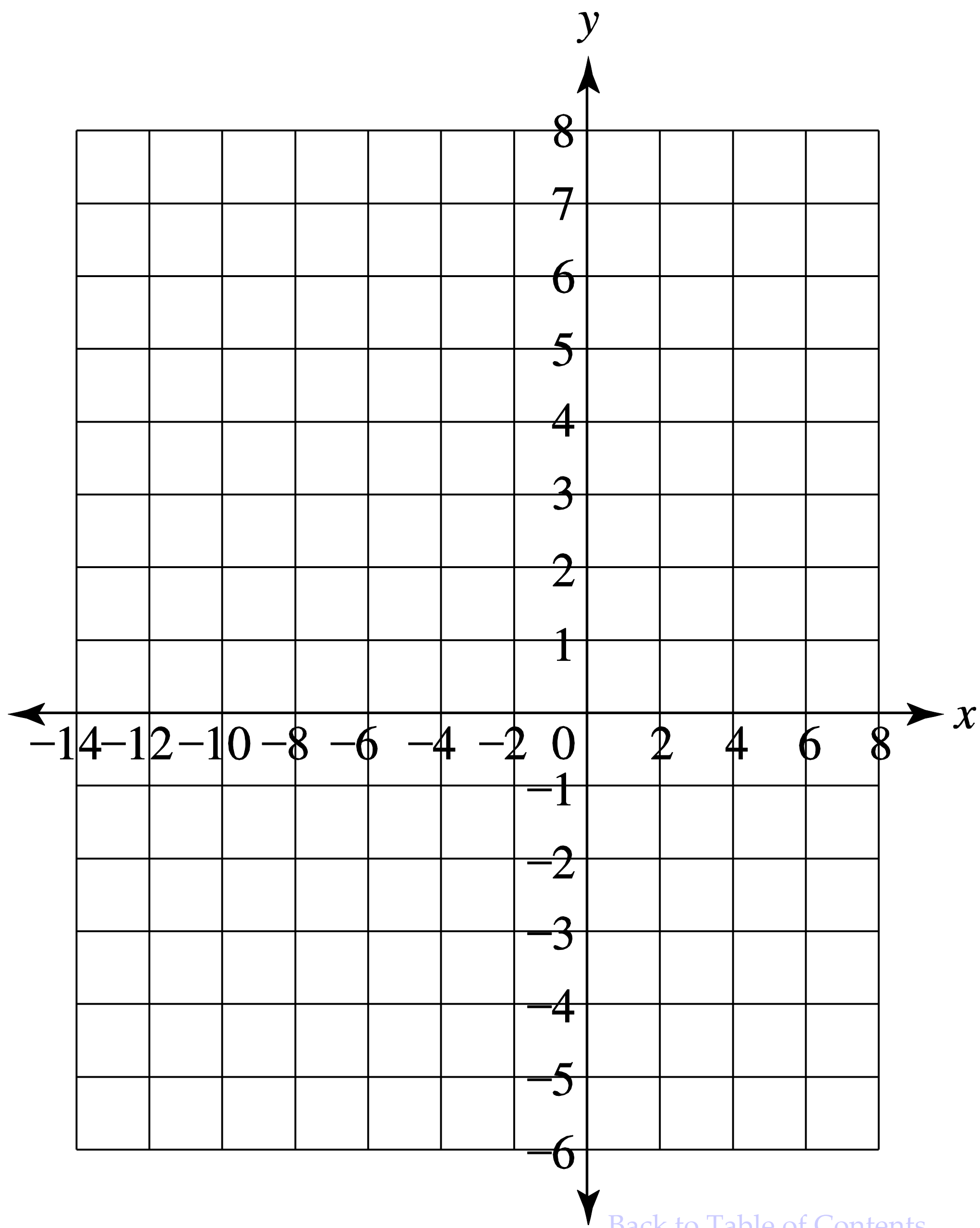
  $(-\infty,k]$ if $a < 0$ (opens down)

  or $[k,\infty)$ if $a > 0$ (opens up)

Sketch the graph of $f(x) = -0.1(x+3)^2 + 5$

Determine the Domain:

Range:



4.7 Graphing Quadratic Equations in Standard Form: $f(x) = ax^2 + bx + c$

- The vertex of the parabola (x, y) can be found by using the formula: $x = \frac{-b}{2a}$ and then substituting this x-value into the equation to find y.
- Just like the vertex form, the value of “a” will determine whether the parabola faces upward or downward, and how wide or narrow the graph is.

$a > 0$	faces UP	$0 < a < 1$	wider
$a < 0$	faces DOWN	$a > 1$	narrower

Steps to graphing a Quadratic Equation from Standard Form: $f(x) = ax^2 + bx + c$

1. Determine whether the graph opens up or down. (Look at the value of ‘a’)
2. Find the vertex (x,y) using $x = \frac{-b}{2a}$ and the equation to calculate the y value.
3. Find the y-intercept $f(0)$: (0, c)
4. Find the x-intercepts (if any). Set y=0 and solve for x. Use your calculator to find the ZERO(s) or see next week’s methods.
5. Use symmetry to plot other points.
6. Connect the points with a smooth curve.

Find the vertex and vertical intercept of the following quadratic equations. State if the vertex is a minimum or maximum point on the graph.

a. $f(x) = x^2 + 10x - 12$

b. $g(a) = -5a^2 - 30a - 15$

A baseball is hit so that its height in feet t seconds after it is hit can be modeled by: $h(t) = -16t^2 + 40t + 4$

a. What is the height of the ball when it is hit?

b. When does the ball reach a height of 20 ft?

c. When does the ball reach its maximum height?

A baseball is hit so that its height in feet t seconds after it is hit can be modeled by: $h(t) = -16t^2 + 40t + 4$

d. What is the ball's maximum height?

e. If the ball does not get caught, when does it hit the ground?