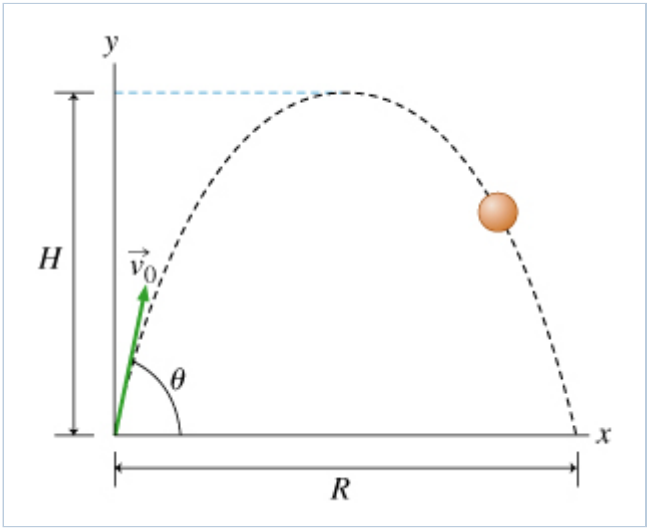
Description: Find everything about standard projectile problem with lots of hints and wrong answer responses.

Constants | Periodic Table

Learning Goal:

Understand how to apply the equations for 1-dimensional motion to the *y* and *x* directions separately in order to derive standard formulae for the range and height of a projectile.

A projectile is fired from ground level at time $t = 0$, at an angle θ with respect to the horizontal. It has an initial speed v_0. In this problem we are assuming that the ground is level.



Part A

Find the time t_H it takes the projectile to reach its maximum height.

Express t_H in terms of v_0, θ, and g (the magnitude of the acceleration due to gravity).

▸ **View Available Hint(s)** (5)

ANSWER:

$$t_H = \frac{v_0 \sin(\theta)}{g}$$

Part B

Find t_R, the time at which the projectile hits the ground.

Express the time in terms of v_0, θ, and g.

View Available Hint(s) (3)

ANSWER:

$$t_R = \frac{2\,(v_0 \sin(\theta))}{g}$$

Part C

Find H, the maximum height attained by the projectile.

Express the maximum height in terms of v_0, θ, and g.

View Available Hint(s) (3)

ANSWER:

$$H(\theta) = \frac{1}{2g}\,(v_0 \sin(\theta))^2$$

Part D

Find the total distance R (often called the range) traveled in the *x* direction; in other words, find where the projectile lands.

Express the range in terms of v_0, θ, and g.

View Available Hint(s) (4)

ANSWER:

$$R(\theta) = \frac{{v_0}^2}{g}\sin(2\theta)$$

The actual formula for $R(\theta)$ is less important than how it is obtained:

1. Consider the *x* and *y* motion separately.
2. Find the time of flight from the *y*-motion
3. Find the *x*-position at the end of the flight - this is the range.

If you remember these steps, you can deal with many variants of the basic problem, such as: a cannon on a hill that fires horizontally (i.e. the second half of the trajectory), a projectile that lands on a hill, or a projectile that must hit a moving target.