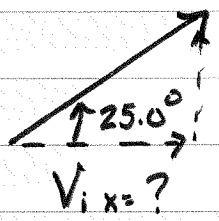
AP Physics - 2 Dimensional Review

1) Given:



Soln:

$V_{ix} = V_i \cos\phi$

$= (165.0 \text{ km/h}) \cos 25.0$

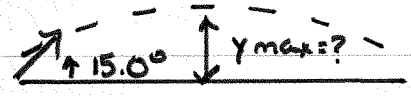
$\boxed{V_{ix} = 150. \text{ Km/h}}$

$V_{iy} = V_i \sin\phi$

$= (165.0 \text{ Km/h}) \sin 25.0$

$\boxed{V_{iy} = 69.7 \text{ Km/h}}$

2) Given:



$\Delta y = 0$

I know

y_{max} @ $\Delta t = \frac{\Delta}{2}$

Soln:

x-dir

① $V_{ix} = \frac{\Delta x}{\Delta t}$?

$V_{ix} = V_i \cos\phi$

$V_i \cos\phi = \frac{\Delta x}{\Delta t}$

$\Delta t = \frac{\Delta x}{V_i \cos\phi}$

y-dir

② $V_y = V_{iy} - gt$

At y_{max}

$V_y = 0$, $\Delta t = \frac{\Delta t}{2}$

$V_{iy} = V_i \sin\phi$

$0 = V_i \sin\phi - g \frac{\Delta t}{2}$?

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

③ Sub in Δt from x-direction

$V_i = \frac{g\,\Delta x}{V_i \cos\phi\, 2\sin\phi}$

$V_i^2 = \frac{g\,\Delta x}{2\cos\phi \sin\phi}$

② continued

X-dir

④ $\Delta t = \frac{\Delta x}{V_i \cos\theta}$

$= \frac{350.2\text{ m}}{82.9\text{ m/s}\cos 15.0^\circ}$

$\Delta t = 4.37\text{ s}$

Y-direction

$V_i^2 = \frac{(9.8\text{ m/s}^2)(350.2\text{ m})}{2(\sin 15.0^\circ)(\cos 150^\circ)}$

$V_i = 82.9\text{ m/s}$

⑤ $\Delta y = V_{iy} t - \frac{1}{2} g t^2$

y_{max} @ $\frac{\Delta t}{2}$

$V_{iy} = V_i \sin\theta$

$y_{max} = V_i \sin\theta\, t/2 - \frac{1}{2} g \left(\frac{\Delta t}{2}\right)^2$

$= 82.9\text{ m/s}(\sin 15.0^\circ)\left(\frac{4.37\text{ s}}{2}\right) - \frac{1}{2}(9.8\text{ m/s})\left(\frac{4.37\text{ s}}{2}\right)^2$

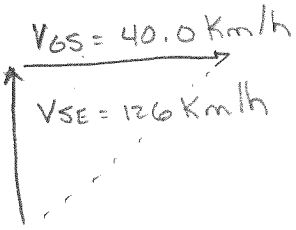
$= 46.9\text{ m} - 23.4\text{ m}$

$\boxed{\Delta y_{max} = 23.5\text{ m}}$

3) Given: $V_{SE} = 126$ Km/h North
$V_{GS} = 40.0$ Km/h EAST

Find: $V_{GE} = ?$

Soln:



$$V_{GE}^2 = V_{GS}^2 + V_{SE}^2$$

$$V_{GE} = \sqrt{(40.0\ \text{Km/h})^2 + (126\ \text{Km/h})^2}$$

$$\boxed{V_{GE} = 132\ \text{Km/h}}$$

$$\emptyset = \text{TAN}^{-1}\left(\frac{40.0}{126}\right)$$

$\emptyset = 17.6°$ EAST of North
or
72.4° North of East

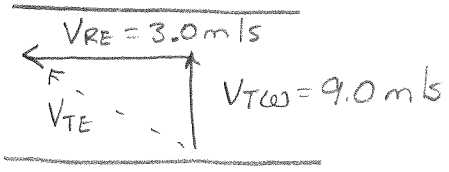
4) Given:
$V_{TW} = 9.0$ m/s Across River

