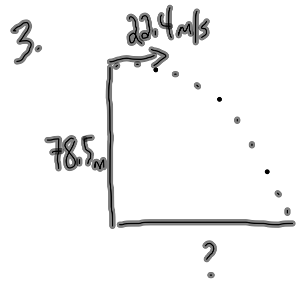
From Hw

PP| 536

3.



Vertically (constant acc)

$v_1 = 0$

$\Delta d = -78.5m$

$a = -9.81 m/s^2$

$\Delta t = ?$

$\Delta d = \cancel{v_1 t}^{\,0} + \frac{1}{2}at^2$

$\Delta d = \frac{1}{2}at^2$

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

$t^2 = \frac{2(-78.5m)}{-9.81m/s^2}$

$\boxed{t \doteq 4.00s}$

Horizontally (constant v)

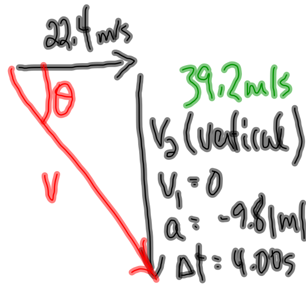
$v = \frac{\Delta d}{\Delta t}$

$\Delta d = v\Delta t$

$\Delta d = (22.4m/s)(4.00s)$

a) $\boxed{\Delta d \doteq 89.6m}$

b) The velocity at impact:



v_2 (vertical)

$v_1 = 0$

$a = -9.81m/s^2$

$\Delta t = 4.00s$

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

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

$a\Delta t = v_2 - v_1$

$v_2 = \cancel{v_1}^{\,0} + a\Delta t$

$v_2 = (-9.81m/s^2)(4.00s)$

$v_2 = -39.2m/s$ (− = down)

$\vec{v}_2 = 39.2m/s$ [down]

$v^2 = a^2 + b^2$

$v^2 = (22.4m/s)^2 + (39.2m/s)^2$

$\boxed{v \doteq 45.1m/s}$

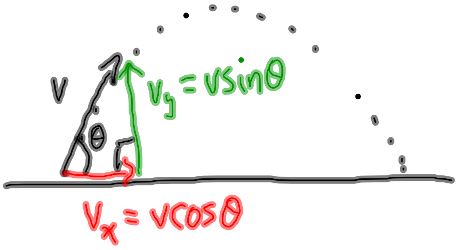
$\tan\theta = \frac{39.2m/s}{22.4m/s}$

$\boxed{\theta \doteq 60.3^\circ}$

The velocity at impact is 45.1m/s [60.3° below the horizontal]

Symmetrical Trajectories

Consider a projectile that returns to the same level:



Vertically (constant acc)

$v_1 = v\sin\theta$
$\Delta d = 0$
$a = -g$

} $\Delta t = ?$

$$\Delta d = v_1 t + \frac{1}{2}at^2$$

$$0 = (v\sin\theta)t - \frac{g}{2}t^2$$

$$0 = t\left(v\sin\theta - \frac{g}{2}t\right)$$

~~$t = 0$~~ and $v\sin\theta - \frac{g}{2}t = 0$

$$v\sin\theta = \frac{g}{2}t$$

$$t = \frac{2v\sin\theta}{g}$$

Horizontally (constant v)

$v_x = v\cos\theta$
$t = \frac{2v\sin\theta}{g}$

} $\Delta d_x = ?$

$$v_x = \frac{\Delta d_x}{\Delta t}$$

$$\Delta d_x = v_x \Delta t$$

$$\Delta d_x = (v\cos\theta)\left(\frac{2v\sin\theta}{g}\right)$$

$$\Delta d_x = \frac{v^2\, 2\sin\theta\cos\theta}{g}$$

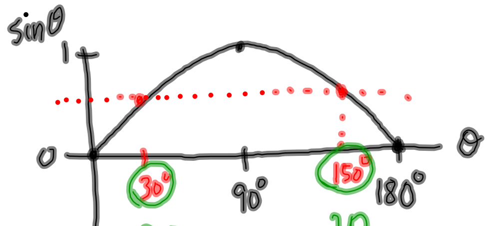
$2\sin\theta\cos\theta \rightarrow \sin 2\theta$

"range" of a projectile →

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

If $2\theta = 90°$
maximum range
$\theta = 45°$
(launch angle)

Range: $\Delta d_x = \dfrac{v^2 \sin 2\theta}{g}$



$2\theta \rightarrow \theta = 15°$ (launch θ)

$2\theta \rightarrow \theta = 75°$ (launch θ)

A launch angle of 15° and a launch angle of 75° will have the same range.

⇒ Complementary launch angles will have the same range.

Maximum height ⇒ vertically (constant acc)

$v_1 = v\sin\theta$

$v_2 = 0$ (at max height)

$\Delta d = h$ ⇒ ??

$a = -g$

$\Delta t = \left(\dfrac{2v\sin\theta}{g}\right)\dfrac{1}{2} = \dfrac{v\sin\theta}{g}$ ← only $\frac{1}{2}$

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

$\dfrac{v_1 + v_2}{2} = \dfrac{\Delta d}{\Delta t}$

$\dfrac{v\sin\theta + 0}{2} = \dfrac{h}{\left(\frac{v\sin\theta}{g}\right)}$

$\dfrac{v\sin\theta}{2} = \dfrac{h}{\left(\frac{v\sin\theta}{g}\right)}$

$\dfrac{v^2\sin^2\theta}{2g} = h$

$\dfrac{(v\sin\theta)^2}{2g}$ $\dfrac{v^2(\sin\theta)^2}{2g}$

TO DO

1. Be sure PP|536 + PP|543
2. Look over MP|542 + MP|547
3. PP|549
4. Assignment: p570|15-20 (due Thurs)
5. Quiz (Projectiles) - FRI