Work Number :
Learning Target :

Exploring Vertical Motion Model

Begin by watching the following video.

An obvious question that arises after watching this video is "How long was the diver in free fall?" To answer this question we need to understand the **Vertical Motion Model.** The V.M.M. Is :

$$h = -16t^2 + v_0 t + h_0$$

h = height v_0 = initial velocity

t = time h_0 = initial height

Using this formula we can insert, what we know from the video.

Let's start with h_0. According to the video, what was the divers initial height? Another words, how high did he dive from?

Next, let's deal with the h variable. What was the divers height when he “hit” the water?

Finally, because the diver basically “fell” to the water his initial velocity would be zero.

Let's insert what we know into the formula. Write the formula below.

Check if your formula is correct with the following QR code.

Press [ZOOM][0]
Press [WINDOW]
Change the Ymin to -500 and change the Ymax to 500
Press [GRAPH]
What are the solutions to the V.M.M. created from the jump?

From your work, how long was the diver in free fall before he “hit” the water?

Verify your answer by watching the video again and timing the free fall.

How close was your calculation to the actual time? Why may the calculated time and the actual times be different?

Before you turn the page...watch this next video.

An obvious question that arises after watching this video is "How high was the belly flopper when he flopped?" To answer this question we will again use the **Vertical Motion Model.** The V.M.M. Is :

$$h = -16t^2 + v_0 t + h_0$$

h = height	v_0 = initial velocity
t = time	h_0 = initial height

Using this formula we can insert, what we know from the video.

Let's start with t. According to the video, how long did the belly flopper free fall?

Next, let's deal with the h variable. What was the belly floppers height when he "hit" the water?

Finally, because the diver basically "fell" to the water his initial velocity would be zero.

Let's insert what we know into the formula. Write the formula below.

Check if your formula is correct with the following QR code.

Solve the equation for the unknown value (initial height).

From your work, how high was the belly flopper before he flopped?

Verify your answer by finding the World Record height for belly flopping in 2011.

How close was your calculation to the actual World Record height? Why may the calculated height and actual height be different?

Before you turn the page...watch this final video.

In the last video, Bill Nye (The Science Guy) is throwing multiple objects from a roof top. We can use the Vertical Motion Model to calculate the time it takes each object to “hit” the ground.

Let's assume Mr. Nye was throwing the objects from a height of 30 ft. Let's also assume that Bill is hurling these objects with an initial vertical velocity of 20 feet per second.

Remember, from our previous work that the V.M.M. Is :

$$h = -16t^2 + v_0 t + h_0$$

h = height v_0 = initial velocity

t = time h_0 = initial height

Using this formula we can insert, what we know from the video.

Let's start with h_0. According to our assumptions, what was Bill's initial height? Another words, how high did he throw the objects from?

Next, let's deal with the h variable. What were the objects height when they “hit” the ground?

Finally, what was the initial velocity that Mr. Nye threw the objects?

Let's insert what we know into the formula. Write the formula below.

Check if your formula is correct with the following QR code.

Press [ZOOM][0]

Press [WINDOW]
Change the Ymin to -100 and change the Ymax to 100
Press [GRAPH]
Finally, find the solutions to your function.

According to your work, how long did it take for the objects to “hit” the ground?

Complete the following problems.

1) You are standing on a cliff 1296 feet high and drop your cell phone. How long will it take until your phone hits the ground (h = 0)?

2. Your sister's hand was 64 ft above the ground when she threw an apple out of an apple tree. She throws an apple with an initial velocity of 48 ft per second. How long will it take until your apple hits the ground?

3. 

In 1987 the Washington Bullets has both the tallest player in the NBA, Manute Bol (7'7”) and the shortest player in the NBA, Muggsy Bogues (5'3”).

When Manute Bol shot the basketball he released it from a height of 9 ft. above the ground. Conversely, when Muggsy Bogues shot the ball his release point was 6 ft. above the ground.

If both players shot the ball at the same time with the same initial velocity of 30 feet per second which players ball would hit the ground first?

How much longer would one ball be in flight compared to the other ball?