

## Sec. 4.3 Modeling With Quadratic Functions

Problem 1:

A parabola contains the points  $(0,0)$ ,  $(-1,1)$  and  $(1,5)$ . What is the equation of this parabola in standard form?

$$y = ax^2 + bx + c$$

$$\begin{matrix} x & y \\ (0, 0) \end{matrix}$$

$$\begin{matrix} x & y \\ (-1, 1) \end{matrix}$$

$$\begin{matrix} x & y \\ (1, 5) \end{matrix}$$

$$0 = a(0)^2 + b(0) + c$$

$$0 = c$$

$$1 = a(-1)^2 + b(-1) + 0$$

$$1 = a - b$$

$$\underline{5 = a + b}$$

$$\frac{6 = 2a}{2 \quad 2}$$

$$3 = a$$

$$5 = a(1)^2 + b(1) + 0$$

$$5 = a + b$$

$$\frac{5 = 3 + b}{-3 \quad -3}$$

$$\underline{2 = b}$$

$$y = 3x^2 + 2x + 0$$

b.  $(0,0)$   $(1,-2)$   $(-1,-4)$

$$y = ax^2 + bx + c$$

$$(0,0)$$

$$0 = a(0)^2 + b(0) + c$$

$$\boxed{0 = c}$$

$$\boxed{y = -3x^2 + x}^*$$

$$(1,-2)$$

$$-2 = a(1)^2 + b(1) + 0$$

$$\boxed{-2 = a + b}$$

$$-4 = a - b$$

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

$$\boxed{-3 = a}$$

$$(-1,-4)$$

$$-4 = a(-1)^2 + b(-1)$$

$$\boxed{-4 = a - b}$$

$$-4 = (-3) - b$$

$$+3 \quad +3$$

$$\underline{-1 = -b}$$

$$\boxed{1 = b}$$

c.  $(1, -2)$   $(2, -2)$   $(3, -4)$

1,2    1,3    2,3

$$y = ax^2 + bx + c$$

$$(1, -2)$$

$$-2 = a(1)^2 + b(1) + c$$

$$-1(-2 = a + b + c)$$

$$2 = -a - b - c$$

$$2 = 1 - 3 - c$$

$$2 = -2 - c$$

$$\begin{array}{r} +2 \quad +2 \\ \hline 4 = -c \end{array}$$

$$\frac{4}{-1} = \frac{-c}{-1}$$

$$\boxed{-4 = c}$$

$$(2, -2)$$

$$-2 = a(2)^2 + b(2) + c$$

$$-2 = 4a + 2b + c$$

$$2 = -a - b - c$$

$$\begin{array}{r} -2 \\ \hline 0 = 3a + b \end{array}$$

$$0 = 3(-1) + b$$

$$0 = -3 + b$$

$$\begin{array}{r} +3 \quad +3 \\ \hline 3 = b \end{array}$$

$$\boxed{3 = b}$$

$$(3, -4)$$

$$-4 = a(3)^2 + b(3) + c$$

$$-4 = 9a + 3b + c$$

$$2 = -a - b - c$$

$$-2 = 8a + 2b$$

$$0 = -6a - 2b$$

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

$$\boxed{-1 = a}$$

$$\boxed{y = -x^2 + 3x - 4}$$

c.  $(3, -6), (1, -2), (6, 3)$

$$y = ax^2 + bx + c$$

$(3, -6)$

$$-6 = a(3)^2 + b(3) + c$$

$$-6 = 9a + 3b + c$$

$$\textcircled{1} \underline{2 = -a - b - c}$$

$$5 \underline{(-4 = 8a + 2b)}$$

$$-20 = 40a + 10b$$

$$\rightarrow -4 = 8(1) + 2b$$

$$-4 = 8 + 2b$$

$$\begin{array}{r} -4 & -8 \\ -8 & -8 \\ \hline -12 & = \frac{2b}{2} \end{array}$$

$$\frac{-12}{2} = \frac{2b}{2}$$

$$-6 = b$$

$(1, -2)$

$$-2 = a(1)^2 + b(1) + c$$

$$-2 = a + b + c \quad \textcircled{2} \quad \text{[*-1]}$$

$$2 = -a - b - c$$

$$-2 = 1 + (-6) + c$$

$$-2 = -5 + c$$

$$\begin{array}{r} -2 & +5 & +5 \\ \hline 3 & = c \end{array}$$

$$3 = c$$

$(6, 3)$   $\textcircled{1}$  Plug in

$$3 = a(6)^2 + b(6) + c$$

$$3 = 36a + 6b + c$$

$$\textcircled{3} \underline{2 = -a - b - c}$$

$$(5 = 35a + 5b)(-2)$$

$$-10 = -70a - 10b$$

$$-20 = 40a + 10b$$

$$\begin{array}{r} -30 & = -30a \\ -30 & -30 \\ \hline -30 & = -30a \end{array}$$

$$1 = a$$

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

$$(1, -2) \quad (2, -4) \quad (3, -4) \quad y = x^2 - 5x + \frac{4}{2}$$

$$y = ax^2 + bx + c \quad \xrightarrow{f(3) = -4}$$

$$(1, -2)$$

$$-2 = a(1)^2 + b(1) + c$$

$$-2 = a + b + c$$

$$2 = -a - b - c$$

$$-2 = 1 + (-5) + c$$

$$-2 = -4 + c$$

$$\begin{array}{r} +4 \quad +4 \\ \hline 2 = c \end{array}$$

$$(2, -4)$$

$$-4 = a(2)^2 + b(2) + c$$

$$-4 = 4a + 2b + c$$

$$2 = -a - b - c$$

$$-2 = 3a + b$$

$$-2 = 3 \cdot 1 + b$$

$$-2 = 3 + b$$

$$\begin{array}{r} -3 \quad -3 \\ \hline -5 = b \end{array}$$

$$(3, -4)$$

$$-4 = a(3)^2 + b(3) + c$$

$$-4 = 9a + 3b + c$$

$$2 = -a - b - c$$

$$-2 = 8a + 2b$$

$$\begin{array}{r} 4 = -6a - 2b \\ \hline 2 = 2a \\ 1 = a \end{array}$$

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