Answers- Week 3

3-1. (i) Because it has a constant acceleration of $\underset{\rightarrow}{a} = -9.8\ m/s^2\ \hat{y}$, the velocity reduces and at the highest point $\underset{\rightarrow}{V} = 0$.

(ii) The acceleration is constant $\underset{\rightarrow}{a} = -9.8\ m/s^2\ \hat{y}$

(iii) $V^2 = V_i^2 - 19.6(y - y_i)$

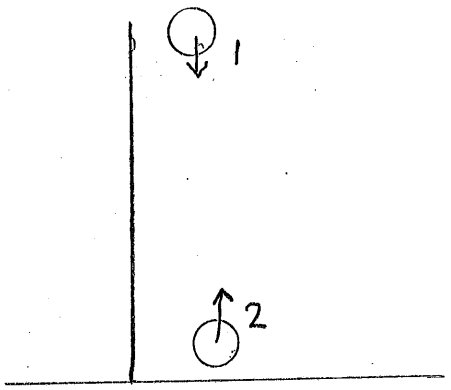
$Y_{top} = 20.4m$

(iv) $y = y_i + V_i t - 4.9t^2$

$tgr = \dfrac{V_i}{4.9} = 4.1\ sec$

(v) $\underset{\rightarrow}{V} = (V_i - 9.8t)\hat{y}$

$\underset{\rightarrow}{V} = -20m/s\ \hat{y}$



3-3. $y_1 = 20 - 4.9t^2$

$y_2 = 15t - 4.9t^2$

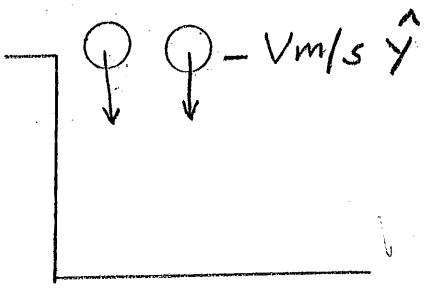
They cross when $y_1 = y_2$

$t = \dfrac{20}{15} = 1.33\ sec$

$y_1 = y_2 = 11.3m$

3-5. $t = \sqrt{\dfrac{20}{4.9}} = 2.02sec$

$v = 14.6m/s$



3-7. $y_t = h - 4.9t_1^2$

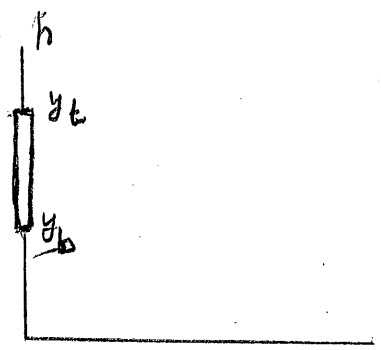
$y_b = h - 4.9\ (t_1 + 0.5)^2$

$4.9\ (t_1 + 0.5)^2 - 4.9t_1^2 = 2m$

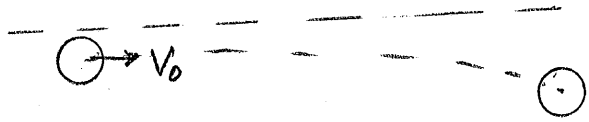
$t_1 = 0.16sec$

$h - y_t = 4.9 \times (0.16)^2$

$= 0.125m$



3-9. Use the formula of Problem 3-8



$$y = y_0 + \tan\theta_0 - 4.9\left(\frac{x}{V_o Cos\theta_o}\right)^2$$

$\theta_o = 0$ $\qquad$ $V_0 = 90\text{mph} = 40.25\text{m/s}$

$$y - y_0 = -4.9\left(\frac{18}{40.25}\right)^2 = -0.98\text{m}$$

3-11. x – vel. const x = $V_i Cos\theta_i$

Time of flight

$$\text{tgr} = \frac{2V_i Sin\theta_i}{9.8}$$

$$R = \frac{2V_i^2 Sin\theta_i Cos\theta_i}{9.8}$$

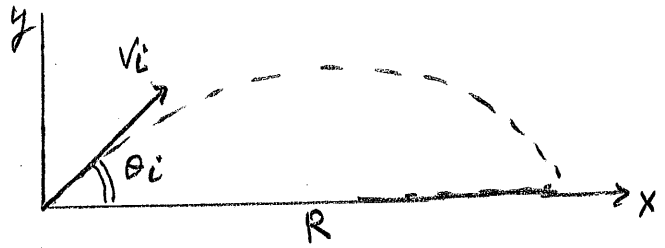
$$= \frac{V_i^2 Sin\theta_i}{9.8}$$

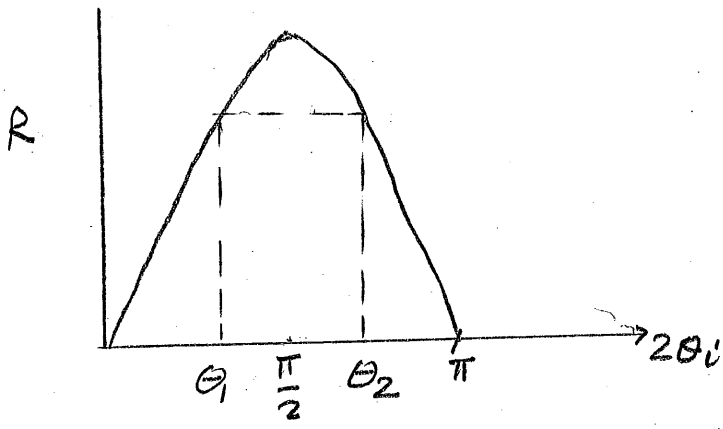
Plot R vs $2\theta_i$

R is maximum

at $\theta_1 = \frac{\pi}{4}$

at $R(\theta_1) = R(\theta_2)$





3-13. $\underrightarrow{V}_{BS} = \underrightarrow{V}_{BW} + \underrightarrow{V}_{WS}$

Downstream

$$\Delta t_d = \frac{100}{600 + 500}\,hrs$$

$\underrightarrow{V}_{BS} = (600\text{m/hr} + 500\text{m/hr})\,\hat{x}$

Upstream

$\underrightarrow{V}_{BS} = (-600\text{m/hr} + 500\text{m/hr})\,\hat{x}$

$$\Delta t_d = \frac{-100}{-600 + 500}\,hrs$$

Total time $\Delta t_d + \Delta t_u = (0.09 + 1)$ hrs.

3-15. An observer or system is said to be inertial if it has NO acceleration. If it has any velocity, neither the magnitude nor the direction is allowed to change.