1.5 Modeling with Quadratic Equation

Learning Objectives:
- Solve geometry problems (especially including the Pythagorean Theorem).
- Find the height of a projectile.
- Find the time it takes a projectile to reach a given height.
- Create a model using quadratic equations.

Box Problem

From each corner of a square piece of sheet metal, remove a square of size 9 centimeters. Turn up the edges to form an open box. If the box is to hold 144 cubic centimeters ($cm^3$), what should be the dimensions of the piece of sheet metal?

Step 1: Draw and label a picture.

Step 2: Define variables.

Step 3: Determine if there is a special formula needed and substitute the given information into the formula.

Step 4: Write equation in standard form.

Step 5: Simplify and Factor.
Step 6: Use Zero-Product Property (set each factor equal to zero)

THE ANSWER IS … ____________________________.

A Pythagorean Theorem Problem

How many right triangles have a hypotenuse that measures $2x + 3$ meters and legs that measure $2x - 5$ meters and $x + 7$ meters? What are the dimensions of the triangle(s)?

Step 1: Draw and label a picture.

Step 2: Define variables.

Step 3: Determine if there is a special formula needed and substitute the given information into the formula.
Step 4: Write equation in standard form.

_________________________________________________________

\( a = \) __________
\( b = \) __________
\( c = \) __________

Evaluate the discriminant: _________________________________

How many triangles do we have? ______________________________

Step 5: Factor or use Quadratic Formula.

Quadratic Formula: _________________________________

_________________________________________

_________________________________________

Step 6: Solve.

_________________________________________

_________________________________________

Step 7: Check your answers.

_________________________________________

_________________________________________

THE ANSWER IS … _________________________ and ________________________.

The Height of a Projectile

The height of an object that is projected into the air at \( v_0 \) feet per second from an initial height of \( h_0 \) feet is given by
where \( h \) is the height in feet and \( t \) is the time after the initial launch in seconds. The equation does not account for air resistance.

1. If a rock is dropped from the Golden Gate Bridge (220 feet above the water), when will it hit the water? Give your answer to the nearest tenth of a second.

__________________________________
Because height is ____
__________________________________
Add ____ to both sides
__________________________________
Divide both sides by ____
__________________________________
Square Root Property
__________________________________
Approximate

The ANSWER is... ________________.

2. If a rock is tossed upward at a velocity of 10 ft/sec from the Golden Gate Bridge so that it lands in the water, when will it hit the water? Give your answer to the nearest tenth of a second.

__________________________________
Because height is ____
__________________________________
Quadratic Formula
__________________________________
Approximate

The ANSWER is... ________________.

3. If a rock is thrown upward at a velocity of 40 ft/sec from the Golden Gate Bridge, when will the rock be 230 feet above the water? Give your answer to the nearest tenth of a second.

__________________________________
Because height is ____
__________________________________
Subtract ___ from both sides
__________________________________
Quadratic Formula
__________________________________
Approximate

The ANSWER is... ________________.

A Projectile Problem

Formula: ____________________________

Tia stands on top of the Bank of America building in Dallas, 921 ft. above the sidewalk.

a. If she drops a water bottle off the edge how long will it take the water bottle to hit the ground?

__________________________________  \( H \) is ____ and \( V_0 \) is ____
__________________________________  Add ____ to both sides
Divide both sides by ___

Take the square root of both sides

The ANSWER is… ______________.

b. If she throws the bottle up at a rate of 20 ft/sec, how long will it take to hit the ground?

H is ____ and \( V_0 \) is ____

Quadratic Formula

Approximate

The ANSWER is… ______________.

c. After how many seconds will the dropped bottle be 500 ft from the ground?

H is ____ and \( V_0 \) is ____

Subtract ___ from both sides

and Add ____ to both sides

Divide both sides by ___

Take the square root of both sides

The ANSWER is… ______________.