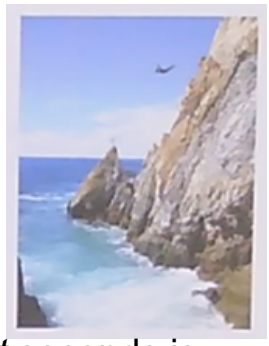
# 6.7 Quadratic Equations & Problem Solving

## OBJECTIVE 1: Solving Problems Modeled by Quadratic Equations

Remember that these answers are real-world and therefore should make sense. For example, a person's age or the length of a rectangle is always a positive number. Discard extraneous solutions that do not make sense as a solution to the problem.

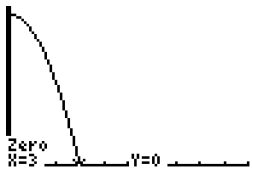
## Example 1: Finding Free-Fall Time

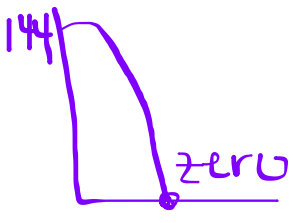


Since the 1940s, one of the top tourist attractions in Acapulco, Mexico, is watching the La Quebrada cliff divers. The divers' platform is about 144 feet above the sea. These divers must time their descent just right, since they land in the crashing Pacific Ocean in an inlet that is at most 9.5 feet deep. Neglecting air resistance, the height $h$ in feet of a cliff diver above the ocean after $t$ seconds is given by the quadratic equation $h = -16t^2 + 144$. Find how long it takes the diver to reach the ocean.

```
WINDOW
 Xmin=0
 Xmax=10
 Xscl=1
 Ymin=0
 Ymax=150
 Yscl=1
↓Xres=1
```

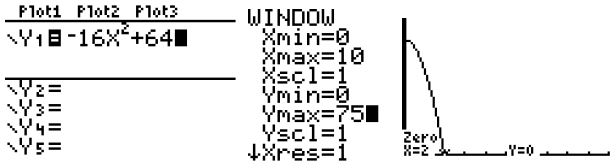
3 secs



## Practice 1:

Cliff divers also frequent the falls at Waimea Falls Park in Oahu, Hawaii. One of the popular diving spots is 64 feet high. Neglecting air resistance, the height of a diver above the pool after $t$ seconds is $h = -16t^2 + 64$. Find how long it takes a diver to reach the pool.




2 secs

(2, 0)

$x = ?$ $y = 0$

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

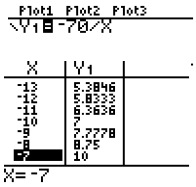
$0 = -16(t+2)(t-2)$

$t+2=0$ $t-2=0$

$t \neq -2$ $t = 2$

## Example 2: Finding an Unknown Number

The square of a number plus three time the number is 70. Find the number.




$x^2 + 3x = 70$

$x^2 + 3x - 70 = 0$

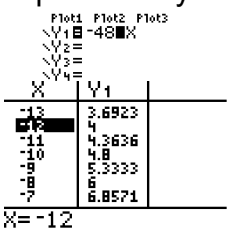
$(x+10)(x-7) = 0$

$x+10=0$ $x-7=0$

$x = -10$ $x = 7$

## Practice 2:

The square of a number minus eight times the number is equal to forty-eight. Find the number.




$x^2 - 8x = 48$

$x^2 - 8x - 48 = 0$

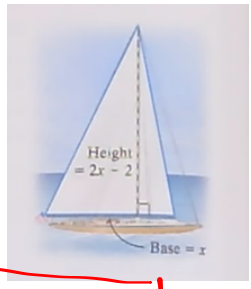
$(x-12)(x+4) = 0$

$x-12=0$ $x+4=0$

$x = 12$ $x = -4$

# Example 3: Find the Dimensions of a Sail

The height of a triangular sail is 2 meters less than twice the length of the base. If the sail has an area of 30 square meters, find the length of its base and the height.




