L5 – Applications of Quadratics Unit 5
MPM2D
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Example 1: The equation $h(t) = -4.9t^2 + 60t + 3$ represents the path of a rocket where h is height in meters and t is time in seconds after is has been launched.

a) What is the height of the rocket when it is launched?
b) How long does it take the rocket to land on the ground?
c) What is the maximum height of the rocket?
d) When is the rocket 4 meters above the ground?

a) $h(0) = -4.9(0)^2 + 60(0) + 3$

$h(0) = 3$

$\boxed{\text{The height at launch is 3 meters.}}$

b) $0 = -4.9t^2 + 60t + 3$

$t = \dfrac{-60 \pm \sqrt{(60)^2 - 4(-4.9)(3)}}{2(-4.9)}$

$t = \dfrac{-60 \pm \sqrt{3658.8}}{-9.8}$

$\cancel{t = -0.05}$ $\boxed{t = 12.29 \text{ seconds}}$

c) $x\text{-vertex} = \dfrac{-60}{2(-4.9)} = 6.12$

$y\text{-vertex} = -4.9(6.12)^2 + 60(6.12) + 3 = 186.7$

$\boxed{\text{The max height is } 186.7 \text{ m}}$

d) $4 = -4.9t^2 + 60t + 3$

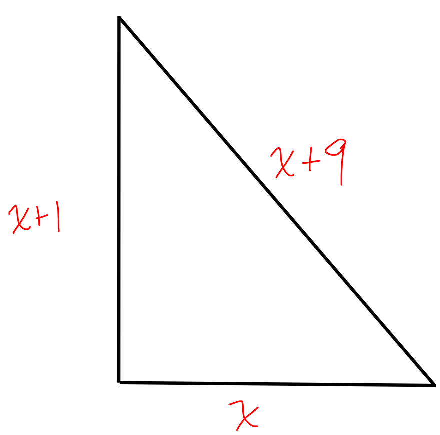
$0 = -4.9t^2 + 60t - 1$

$t = \dfrac{-60 \pm \sqrt{(60)^2 - 4(-4.9)(-1)}}{2(-4.9)}$

$t = \dfrac{-60 \pm \sqrt{3580.4}}{-9.8}$

$\boxed{t = 12.23 \text{ and } 0.02 \text{ seconds}}$

Example 2: One leg of a right triangle is 1 cm longer than the other leg. The length of the hypotenuse is 9 cm greater than that of the shorter leg. Find the length of the three sides.



$x^2 + (x+1)^2 = (x+9)^2$

$x^2 + x^2 + 2x + 1 = x^2 + 18x + 81$

$x^2 - 16x - 80 = 0$ $\quad \underline{-20} \times \underline{4} = -80$

$(x-20)(x+4) = 0$ $\quad \underline{-20} + \underline{4} = -16$

$x - 20 = 0 \quad x + 4 = 0$

$x = 20 \quad \cancel{x = -4}$

$\boxed{\text{The side lengths are 20, 21, and 29 cm.}}$

Example 3: The length of a rectangle is 16cm greater than its width. The area is 35cm^2. Find the dimensions of the rectangle.

width $= x$

length $= x+16$

Area = length × width

$35 = (x+16)(x)$

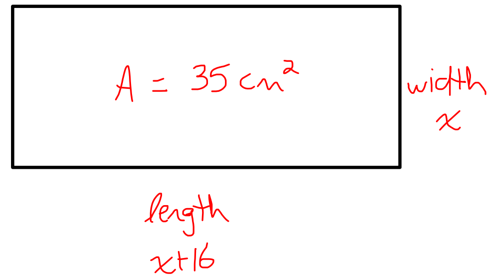
$35 = x^2+16x$

$0 = x^2+16x-35$

$x = \dfrac{-16 \pm \sqrt{(16)^2-4(1)(-35)}}{2(1)}$

$x = \dfrac{-16 \pm \sqrt{396}}{2}$

$x = 1.95$ $\quad$ $\cancel{x = -17.95}$



The dimensions are:

width $= x = 1.95$cm

length $= x+16 = 17.95$cm

Example 4: The path of a soccer ball after it is kicked from a height of 0.5 meters above the ground is given by the equation $h(d) = -0.1d^2 + d + 0.5$, where h is the height in meters, and d is the horizontal distance in meters.

a) How far has the soccer ball travelled horizontally when it lands on the ground?
b) Find the horizontal distance when the soccer ball is at a height of 2.6 meters above the ground.
c) What is the max height of the ball?

a) $0 = -0.1d^2+d+0.5$

$0 = -0.1(d^2-10d-5)$

$0 = d^2-10d-5$

$d = \dfrac{10 \pm \sqrt{(-10)^2-4(1)(-5)}}{2(1)}$

$d = \dfrac{10 \pm \sqrt{120}}{2}$

$d = 10.48$m $\quad$ $\cancel{d = -0.48}$

It travels 10.48m horizontally before landing.

b) $2.6 = -0.1d^2+d+0.5$

$0 = -0.1d^2+d-2.1$

$0 = -0.1(d^2-10d+21)$

$0 = d^2-10d+21$

$0 = (d-3)(d-7)$

$d_1 = 3 \quad d_2 = 7$

It's at a height of 2.6m when it is at a horizontal distance of 3m and 7m.

c) x-vertex $= \dfrac{-1}{2(-0.1)} = 5$

y-vertex $= -0.1(5)^2+5+0.5 = 3$

The max height is 3m.

Example 5: A sporting goods store sells 90 ski jackets in a season for \$200 each. Each \$10 decrease in the price would result in five more jackets being sold. At what price should they sell the jackets in order to obtain a maximum revenue? What is the max revenue?