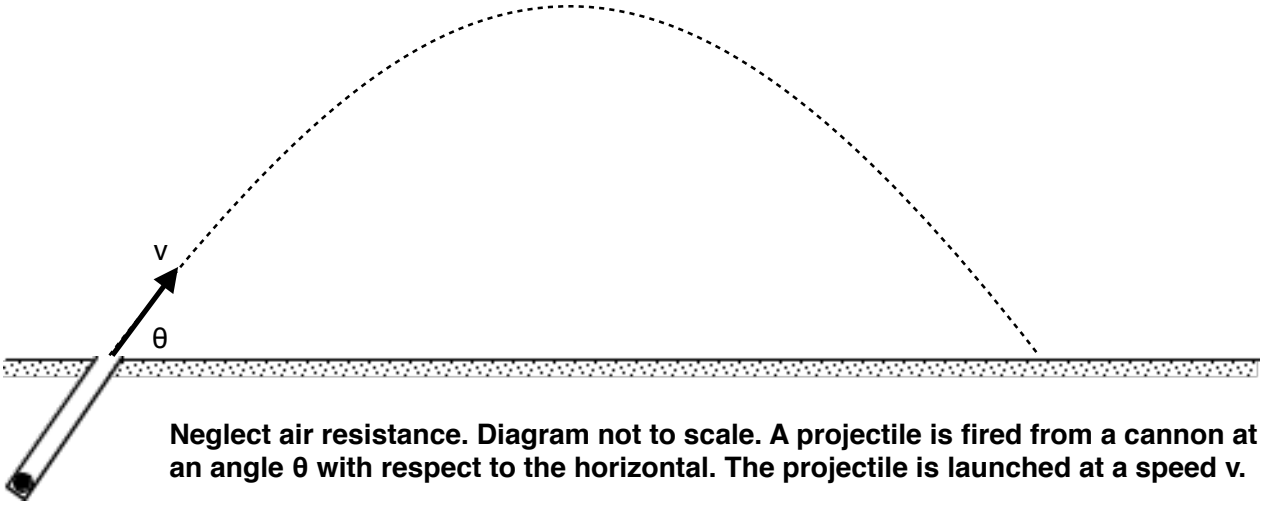
PhyzJob: Projectile Problem

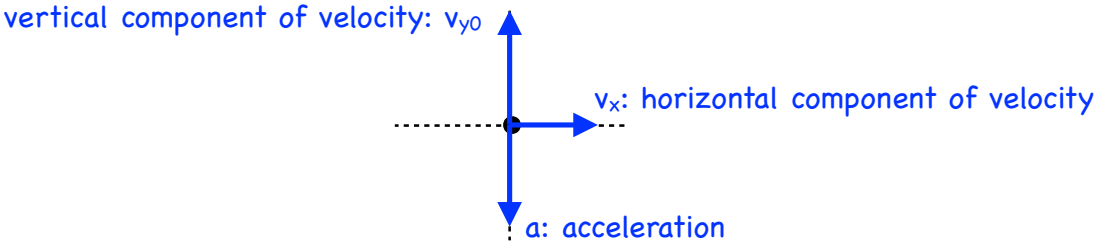
AP FREE RESPONSE PRACTICE - Level 1

Felix



Neglect air resistance. Diagram not to scale. A projectile is fired from a cannon at an angle θ with respect to the horizontal. The projectile is launched at a speed v.

a. On the diagram below, sketch and label vectors showing the horizontal component of velocity, the vertical component of velocity, and the acceleration of the projectile at the moment it has left the cannon.



b. Given: θ = 53° and v = 25 m/s.

i. Calculate the horizontal component of the launch velocity?

$v_x = v \cdot \cos\theta = 25\ m/s \cdot \cos 53° = 15\ m/s$

ii. Calculate the vertical component of the launch velocity?

$v_y = v \cdot \sin\theta = 25\ m/s \cdot \sin 53° = 20\ m/s$

c. Determine the maximum height attained by the projectile in its flight.

y: UAM

$y = ?$
$v_{y0} = 20\ m/s$
$v_y = 0$
$a = -9.8\ m/s^2$
$t = ?$

$(v_y)^2 = (v_{y0})^2 + 2ax$
$y = -(v_{y0})^2 / 2a$
$y = -(20\ m/s)^2 / 2 \cdot -9.8\ m/s^2$
$y = 20\ m$

d. Determine the time of flight of the projectile.

y: UAM

$y = 0$

$v_{y0} = 20$ m/s

$v_y = ?$

$a = -9.8$ m/s^2

$t = ?$

$y = v_{y0}t + (1/2)at^2$

$0 = v_{y0}t + (1/2)at^2$

$0 = v_{y0} + (1/2)at$

$v_{y0} = -(1/2)at$

$t = -2v_{y0}/a$

$t = -2 \cdot 20$ m/s $/ -9.8$ m/s^2

$t = 4.0$ s

e. How far downrange does the projectile land?

x: UM

$x = ?$

$v_x = 15$ m/s

$t = 4.0$ s

$x = v_x \cdot t$

$x = 15$ m/s $\cdot$ 4.0 s

$x = 60$ m

f. After the projectile leaves the barrel but before it hits the ground,

i. where does it have the lowest speed, or is its speed uniform throughout the flight? Explain your answer.

The speed is lowest at the apex, where v_y is zero. Everywhere else, the non-zero vertical velocity adds to the horizontal velocity.

ii. where does it have the smallest acceleration, or is the its acceleration uniform throughout the flight? Explain your answer.

The acceleration is the same throughout. Vertical acceleration is gravitational; horizontal motion is unaffected.