$30\ m^2$

$A = \frac{1}{2}bh$

$30 = \frac{1}{2}(x)(2x-2)$

$30 = \frac{1}{2}(2x^2-2x)$

$30 = x^2 - x$

$0 = x^2 - x - 30$

$0 = (x-6)(x+5)$

$x-6=0$ $\quad x+5=0$

$x=6$ $\quad x \neq -5$

$h = 2(6)-2$

$= 12-2$

$= 10$

base : 6m

ht : 10m

## Practice 3:

An engineering team from Georgia Tech earned second place in a flight competition, with their triangular shaped paper hang glider. The base of their prize-winning entry was 1 foot less than three times the height. If the area of the triangular glider wing was 210 square feet, find the dimensions of the wing.

$h = x$

$b = 3x-1$

$A = 210\ ft^2$

h = 12ft

b = 35ft

$A = \frac{1}{2}bh$

$2 \cdot 210 = \frac{1}{2}(3x-1)(x) \cdot 2$

$420 = 3x^2 - x$

$-420 \quad -420$

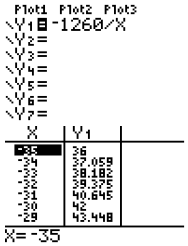
$0 = 3x^2 - x - 420$

a. c

-1260

35 -36

-1




$b = 3(12)-1$

$= 36-1$

$= 35$

$0 = (3x^2 - 36x) + (35x - 420)$

$= 3x(x-12) + 35(x-12)$

$= (3x+35)(x-12)$

$3x+35=0$ $\quad x-12=0$

$3x=-35$ $\quad x=12$

$x = -\frac{35}{3}$

## Example 4: Finding Consecutive Even Integers

Find two consecutive even integers whose product is 34 more than their sum.

6, 8
-6, -4

$x(x+2) = 34 + x + x + 2$

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

$x^2 - 36 = 0$

$(x+6)(x-6) = 0$ $x = 6, -6$

## Practice 4:

Find two consecutive integers whose product is 41 more than their sum.

$x(x+1) = 41 + x + x + 1$

$x^2 + x - 42 - 2x = 0$

$x^2 - x - 42 = 0$

$(x-7)(x+6) = 0$

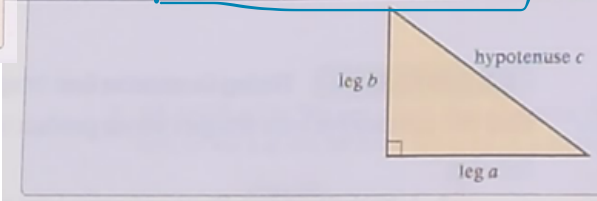
$x = 7, -6$

7, 8
-6, -5

**Pythagorean Theorem**

In a right triangle, the sum of the squares of the lengths of the two legs is equal to the square of the length of the hypotenuse.

$(\text{leg})^2 + (\text{leg})^2 = (\text{hypotenuse})^2$ or $a^2 + b^2 = c^2$



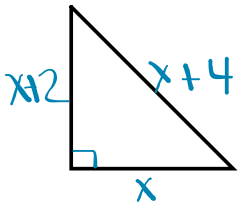

Helpful Hint

If you use this formula, don't forget that $c$ represents the length of the hypotenuse.

$l_1^2 + l_2^2 = h^2$

## Example 5: Finding the Dimensions of a Triangle

Find the lengths of the sides of a right triangle if the lengths can be expressed as three consecutive even integers.




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

$x^2 + x^2 + 4x + 4 = x^2 + 8x + 16$

$x^2 - 4x - 12 = 0$

$(x-6)(x+2) = 0$

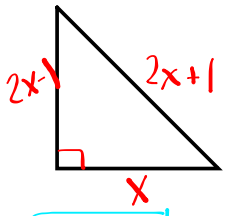
$x = 6 \quad x \neq -2$

6, 8, 10

3, 4, 5 x 2

## Practice 5:

Find the dimensions of a right triangle where the second leg is 1 unit less than double the first leg, and the hypotenuse is 1 unit more than double the length of the first leg.




8, 15, 17

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

$x^2 + 4x^2 - 4x + 1 = 4x^2 + 4x + 1$

$x^2 - 8x = 0$

$x(x-8) = 0$

$x \neq 0 \quad x = 8$

## 6.7 HW Assignment

pg. 432: 1 - 55 (o)