

Teacher Notes






Activity 8

Two Dimensional Particle Motion

Objective

- ◆ Students will explore the motion of a projectile parametrically by adjusting the projectile's initial height, initial velocity and angle to the horizontal.

Applicable TI InterActive! Functions

- ◆ Define  variable: = value
- ◆ Mode settings 
- ◆ Parametric graph 

Problem

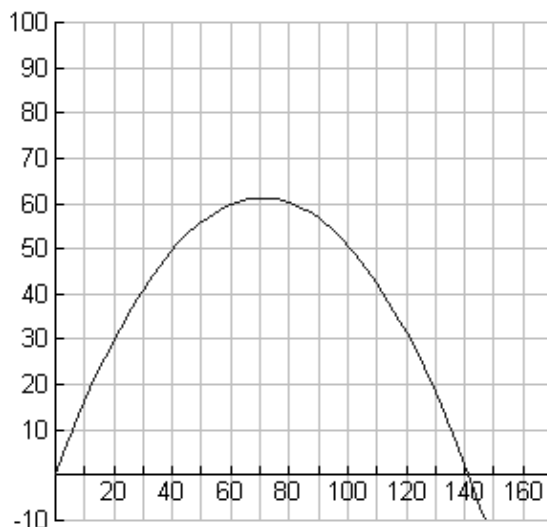
Students will explore the motion of a projectile using the parametric equations

$$x(t) = x_0 + v_0 \cos(\theta)t \text{ and } y(t) = y_0 + v_0 \sin(\theta)t + \frac{1}{2}gt^2 \text{ by changing the}$$

parameters of the equations and observe the results. The students will then examine problems involving two-dimensional particle motion.

Exploration

1. through 10.

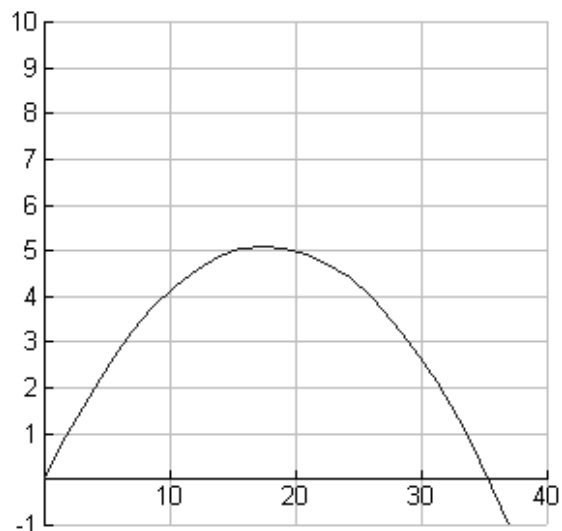


Analysis

- $t = 3.53$ or 3.54 s $x = 70.6$ or 70.8 m $y = 61.22$ m
- $t = 7.07$ s $x = 141.4$ m $y = -0.01$ m
- $v_0 = 30$ The particle does not rise as high or travel as far horizontally.
 $v_0 = 50$ The particle rises higher and travels further horizontally.
 Change X_{\max} to 250 and T_{\max} to 9 to see a complete graph.
- $\theta = 30$ The particle does not rise as high and travels about the same horizontally.
 $\theta = 70$ The particle rises higher and does not travel as far horizontally.
- $y_0 = 10$ The graph is shifted up 10 m making the object rise higher and travel further horizontally.
 $y_0 = 15$ The graph is shifted up 15 m making the object rise higher and travel further horizontally.
- The greater the value of v_0 , the higher and further the object will travel. The greater the value of θ , the higher the object will rise. But the horizontal distance will decrease once the angle reaches 45° . The graph of the object is shifted up as y_0 is increased.

Additional Exercises Solutions

- $t = [0,3]$
 $x = [0,40]$
 $y = [-1,10]$
 Highest Point:
 $t = 1.02$ s
 $x = 17.67$ m
 $y = 5.10$ m
 Strikes the ground:
 $t = 2.04$ s
 $x = 35.33$ m
 $y = 0.01$ m



2. $t = [0,6],$

$x = [0,450],$

$y = [-10,50]$

Highest Point:

$t = 2.79 \text{ s}$

$x = 209.74 \text{ m}$

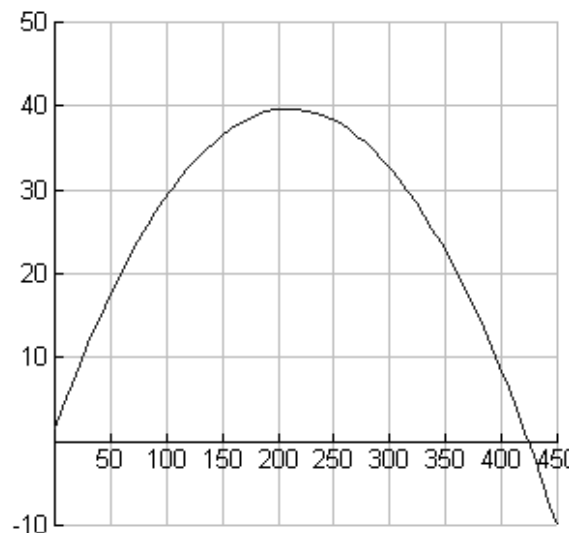
$y = 39.70 \text{ m}$

Strikes the ground:

$t = 5.64 \text{ s}$

$x = 423.99 \text{ m}$

$y = -0.05 \text{ m}$



3. $t = [0,30]$

$x = [0,5000]$

$y = [-100,1200]$

Highest Point:

$t = 14.43 \text{ s}$

$x = 2040.71 \text{ m}$

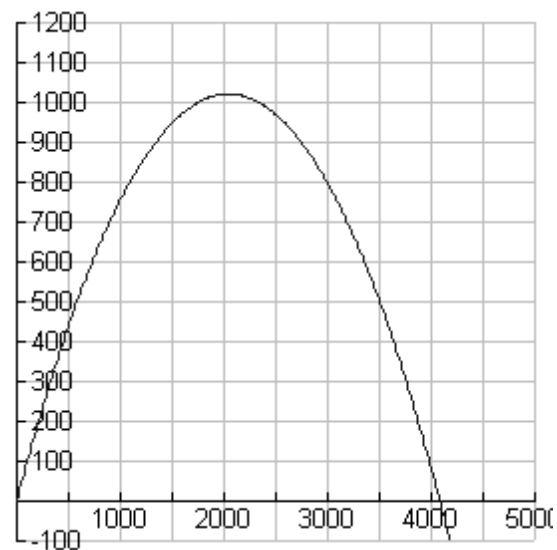
$y = 1021.41 \text{ m}$

Strikes the ground:

$t = 28.87 \text{ s}$

$x = 4082.83 \text{ m}$

$y = -0.20 \text{ m}$



4. The angle is 45° . Students should fix the values of v_0 and y_0 and change θ until they see that the maximum horizontal distance occurs at that point.

5. Students should use the steps 1 through 9 from the Activity to see the results.