

5.2

Projectile Motion

LEARNING TARGETS

5.2

I can interpret, analyze, and calculate the motion of a zero launch angle projectile.

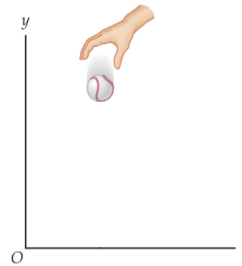
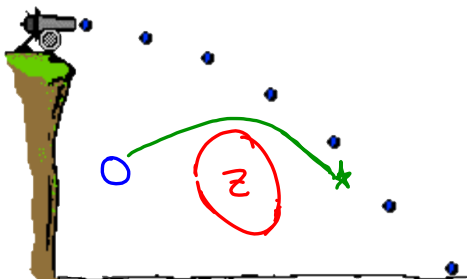
Projectile Motion

Projectile Motion is the motion of objects that are initially launched, or “projected,” and which then continue moving under the influence of gravity alone.

Projectile Motion

In studying projectile motion we make the following assumptions:

3. The Earth's rotation is ignored

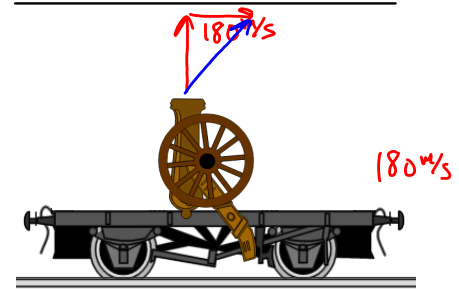
Acceleration In Free FallZero Launch AngleAcceleration In Free Fall

All objects in free fall have acceleration components $a_{\text{horizontal}} = 0$ and $a_{\text{vertical}} = -g$. This is true regardless of whether the object is dropped, thrown, kicked, or otherwise set into motion.

Acceleration In Free Fall

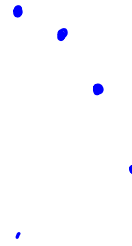
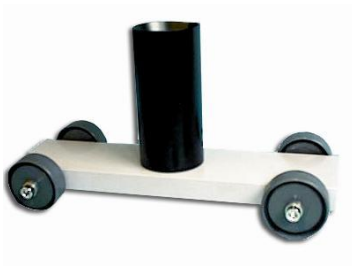
The horizontal and vertical motions of a projectile are independent of each other.

Cannon On A Train



B I F
4 8 0

Ballistics Car



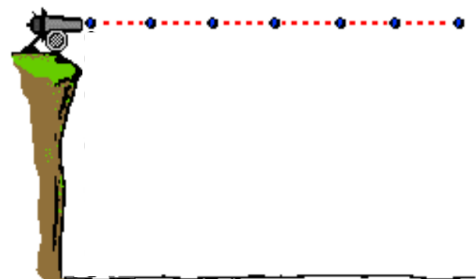
Equations For Projectile Motion ($a_x = 0$, $a_y = -g$)

$$\begin{aligned} x &= x_0 + v_{0x}t \\ y &= y_0 + v_{0y}t - \frac{1}{2}gt^2 \end{aligned}$$

$$\begin{aligned} v_x &= v_{0x} \\ v_y &= v_{0y} - gt \end{aligned}$$

$$\begin{aligned} v_x^2 &= v_{0x}^2 \\ v_y^2 &= v_{0y}^2 - 2g\Delta y \end{aligned}$$

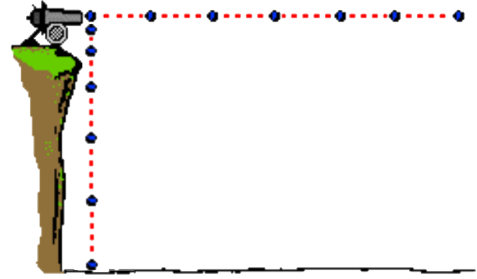
Zero Launch Angle



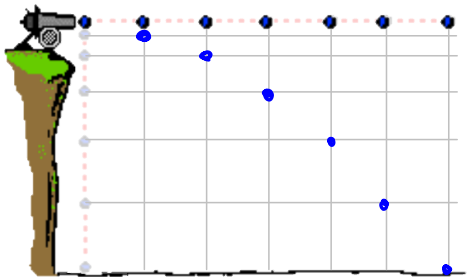
Zero Launch Angle



Zero Launch Angle



Zero Launch Angle



Fire When Ready!

A cannon ball is fired horizontally at 180.0 m/s from the top of a cliff that is 30.0 m high. How far from the bottom of the cliff will the cannon ball land?

$x_0 = 0$
 $a_x = 0$
 $v_{ix} = 180 \text{ m/s}$
 $x_f = ?$

$y_0 = 0$
 $a_y = 9.8 \text{ m/s}^2$
 $v_{iy} = 0$
 $y_f = -30 \text{ m}$

$x_f = x_0 + v_{ox}t + \frac{1}{2}a_x t^2$
 $x_f = v_{ox}t$
 $x_f = (180 \text{ m/s})(2.47 \text{ s})$
 $x_f = 445 \text{ m}$

$y_f = y_0 + v_{iy}t + \frac{1}{2}a_y t^2$
 $y_f = \frac{1}{2}gt^2$
 $\sqrt{\frac{2y_f}{g}} = t$
 $t = 2.47 \text{ s}$

HOMEWORK

Unit 5 Problems (5-8)