An object is shot into the air. The following equation gives the height of the object as a function of time since launch.

$$h(t) = -16t^2 + 144t + 65$$

a) Find the maximum height of the object and the time it takes to reach that height.

b) Find the time it takes the object to reach a height of 200 feet.

c) Find the time it takes the object to reach a height of 50 feet.

An object is shot into the air. The following equation gives the height of the object as a function of time since launch.

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a) Find the maximum height of the object and the time it takes to reach that height.

Vertex

LOS: $t = \frac{-144}{-32} = 4.5$ sec

$h(4.5) = 389$ ft

Max height of 389 feet will occur after 4.5 seconds

$$h(t) = -16t^2 + 144t + 65$$

b) Find the time it takes the object to reach a height of 200 feet.

$200 = -16t^2 + 144t + 65$

$-200 \qquad -200$

$0 = -16t^2 + 144t - 135$

$b^2 - 4ac = 12096$

$t = \frac{-144 \pm \sqrt{12096}}{-32}$ ≈ 1.06 sec, 7.94 sec

The object will reach a height of 200 feet twice, once on the way up to the max height and again on the way down to the ground. Therefore, both answers make sense.

$$h(t) = -16t^2 + 144t + 65$$

c) Find the time it takes the object to reach a height of 50 feet.

$50 = -16t^2 + 144t + 65$

$0 = -16t^2 + 144t + 15$

$b^2 - 4ac = 21696$

$\frac{-144 \pm \sqrt{21696}}{-32} = -0.10$ & 9.10 sec

the object will reach a height of 50 feet only once, after 9.10 sec. A negative time doesn't make sense.

$$h(t) = -16t^2 + 144t + 65$$

d) Find the time it takes the object to reach the ground.

$h = 0$

$0 = -16t^2 + 144t + 65$

$b^2 - 4ac = 24{,}896$

$t = \frac{-144 \pm \sqrt{24896}}{-32} = -0.43 \text{ or } 9.43$

The object will reach the ground in 9.43 sec
(a negative time doesn't make sense and
it will reach the ground only once)

Ways to solve Quadratic Equations:

- Factoring ✓
- Square Roots ✓
- Quadratic Formula ✓
- Graphing
- Completing the Square

Sec 5-7

$$(x+6)^2 = x^2 + 12x + 36$$
$$(x-4)^2 = x^2 - 8x + 16$$
$$(x+11)^2 = x^2 + 22x + 121$$
$$(x-7)^2 = x^2 - 14x + 49$$
$$(x+8)^2 = x^2 + 16x + 64$$
$$(x-5)^2 = x^2 - 10x + 25$$

What relationships do you see here?

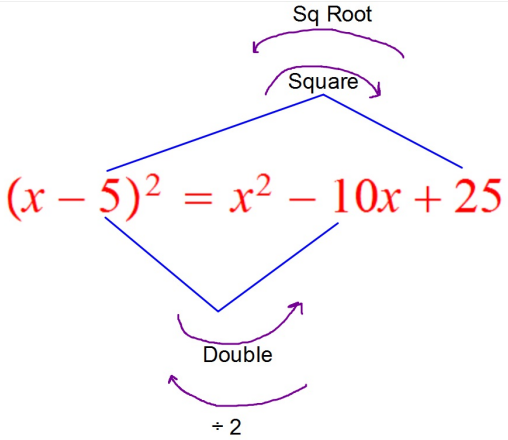
$$(x+6)^2 = x^2 + 12x + 36$$
$$(x-4)^2 = x^2 - 8x + 16$$
$$(x+11)^2 = x^2 + 22x + 121$$
$$(x-7)^2 = x^2 - 14x + 49$$
$$(x+8)^2 = x^2 + 16x + 64$$
$$(x-5)^2 = x^2 - 10x + 25$$

$(x + h)^2 = x^2 + bx + c$

$b = 2h$ $\quad b = 2 \cdot \sqrt{c}$

$c = h^2$ $\quad c = \left(\frac{b}{2}\right)^2$

$h = \frac{b}{2}$ $\quad h = \sqrt{c}$



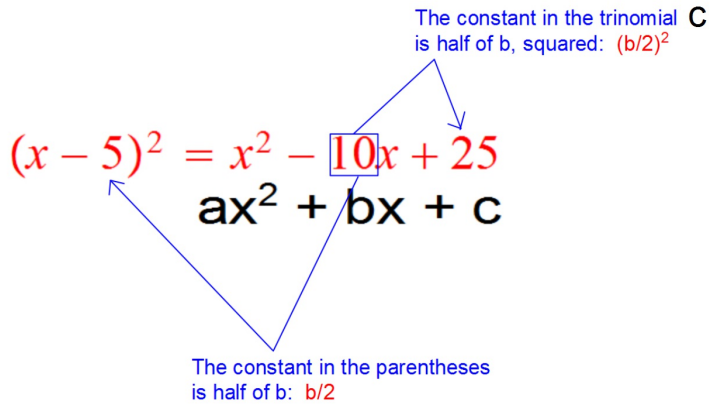
Sec 5-7: Completing the Square

Fill in the blanks.

1. $x^2 + 20x +$ 100 $= (x +$ 10 $)^2$

2. $x^2 - 4x +$ 4 $= (x -$ 2 $)^2$

This is called "Completing the Square."



In general, to complete the square:

$$x^2 + 16x + 64 = (x + 8)^2$$

2nd

$$x^2 + bx + \left(\frac{b}{2}\right)^2 = (x + \frac{b}{2})^2$$

1st

Complete the square for each.

1. $x^2 - 12x + 36 = (x - 6)^2$

2. $x^2 + 20x + 100 = (x + 10)^2$

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