

- 1.) False
- 3.) $a = -1, b = 9, c = 1$
- 5.) parabola opens up with x-intercepts of $(-2, 0)$ and $(1, 0)$, y-intercept of $(0, -2)$
- 7.) $-3x^2 + 5x - 9 = 0$
- 9.) $x^2 + 3x - 9 = 0$
- 11.) 17
- 13.) 64
- 15.) $3, \frac{1}{4}$
- 17.) $-\frac{1}{2}, -3$
- 19.) $\frac{-1 \pm \sqrt{11}}{5} \approx 0.46 \text{ or } -0.86$
- 21.) $\frac{-10 \pm \sqrt{70}}{6} \approx -0.27 \text{ or } -3.06$
- 23.) 25 or -25
- 25.) $\frac{3 \pm \sqrt{11}}{2} \approx 3.16 \text{ or } -0.16$
- 27.) none
- 29.) 4, -5
- 31.) $\frac{1}{2}, -\frac{3}{2}$



$$19.) \frac{-1 \pm \sqrt{11}}{5}$$

$$\frac{-2 \pm \sqrt{44}}{10} = \frac{-2 \pm \sqrt{4} \sqrt{11}}{10} = \frac{-2 \pm 2\sqrt{11}}{10}$$

$$\rightarrow \frac{2(-1 \pm \sqrt{11})}{10} = \frac{1(-1 \pm \sqrt{11})}{5} = \frac{-1 \pm \sqrt{11}}{5}$$

$$11.) 2x^2 - 3x - 1$$

$$b^2 - 4ac?$$

$$a=2 \quad b=-3 \quad c=-1$$

$$-3^2 \neq (-3)^2$$

$$-3 \cdot 3 \neq (-3)(-3)$$

$$-9 \neq 9$$

$$\begin{aligned} &(-3)^2 - 4(2)(-1) \\ &9 + 8 = \textcircled{17} \end{aligned}$$



$$17.) 2x^2 + 7x + 3 = 0$$

$$a=2$$

$$b=7$$

$$c=3$$

$$x = \frac{-(7) \pm \sqrt{(7)^2 - 4(2)(3)}}{2(2)}$$

$$x = \frac{-7 \pm \sqrt{49 - 24}}{4}$$

$$x = \frac{-7 \pm \sqrt{25}}{4}$$

$$x = \frac{-7 \pm 5}{4}$$

$$x = \frac{-7 + 5}{4}$$

$$= \frac{-2}{4} = \boxed{-\frac{1}{2}}$$

or

$$x = \frac{-7 - 5}{4}$$

$$= \frac{-12}{4} = \boxed{-3}$$



$$19.) 5y^2 + 2y - 2 = 0$$

$$a=5 \quad b=2 \quad c=-2$$

$$x = \frac{-2 \pm \sqrt{4 - 4(5)(-2)}}{2(5)}$$

$$x = \frac{-2 \pm \sqrt{4 + 40}}{10}$$

$$x = \frac{-2 \pm \sqrt{44}}{10}$$



$$x = \frac{-2 \pm \sqrt{4} \sqrt{11}}{10}$$

$$x = \frac{-2 \pm 2\sqrt{11}}{10}$$

$$x = \frac{-1 \pm \sqrt{11}}{5}$$

$$x = \frac{-1 \pm \sqrt{11}}{5}$$

$$19.) 5y^2 + 2y - 2 = 0$$

$$\begin{aligned} a &= 5 \\ b &= 2 \\ c &= -2 \end{aligned}$$

$$x = \frac{-2 \pm \sqrt{(2)^2 - 4(5)(-2)}}{2(5)}$$

$$x = \frac{-2 \pm \sqrt{4 + 40}}{10}$$

$$x = \frac{-2 \pm \sqrt{44}}{10}$$

$$x = \frac{-2 + \sqrt{44}}{10}$$

$$\approx 0.46$$

or

$$x = \frac{-2 - \sqrt{44}}{10}$$

$$\approx -0.86$$

$$25.) -2x^2 + 6x + 1 = 0$$

$$x = \frac{-(-6) \pm \sqrt{(-6)^2 - 4(-2)(1)}}{2(-2)}$$

$$x = \frac{-6 \pm \sqrt{36 + 8}}{-4}$$

$$x = \frac{-6 \pm \sqrt{44}}{-4}$$

$$x \approx -0.16$$

OR

$$x \approx 3.16$$

Goal 2

Using Quadratic Models in Real Life



Real Life
Hot Air Balloon



In Lesson 9.2, you studied the model for the height of a falling object that is *dropped*. For an object that is *thrown* down or up, the model changes to have an extra term. Problems involving these two models are *vertical motion* problems.

