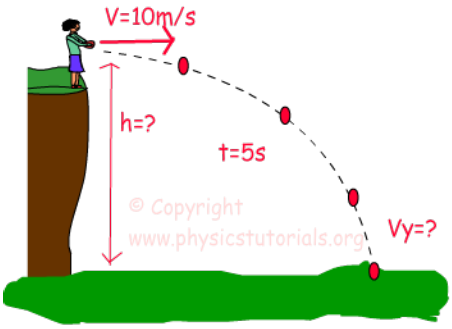
content

Projectile Motion with Examples

Example In the given picture below, Alice throws the ball to the +X direction with an initial velocity 10m/s. Time elapsed during the motion is 5s, calculate the height that object is thrown and Vy component of the velocity after it hits the ground.



In vertical direction we have free fall motion.

$h = \frac{1}{2} g.t^2 = \frac{1}{2} 10.5^2$

$h = 125m$

$Vy = -g.t$

$Vy = -10m/s^2.5s$

$Vy = -50m/s$

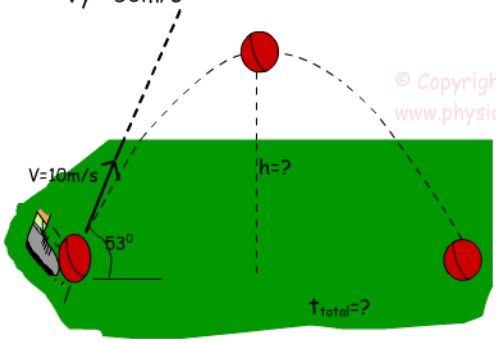
In horizontal since our velocity is constant;

$X = V.t$

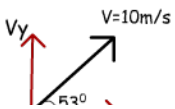
$X = 10m/s.5s = 50m$

Example John kicks the ball and ball does projectile motion with an angle of 53º to horizontal. Its initial velocity is 10 m/s, find the maximum height it can reach, horizontal displacement and total time required for this motion. (sin53º=0, 8 and cos53º=0, 6)

Example In the given picture you see the motion path of cannonball. Find the maximum height it can reach, horizontal distance it covers and total time from the given information. (The angle between cannonball and horizontal is 53º and sin53º=0, 8 and cos53º=0, 6)



First we seperate our velocity into its components to make problem simple.



$Vx = V.\cos 53^0 = 10.0,6 = 6m/s$

$Vy = V.\sin 53^0 = 10.0,8 = 8m/s$

Kinematics Exams

In vertical;

$V=V_o-g.t$

$0=8-10.t$

$t=0,8s$

$t_{total}=1,6s$

0,8s is the time required only for the half of the motion. Thus, we multiply it with two for total time.

$h=\frac{1}{2}g.t^2$

$h=\frac{1}{2}10.(0,8s)^2=3,2m$

We use 0.8s time because we just consider vertical motion.

In horizontal;

$X=V.t$

$X=6.1,6=9,6m$

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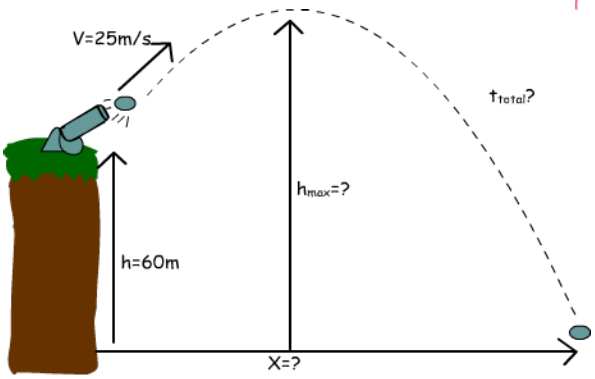

First, we find the components of the velocity.

$V_x=V.\cos 53^0$

$V_x=25.0,6=15m/s$

$V_y=V.\sin 53^0$

$V_y=25.0,8=20m/s$

Motion in vertical;

$V_{final}=V_{initial}-g.t$

$0=20m/s-10.t$

$t=2s$

2s is the time required for cannonball to reach maximum height

$h=V_y.t-\frac{1}{2}g.t^2$

$h=20m/s.2s-\frac{1}{2}10m/s^2.(2s)^2$

$h=20m$

$h_{max}=20m+60m=80m$

Free fall from the maximum height;

$h=\frac{1}{2}g.t^2$

$80m=\frac{1}{2}10m/s^2.t^2$

$t=4s$

$t_{total}=4s+2s=6s$

Motion in horizontal;

$X=V.t$

$X=15m/s.6s$

$X=90m$

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