

Name: KEY

Grader: _____

Projectile Motion Word Problem

At its lowest level, the Willamette River is 48 feet below the Hawthorne Bridge. During the last snowstorm, Mr. Maurer threw a snowball off the bridge into the river. He threw the snowball up with an initial speed of 32 feet per second. Ignore air resistance, and assume the constant of gravity applies.

1. When does the snowball reach its max height?
2. What is the max height?
3. What are the two times the snowball is 48 feet high?
4. When does the snowball hit the water?

Remember to define your variables, show your work, and verify your answers.

Initial height = ~~48~~ 48 feet

Initial speed = 32 feet per second

Gravity = -16

$$y = -16x^2 + 32x + 48, \quad \begin{array}{l} x = \text{time (in seconds)} \\ y = \text{height (in feet)} \end{array}$$

1) I'll use the vertex formula $h = \frac{-b}{2a}$

$$\frac{-(-32)}{2(-16)} = \frac{-32}{-32} = 1. \quad \text{The max height is reached after 1 second.}$$

2) Plug in $x=1$.

$$\begin{aligned} y &= -16(1)^2 + 32(1) + 48 \\ &= -16 + 32 + 48 = 64. \end{aligned}$$

The max height is 64 feet

3) Set equal to 48, then solve.

$$\begin{aligned} 48 &= -16x^2 + 32x + 48 \\ -48 & \quad \quad \quad -48 \\ 0 &= -16x^2 + 32x + 0 \end{aligned}$$

Use quadratic formula

$$x = \frac{-32 \pm \sqrt{32^2 - 4(-16)(0)}}{2(-16)} = \frac{-32 \pm \sqrt{1024}}{-32} = \frac{-32 \pm 32}{-32}$$

The snowball is 48 feet high @ 0 & 2 seconds

BACK!

0
2

4) Set equal to 0 and solve.

$$0 = -16x^2 + 32x + 48$$

Quadratic Formula

$$x = \frac{-(-32) \pm \sqrt{(-32)^2 - 4(-16)(48)}}{2(-16)}$$

$$x = \frac{-32 \pm \sqrt{4096}}{-32} = \frac{-32 \pm 64}{-32}$$

The snowball hits the river after
3 seconds.

Verify: Option 1: Table

x	0	1	2	3
y	48	64	48	0

↑
Max height

↑
Hits water.

Option 2: Factor

$$y = -16x^2 + 32x + 48$$

$$y = -16(x^2 - 2x - 3)$$

$$0 = -16(x - 3)(x + 1)$$

$x = 3$, ~~$x = -1$~~
Hits water.

Vertex is halfway
 $h = \frac{3 + (-1)}{2} = \frac{2}{2} = 1$

Plug in.

$$\begin{aligned} & -16(1 - 3)(1 + 1) \\ & -16(-2)(2) = 64 \\ & V: (1, 64). \end{aligned}$$