Models	$h = -16t^2 + s$	Object is <i>dropped</i> .
	$h = -16t^2 + vt + s$	Object is <i>thrown</i> .
Labels	$h = \text{height}$	(feet)
	$t = \text{time in motion}$	(seconds)
	$s = \text{initial height}$	(feet)
	$v = \text{initial velocity}$	(feet per second)

Remember that v is the velocity, not the speed.

Example 4 When Does It Hit the Water?

Your brother is riding in a hot-air balloon over a lake. From an altitude of 4000 feet, he throws a rock straight down toward the water. When the rock leaves his hand, its speed is 30 feet per second. How long will it take the rock to hit the water?

Solution Because the rock is thrown down, its initial velocity is $v = -30$ feet per second. The initial height is $s = 4000$ feet. The rock will hit the water when height h is 0.

$$\begin{array}{ll}
 h = -16t^2 - 30t + 4000 & \text{Vertical motion model} \\
 0 = -16t^2 - 30t + 4000 & \text{Substitute 0 for } h. \\
 16t^2 + 30t - 4000 = 0 & a = 16, b = 30, c = -4000
 \end{array}$$

Solution to the hot air balloon problem

$$0 = -16t^2 - 30t + 4000$$

$$a = -16 \quad b = -30 \quad c = 4000$$

$$x = \frac{-(-30) \pm \sqrt{(-30)^2 - 4(-16)(4000)}}{2(-16)}$$

$$x = \frac{30 \pm \sqrt{256900}}{-32}$$

no b/c its
negative

$$\frac{30 \pm 506.85}{-32} = -16.7, 8$$

14.9 seconds



simplifying a square root? Or you can just round two places

$$\begin{aligned}\sqrt{90} &= \sqrt{9} \sqrt{10} \\ &= 3\sqrt{10}\end{aligned}$$

$$\begin{aligned}\sqrt{50} &= \sqrt{25} \sqrt{2} \\ &= 5\sqrt{2}\end{aligned}$$

Square root method
 $ax^2 - c = 0$



$$\begin{array}{rcl}
 3x^2 - 27 & = & 0 \\
 +27 & +27 & \\
 \hline
 \frac{3x^2}{3} & = & \frac{27}{3} \\
 \hline
 \sqrt{x^2} & = & \sqrt{9} \\
 x & = & \pm 3
 \end{array}$$

Factoring

$$\begin{aligned}
 3(x^2 - 9) &= 0 \\
 3(x+3)(x-3) &= 0 \\
 x &= -3 \text{ or } x = 3
 \end{aligned}$$

Complete the square

$$x^2 + 8x + 3 = 0$$
$$\quad \quad -3 \quad -3$$

$$x^2 + 8x = -3$$

$$\quad \quad +16 \quad +16$$

$$\sqrt{(x+4)^2} = \sqrt{13}$$

$$x+4 = \pm\sqrt{13}$$
$$\quad -4 \quad -4$$

$$x = -4 \pm \sqrt{13}$$

Factoring method

$$x^2 + x - 2 = 0$$

$$(x+2)(x-1) = 0$$

$$\begin{array}{cc} \swarrow & \searrow \\ x+2=0 & \text{or } x-1=0 \\ x=-2 & x=1 \end{array}$$

$$\frac{ax^2}{a} + \frac{bx}{a} + \frac{c}{a} = \frac{0}{a}$$

$$x^2 + \frac{b}{a}x + \frac{c}{a} = 0$$

$$-\frac{c}{a} \quad -\frac{c}{a}$$

$$x^2 + \frac{b}{a}x = -\frac{c}{a}$$

$$+ \left(\frac{b}{2a}\right)^2 \quad + \left(\frac{b}{2a}\right)^2$$

$$x^2 + \frac{b}{a}x + \left(\frac{b}{2a}\right)^2 = -\frac{c}{a} + \left(\frac{b}{2a}\right)^2$$

to be continued

Complete the square
to derive the
Quadratic Formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$



... as a bonus question on next test?