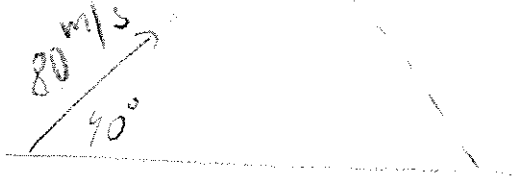
Example1: An object is thrown from the ground with initial velocity of 80m/s [40° above horizontal]. Find its maximum eight and its range.

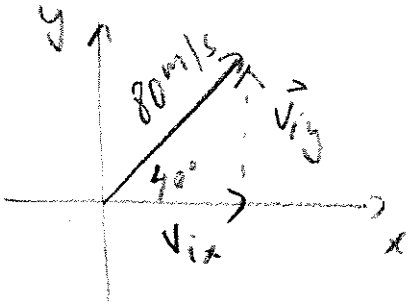
Given: $\vec{v}_i = 80\ m/s\ [40°\ above\ horizontal]$

$a_y = g = -9.8\ m/s^2$

Diagram:



Vector diagram of v_i:



Vector components of v_i:

$\vec{v}_{ix} = 80 \cdot \cos 40°$

$= 61.2836\ m/s\ [\rightarrow$

$\vec{v}_{iy} = 80 \cdot \sin 40°$

$= 51.4230\ m/s\ [\uparrow$

Time to reach maximum height:

$$t_{h_{max}} = \frac{v_{fy} - v_{iy}}{g} = \frac{0 - 51.4230}{-9.8} = 5.24725 \doteq \underline{5.2\ s}$$

Maximum height:

$$h_{max} = \frac{v_{fy}^2 - v_{iy}^2}{2a_y} = \frac{0^2 - 51.4230^2}{2(-9.8)} = 134.914\ldots\ m \doteq \underline{1.3 \times 10^2\ m}$$

Time in the air:

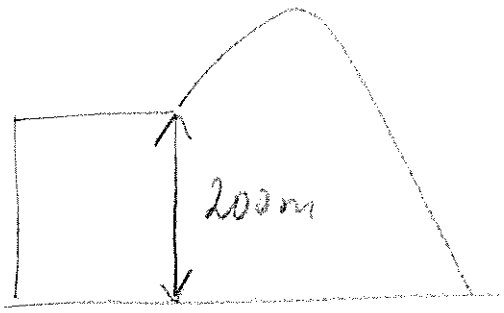
$t_{air} = 2t_{h_{max}} = 2(5.2472\ldots) = \underline{1.0 \times 10^1\ s}$ OR $10.5\ s$

Range:

$d_x = v_{ix} \cdot t_{air}$

$= (61.2836)(10.4945) \doteq \underline{6.4 \times 10^2\ m}$

Example 2: In your notebook solve the above problem with a projectile launched 200 m above the ground level. Assume that the projectile lands on the ground. Compare your results with ex. 1.



⇒ lands below it launching level ⇒ $t_{fall} \uparrow \Rightarrow t_{air} \uparrow$

$\vec{d}_y = -(134.9145 + 200)\,m$

$= -334.9145\,m$

$t_{fall} = \sqrt{\frac{2(-334.9145)}{-9.8}}$

$t_{fall} \doteq 8.2674\,s$

$t_{air} = t_{h_{max}} + t_{fall}$

$= 5.2472 + 8.2674$

$= 13.5146\,s$

$\doteq 14\,s$

range: $d_x = v_x \cdot t_{air}$

$= (61.2836)(13.5146)$

$\doteq 828.2233\,m$

$\doteq 8.3 \times 10^2\,m$

∴ Comparison: the range increases from $6.4 \times 10^2\,m$ to $8.3 \times 10^2\,m$ because the time total increases due to longer free fall from 10.5 s to 13.5 s.