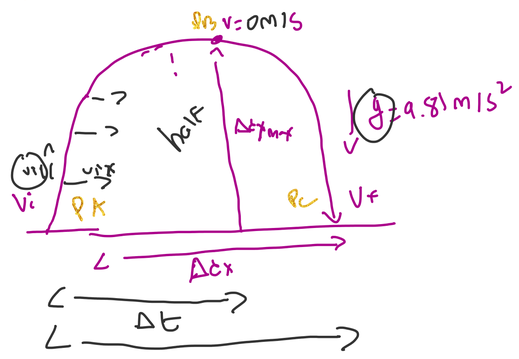
Projectile motion P1

Wednesday, October 16, 2024 1:48 PM

Case 1:



Case Basic Rules:

t to go from $P_A \to P_B$

$= \frac{V \sin\theta}{g} \leftarrow v_{iy} = \left(\frac{v_{iy}}{g}\right) 2$

t to go from $P_A \to P_C$

$= \frac{2 V \sin\theta}{g}$

$\Delta d_{y\,max} = \frac{v^2 \sin^2\theta}{2g}$ → Height max $\frac{(V\sin(\theta))^2}{2g}$

$\Delta d_x (R) = \frac{v^2 \sin(2\theta)}{g}$

General Rule:

→ v_{ix} is constant

∴ $v_{ix} = v_{fx}$

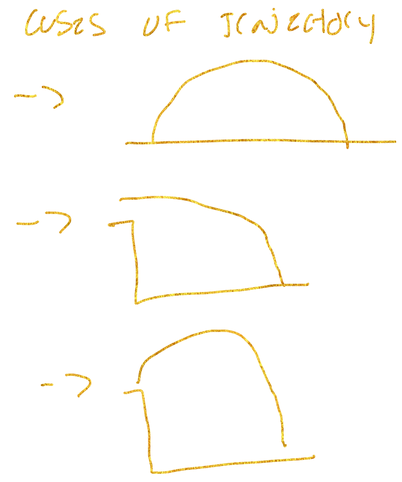
→ a_y(g) changes v_y but there is no a_x so v_x is constant

→ If there is an angle for v

$\cos\theta = \frac{v_x}{v}$ $\sin\theta = \frac{v_y}{v}$

$v_x = v\cos\theta$ $v_y = v\sin\theta$

→ 3 cases of Trajectory



Ex: Soccer player kicks a ball with initial velocity of 25m/s at an angle of 40° above the horizontal. Calculate time of flight (Δt) and Range (Δd_x)

(1) write givens/unknowns

Givens: $V_i = 25 m/s$ $a_y = 9.81 m/s^2$

$\theta = 40°$

unknowns:

$v_{iy} = ?$ $\Delta t = ?$

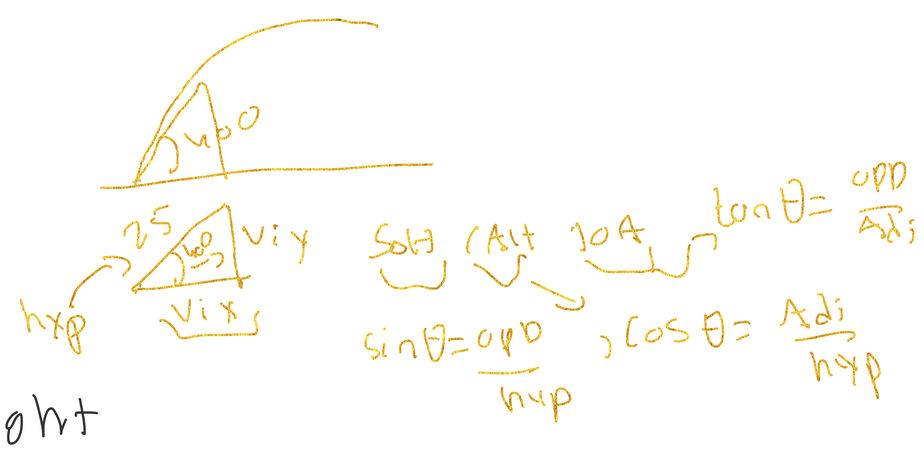
$v_{ix} = ?$ $\Delta d_x = ?$

(2) Determine vertical/horizontal components of V_i

$V_{iy} = V\sin\theta \leftarrow$ $V_{ix} = V\cos\theta \leftarrow$

$= 25\sin 40$ $= 25\cos 40$

$= 16.07 m/s$ $= 19.15 m/s$



(3) Calculate Δt: ← total time of flight

$\Delta t = \frac{2 V_i \sin\theta}{g}$

$\Delta t = \frac{2(25\sin 40)}{9.81}$ ✓ $\Delta t = 3.28 s$

(4) Calculate Range (Δd_x)

$\Delta d_x = \frac{v_i^2 \sin(2\theta)}{g}$

$= \frac{25^2 \sin(2(40))}{9.81}$

$= 62.74 m$