Chapter 11 - Projectile Motion + Circular Motion

Projectiles

horizontally - no force acting on the object, so the velocity is constant

vertically - force of gravity acts on the object, so the acceleration is that of gravity ($a = -9.81 \text{ m/s}^2$)

↑ down!

Horizontally

$v = \frac{\Delta d}{\Delta t}$ ← horizontal displacement

↑ horizontal velocity

Time is the connection between horizontal + vertical

Vertically

$v_{ave} = \frac{\Delta d}{\Delta t}$

$a = \frac{\Delta v}{\Delta t}$

$\Delta d = v_1 \Delta t + \frac{1}{2} a (\Delta t)^2$

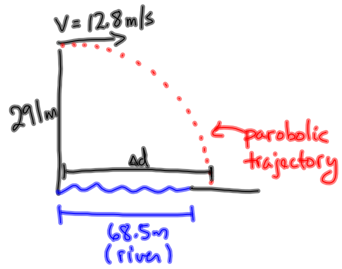
$\Delta d = v_2 \Delta t - \frac{1}{2} a (\Delta t)^2$

$v_2^2 = v_1^2 + 2a\Delta d$

} everything is vertical (a, v_1, v_2, Δd)

Projectiles Launched Horizontally

mp|534



Horizontally, the velocity is always 12.8 m/s.

Vertically, the velocity is initially zero and is constantly changing due to the acc of gravity

Vertically

$\Delta d = -291\,m$

$v_1 = 0$

$a = -9.81\,m/s^2$

$\Delta t = ?$

$\Delta d = v_1\Delta t + \frac{1}{2}a(\Delta t)^2$ ($v_1 = 0$)

$\Delta d = \frac{1}{2}a(\Delta t)^2$

$\frac{2\Delta d}{a} = (\Delta t)^2$

$\frac{2(-291\,m)}{-9.81\,m/s^2} = (\Delta t)^2$

$\Delta t = 7.70\,s$

Horizontally

$v = \frac{\Delta d}{\Delta t}$

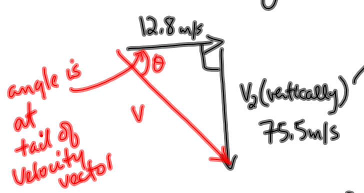
$\Delta d = v\Delta t$

$\Delta d = (12.8\,m/s)(7.70\,s)$

$\Delta d \doteq 98.6\,m$

a) Since 98.6m > 68.5m, the rock lands on the other side of the river.

b) At the instant the rock hits the ground, it is moving both horizontally and vertically.



vertically:

$a = \frac{\Delta v}{\Delta t}$

$a = \frac{v_2 - v_1}{\Delta t}$

$v_2 = v_1 + a\Delta t$

$v_2 = 0 - 9.81\,m/s^2(7.70\,s)$

$v_2 = -75.5\,m/s$

$v^2 = (12.8\,m/s)^2 + (75.5\,m/s)^2$

$v \doteq 76.6\,m/s$

$\tan\theta = \frac{75.5\,m/s}{12.8\,m/s}$

$\theta \doteq 80.4°$

The velocity at impact is 76.6m/s [80.4° (to) below the horizontal]

horizontal ⇄ Δt ⇄ vertical

TO DO: PP|536-537