PROBLEM SOLVING

PROJECTILE PROBLEMS

\[ U_x = \text{const} = U_0 x \]

Usually (not always)

Horizontal motion gives info about vertical motion

OR

Vertical motion gives info about horizontal motion
23) \( U_0 = U_0x = U_x = 200 \text{ mph} = 89.4 \text{ m/s} \)
\( U_{oy} = 0 \)

\[ \text{GIVEN: } x, U_0 \text{ NEED: } y \] \( (\text{HORIZ}) \) \( (\text{VERT}) \)

\[ \text{TIME TO FLY 100 m } \quad x = U_0x t \quad t = x/U_0x = 100/89.4 = 1.125 \text{ s} \]

\[ \text{FALLING ALL THIS TIME (START } y = 0) \]

\[ \text{USE } y = U_{oy} t - \frac{1}{2} g t^2 \quad U_{oy} = 0! \]

\[ y = \frac{1}{2} g t^2 = -\frac{1}{2} g \left( \frac{x}{U_0x} \right)^2 \]

\[ y = -6.13 \text{ m} \]

\[ \text{FALLS } 6.13 \text{ m} \]

\[ \text{HORIZ } \Rightarrow t \]

\[ t \ (\text{VERT}) \Rightarrow y \]
26)

$y = 0$

$u_0 = 5 \text{ m/s}$

$y = -1.5 \text{ m}$

$h = 1.5 \text{ m}$

$\text{VERT: } v_{oy} = 0 \Rightarrow y = v_{oy}t - \frac{1}{2} gt^2$

$-h = -\frac{1}{2} gt^2$

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

$t = \sqrt{\frac{2h}{g}}$

$x = u_0 t = u_0 \sqrt{\frac{2h}{g}} = 5 \times \sqrt{\frac{2 \times 1.5}{9.8}}$

$x = 2.8 \text{ m}$
26) VELOCITY:
\[ \vec{u}_x = \vec{u}_0 x = \vec{u}_0 = 5 \, \text{m/s} \]

\[ \text{EITHER:} \quad u_y = u_{0y} - gt = -9 \sqrt{\frac{2h}{9}} \]
\[ = -\frac{\sqrt{2gh}}{9} = -\frac{\sqrt{2gh}}{9} \]
\[ = -5.4 \, \text{m/s} \downarrow u_y. \]

\[ \text{OR:} \quad u_y = \vec{u}_{0y} - 2gy \]
\[ = -2g(-h) = 2gh \]
\[ u_y = \pm \sqrt{2gh} \]
\[ = -\sqrt{2gh} = -5.4 \, \text{m/s} \]
2 g) \[ y = 0 \quad v_0 = 15 \, \text{m/s} \quad \theta = 25^\circ \]

GIVEN: \( v_0, t \)

NEED: \( y \)

\[
y = -h
\]

\[
y = 0
\]

ALL WE NEED IS: \( v_0 y = v_0 \sin \theta \)

THEN: \[
y = v_0 y t - \frac{1}{2} g t^2
\]

\[
y = 15 \times 5 \sin 25^\circ \times 3 - \frac{1}{2} \times 9.8 \times 3^2 = -25 \, \text{m}
\]

\[
h = 25 \, \text{m}
\]
(1) SEE LECTURE NOTES:

\[ x_{\text{max}} = R = \frac{v_0^2}{g} \quad (x = \frac{2v_0^2 \sin \theta \cos \theta}{g}) \]

**GIVEN R:**

\[ v_0^2 = Rg \]

\[ v_0 = \sqrt{Rg} \]

**THROW BALL UP WITH \( v_0 \): HOW HIGH?**

\[ v^2 = v_0^2 - 2gy \quad \text{WITH} \quad v = 0 \]

\[ 0 = v_0^2 - 2gy \quad \Rightarrow \quad 2gy = v_0^2 \]

\[ y = \frac{v_0^2}{2g} = \frac{Rg}{2g} = \frac{R}{2} \]

\[ y = \frac{R}{2} \]