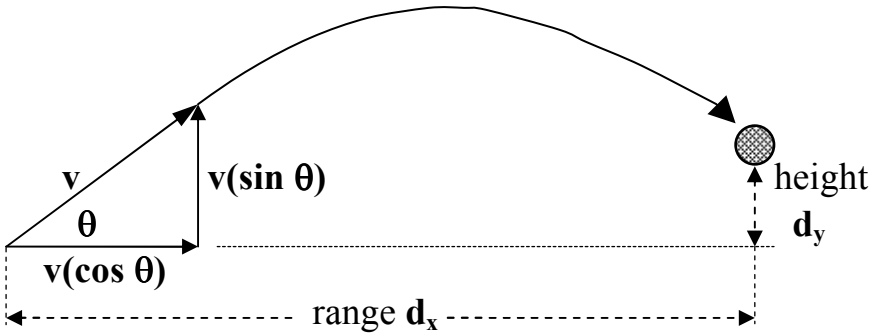
Two-Dimensional Projectile Motion

Now we'll examine mor general 2-d projectile motion problems, where the object is launched at an angle to the horizontal.

First, we must resolve the given initial velocity into horizontal and vertical components by trig:

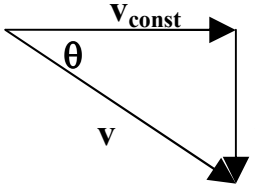


Next, arrange all information into a horizontal and vertical list (as before):

Hor.	Vert.
$v_{const} = v \cos\theta$	$v_o = v \sin\theta$
$a = 0$	$a = -9.8$

Using this information, we can:

- use vert. data to find total time up and down
  - use the total time to find overall range
- find both range and height, given any time **t**
- find the final resultant velocity, given any time **t**:
  - remember that horizontal speed is *constant*
  - kinematics can be used to find the final vertical speed
  - finally, vector-add these velocity components to find the resultant speed and direction:



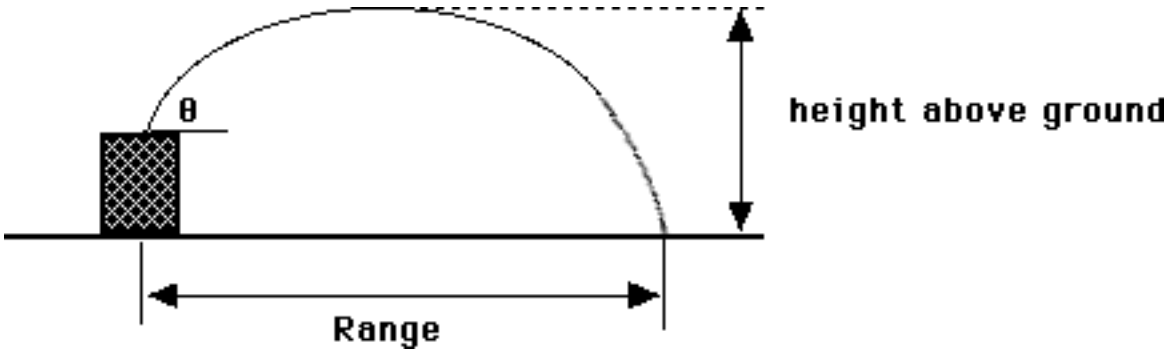
$v_y = v_o + at$ $v = \left(v_{const}^2 + v_y^2\right)^{\frac{1}{2}}$ $\theta = \tan^{-1}\left(\frac{v_y}{v_{const}}\right)$

Example 5.
An artillery shell is fired over level ground, at 400. m/s and at an angle of 50° to the horizontal. Find:

(a) total time in the air.
(b) how high the shell rises.
(c) the location of the shell after 25.0 seconds.
(d) the velocity at impact.
(e) the range of the shell.

(see Projectiles Ex 5 for answer)

Example 6.
The case of a projectile launched at an angle to the horizontal from a point above the ground.



In this example the mass is shot at 25° above the horizontal at a velocity of 120 m/s from a height of 65.0 meters. Find:

a) the time in the air.
b) the highest height of the projectile <u>above the ground</u>.
c) the range.
d) the final velocity.

(see Projectiles Ex 6 for answer)