$V_{RE} = 3.0$ m/s
$\Delta t = 1.0$ min

Find: $\Delta X = ?$

Soln:

$$V_{TE} = \frac{\Delta X}{\Delta t} \Rightarrow \Delta X = V_{TE}\,\Delta t$$



$$V_{TE}^2 = V_{RE}^2 + V_{TW}^2$$

$$= \sqrt{(3.0\text{m/s})^2 + (9.0\text{m/s})^2}$$

$$V_{TE} = 9.5\ \text{m/s}$$

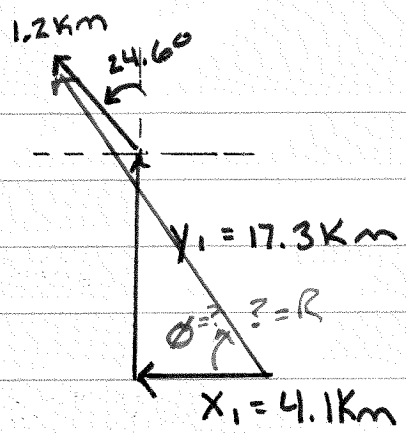
$$\Delta X = \left(\frac{9.5\text{m}}{\text{s}}\right)\left(\frac{60\text{sec}}{\text{min}}\right)(1.0\text{min})$$

$$\boxed{\Delta X = 570\text{m}}$$

$$\emptyset = \text{TAN}^{-1}\left(\frac{3.0}{9.0}\right)$$

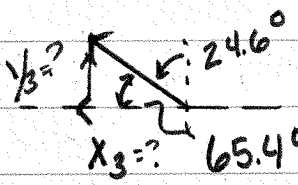
$$\boxed{\emptyset = 18°}$$

5) Given:



Find: Resultant displacement?

Soln:



$x_3 = R\cos\emptyset$ $\quad y_3 = R\sin\emptyset$

$= 1.2Km \cos 65.4°$ $\quad = 1.2Km \sin 65.4°$

$x_3 = 0.50m$ $\quad y_3 = 1.1Km$

$x_T = x_1 + x_2 + x_3$

$= 4.1Km + 0 + 0.50m$

$x_T = 4.6Km$

$y_T = y_1 + y_2 + y_3$

$= 0 + 17.3Km + 1.1Km$

$y_T = 18.4Km$

$d^2 = x_T^2 + y_T^2$

$= (4.6Km)^2 + (18.4Km)^2$

$d = 19.0Km$

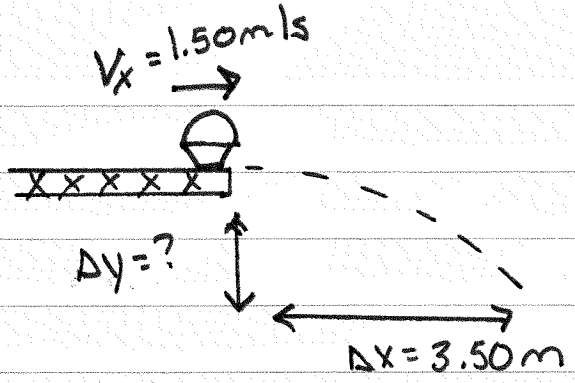
@ 76° North of West

$\emptyset = \tan^{-1} \frac{y_T}{x_T}$

$= \tan^{-1} \frac{18.4}{4.6}$

$= 76°$

6) Given:



$g = 9.8 m/s^2$

Soln:

X-dir

$V_x = \frac{\Delta x}{\Delta t}$?

$\Delta t = \frac{\Delta x}{V_x}$

$= \frac{3.50 m}{1.50 m/s}$

$\Delta t = 2.33 s$

Y-dir

$\Delta y = V_{y_i}^{0} t - \frac{1}{2} g t^2$

$\Delta y = -\frac{1}{2} g t^2$

$= -\frac{1}{2}(9.8 m/s^2)(2.33)^2$

$\boxed{\Delta y = -26.6 m}$

7) D

Reason: Because the object is a projectile

- It can move Both Hoz & Vertically
- It has a NONzero initial Hoz Velocity $V_x \neq 0$

But the problem is asking only About Vertical Component

we can ignore Hoz velocity

- It has a constant acceleration of $-g$ due to gravity

1st graphs V vs. Time if a is constant, slope of $\frac{\Delta V}{\Delta t}$ is a

choose up a + direction

Correct options are A, B, D

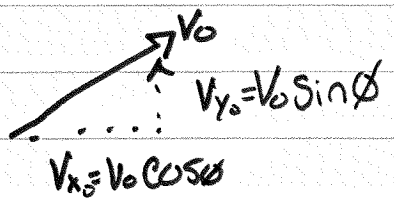
2nd graph a vs. Time

we know a is constant so A, B out!

accel is Not $\emptyset$ ∴ C out

D only Choice

8) A) Find: $t = ?$



$$V_x = \frac{d}{t}$$

$$V_x = V_0 \cos\phi$$

$$V_0 \cos\phi = \frac{d}{t}$$

$$\boxed{t = \frac{d}{V_0 \cos\phi}}$$

B) Find: $V_y = ?$

$$V_y = V_{y0} - gt$$

$$V_{y0} = V_0 \sin\phi$$

$$V_y = V_0 \sin\phi - gt$$

$$t = \frac{d}{V_0 \cos\phi}$$

$$\boxed{V_y = V_0 \sin\phi - \frac{gd}{V_0 \cos\phi}}$$