

## Graphing Quadratics, Properties of a Parabola

Quick Review	
Standard Form	$y = ax^2 + bx + c$
Vertex Form	$y = a(x - h)^2 + k$
The <i>axis of symmetry</i> is a line that divides the parabola into two symmetrical halves.	
The <i>vertex</i> of a parabola is its turning point. This is the highest or lowest point on the parabola and always lies on the axis of symmetry.	
The parabola turns down (is <i>concave down</i> ) if $a < 0$ . The parabola turns up (is <i>concave up</i> ) if $a > 0$ .	
The $x$ -intercepts of a parabola are its intersections with the $x$ -axis. Find the $x$ -intercepts by setting $y = 0$ .	
Solve the resulting quadratic equation either by factoring or by using the quadratic formula.	

**Example** Find the coordinates of the  $x$ -intercepts, the equation of the axis of symmetry, and the coordinates of the vertex, of the parabola whose equation is  $y = 2x^2 - 6x - 20$ . Write the parabola in vertex form.

**Solution** (a) Set  $y = 0$  and solve  $0 = 2x^2 - 6x - 20$  by factoring. We get

$$2(x - 5)(x + 2) = 0 \text{ so } x = 5 \text{ or } x = -2. \text{ Therefore, the coordinates of the } x\text{-intercepts are } (5, 0) \text{ and } (-2, 0).$$

(b) The axis of symmetry must lie midway between the  $x$ -intercepts, so the equation of the axis is  $x = (5 - 2)/2$  or  $x = 1.5$ .

(c) Since the vertex lies on the axis of symmetry, find its  $y$ -coordinate by substituting  $x = 1.5$  to get  $y = 2(1.5)^2 - 6(1.5) - 20 = -24.5$ . The coordinates of the vertex are  $(1.5, -24.5)$ .

(d) The vertex form of the equation is  $y = 2(x - 1.5)^2 - 24.5$ .

**Problems**

1. For each equation of a parabola below:

- (i) Find the coordinates of the  $x$ -intercepts
- (ii) Find the equation of the axis of symmetry
- (iii) Find the coordinates of the vertex
- (iv) Write the equation in vertex form.

a)  $y = x^2 - 8x - 20$

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

c)  $y = 3x^2 - x - 10$

d)  $y = 4x^2 + 3x - 27$

2. Rewrite each of these quadratic equations in standard form.

a)  $y = 2(x - 4)^2 + 5$

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

3. Use the Quadratic Formula to find the coordinates of the  $x$ -intercepts of each parabola.

a)  $y = 2x^2 - 7x - 20$

b)  $y = x^2 + 5x - 2$

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

d)  $y = 4x^2 + 3x - 7$