MATH 1010 ~ Intermediate Algebra

Chapter 8: QUADRATIC EQUATIONS AND FUNCTIONS

Chapter 8: Applications of Quadratic Equations

Objectives:

- ✯ Set up and solve problems using quadratic equations.

$$3x^2 - 2x - 5 = 0$$

1) Height of a Projected Object

An object is projected vertically upward at an initial velocity of 64 feet per second from a height of 192 feet.
The height h at time t is given by $h = -16t^2 + 64t + 192$.

h = ht (ft)
t = time (sec)

a) After how many seconds is the height 256 ft?
b) When does the object hit the ground?

(a) $t = ?$ when $h = 256$ ft

$256 = -16t^2 + 64t + 192$

$-256 \qquad -256$

$0 = -16t^2 + 64t - 64$

$0 = -16(t^2 - 4t + 4)$

$\frac{0}{-16} = \frac{-16(t-2)(t-2)}{-16}$

$0 = (t-2)(t-2)$

$t - 2 = 0$

$t = 2$ sec

(b) $t = ?$ when $h = 0$

$h = -16t^2 + 64t + 192$

$0 = -16t^2 + 64t + 192$

$0 = -16(t^2 - 4t - 12)$

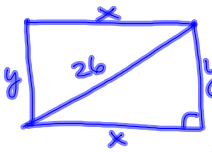
$0 = -16(t-6)(t+2)$

$t - 6 = 0$ or $t + 2 = 0$

$t = 6$ sec $\qquad$ ~~$t = -2$~~

2) Geometry

The perimeter of my computer screen is 72 inches. The diagonal distance is 26 inches.
What are the dimensions of the screen?



① $72 = 2x + 2y$

Pythagorean Thm $x^2 + y^2 = 26^2$

② $x^2 + y^2 = 676$

use substitution:

① $\frac{72}{2} = \frac{2x}{2} + \frac{2y}{2} \Leftrightarrow 36 = x + y$

$y = 36 - x$

② $x^2 + (36-x)^2 = 676$

$x^2 + (36-x)(36-x) = 676$

$x^2 + 1296 - 36x - 36x + x^2 = 676$

$-676 \qquad\qquad -676$

$2x^2 - 72x + 620 = 0$

$\frac{2(x^2 - 36x + 310)}{2} = \frac{0}{2}$

use quadratic formula:

$x^2 - 36x + 310 = 0$

$a = 1,\ b = -36,\ c = 310$

$x = \frac{36 \pm \sqrt{(-36)^2 - 4(1)(310)}}{2(1)}$

$56 = 7 \cdot 8$
$= 4 \cdot 14$
$= 2\sqrt{14}$

$= \frac{36 \pm \sqrt{1296 - 1240}}{2} = \frac{36 \pm \sqrt{56}}{2}$

$x = \frac{36 \pm \sqrt{4}\sqrt{14}}{2} = \frac{36 \pm 2\sqrt{14}}{2}$

$x = \frac{2(18 \pm \sqrt{14})}{2}$

$x = 18 \pm \sqrt{14} = 18 + \sqrt{14} \simeq 21.7$
or $18 - \sqrt{14} \simeq 14.3$

$y = 36 - x$

$x = 18 + \sqrt{14} \Rightarrow y = 36 - (18 + \sqrt{14}) = 18 - \sqrt{14}$

$x = 18 - \sqrt{14} \Rightarrow y = 36 - (18 - \sqrt{14}) = 18 + \sqrt{14}$

dimensions: $18 + \sqrt{14}$ and $18 - \sqrt{14}$

$\sim$ 21.7 in by 14.3 in

3) Reduced Rates

The Glee Club charters a bus to attend a competition. The cost of the bus is $480. To lower the bus fare per person, the club invites non-members to go along. When two non-members join the trip, the fare per person is decreased by $1.00. How many people are taking the bus to the competition?

x = final number of people on bus

p = original price per person (fare per person)

original ① $480 = p(x-2)$

+ non members ② $480 = (p-1)x$

① (solve for p.) $\frac{480}{x-2} = \frac{p(x-2)}{x-2}$

$p = \frac{480}{x-2}$

② $480 = \left(\frac{480}{x-2} - 1\right)x$

$(x-2)(480) = \left(\frac{480x}{x-2} - x\right)(x-2)$

$480(x-2) = \frac{480x(x-2)}{(x-2)} - x(x-2)$

$480x - 960 = 480x - x^2 + 2x$

$-480x + x^2 - 2x \quad -480x + x^2 - 2x$

$x^2 - 2x - 960 = 0$

$a=1, b=-2, c=-960$

$x = \frac{2 \pm \sqrt{(-2)^2 - 4(1)(-960)}}{2(1)}$

$x = \frac{2 \pm \sqrt{4+3840}}{2}$

$x = \frac{2 \pm \sqrt{3844}}{2} = \frac{2 \pm 62}{2} = \begin{cases} \frac{2+62}{2} = 32 \\ \frac{2-62}{2} = -30 \end{cases}$

32 people