Chapter 3 Homework 3

chapter 3

Homework - 3 [8, 10, 17, 31, 46, 53]

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Q8] a] $\vec{V_1} = -6.0\hat{i} + 8.0\hat{j}$ $V_1 = \sqrt{6.0^2 + 8.0^2} = \boxed{10.0}$

$\theta = \tan^{-1}\frac{8.0}{-6.0} = \boxed{127^\circ}$

b] $\vec{V_2} = 4.5\hat{i} - 5.0\hat{j}$ $V_2 = \sqrt{4.5^2 + 5.0^2} = \boxed{6.7}$

$\theta = \tan^{-1}\frac{-5.0}{4.5} = \boxed{312^\circ}$

c] $\vec{V_1} + \vec{V_2} = (-6.0\hat{i} + 8.0\hat{j}) + (4.5\hat{i} - 5.0\hat{j}) = -1.5\hat{i} + 3.0\hat{j}$

$|\vec{V_1} + \vec{V_2}| = \sqrt{1.5^2 + 3.0^2} = \boxed{3.4}$

$\theta = \tan^{-1}\frac{3.0}{1.5} = \boxed{117^\circ}$

d] $\vec{V_2} - \vec{V_1} = (4.5\hat{i} - 5.0\hat{j}) - (-6.0\hat{i} + 8.0\hat{j}) = 10.5\hat{i} - 13.0\hat{j}$

$|\vec{V_2} - \vec{V_1}| = \sqrt{10.5^2 + 13.0^2} = \boxed{16.7}$ $\theta = \tan^{-1}\frac{-13.0}{10.5} = \boxed{309^\circ}$

Q10] $A_x = 44.0 \cos 28.0^\circ = 38.85$

$A_y = 44.0 \sin 28.0^\circ = 20.66$

$B_x = -26.5 \cos 56.0^\circ = -14.82$

$B_y = -26.5 \sin 56.0^\circ = +21.97$

$C_x = 31.0 \cos 270^\circ = 0.0$

$C_y = 31.0 \sin 270^\circ = -31.0.$

a] $(\vec{A}+\vec{B}+\vec{C})_x = 38.85 + (-14.82) + 0.0 = \boxed{24.03} = \boxed{24.0}$

$(\vec{A}+\vec{B}+\vec{C})_y = 20.66 + 21.97 + (-31.0) = \boxed{11.63} = \boxed{11.6}$

b] $|\vec{A}+\vec{B}+\vec{C}| = \sqrt{(24.03)^2 + (11.63)^2} = \boxed{26.7}$

$\theta = \tan^{-1}\frac{11.63}{24.03} = \boxed{25.8^\circ}$

17] $\vec{r} = (9.60t\hat{i} + 8.85\hat{j} - 1.00t^2\hat{k})\,m \rightarrow$

$\vec{v} = \frac{d\vec{r}}{dt} = (9.60\hat{i} - 2.00t\hat{k})\,m/s \rightarrow$

$\vec{a} = \frac{d\vec{v}}{dt} = \boxed{-2.00\hat{k}\ m/s^2}$

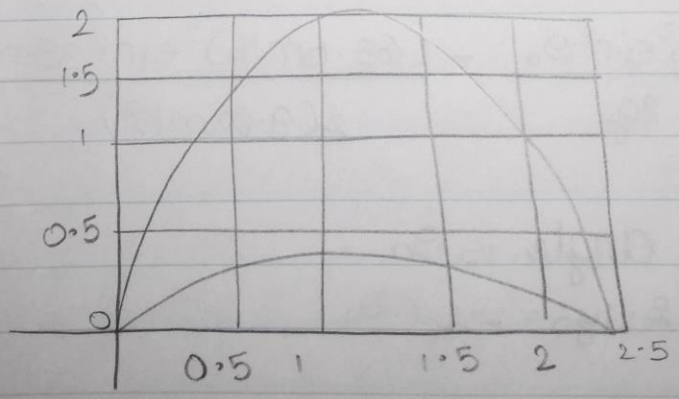
31] Apply the range formula

$R = \frac{v_0^2 \sin 2\theta_0}{g} \rightarrow \sin 2\theta_0 = \frac{Rg}{v_0^2} = \frac{(2.5m)(9.80m/s^2)}{(6.5m/s)^2}$

$= \boxed{0.5799}$

$2\theta = \sin^{-1} 0.5799 \rightarrow \theta_0 = \boxed{18.72^\circ}$

The reason for two angle as they have same range for example if one angle is $\theta = 45^\circ + \delta$ then $\theta = 45^\circ - \delta$



46] $v_0 = 65.0 \text{ m/s}$; $\theta_0 = 35.0°$, $a_y = -g$, $y_0 = 115 \text{ m}$,

$v_{y_0} = v_0 \sin\theta_0$

a] $y = y_0 + v_{y_0} t + \frac{1}{2} a_y t^2 \rightarrow 0 = y_0 + v_0 \sin\theta t - \frac{1}{2} g t^2 \rightarrow$

$$t = \frac{-v_0 \sin\theta_0 \pm \sqrt{v_0^2 \sin^2\theta_0 - 4(-\frac{1}{2}g) y_0}}{2(-\frac{1}{2}g)} = 9.964 \text{ s}, \; -2.3655 \text{ s} =$$

$\boxed{9.96 \text{ s}}$

b] $\Delta x = v_x t = (v_0 \cos\theta_0) t = (65.0 \text{ m/s})(\cos 35.0°)(9.964 \text{ s}) = \boxed{531 \text{ m}}$

c] $v_x = v_0 \cos\theta_0 = (65.0 \text{ m/s}) \cos 35.0° = \boxed{53.2 \text{ m/s}}$

$v_y = v_{y_0} + at = v_0 \sin\theta_0 - gt = (65.0 \text{ m/s}) \sin 35.0° - (9.80 \text{ m/s}^2)(9.964 \text{ s}) = \boxed{-60.4 \text{ m/s}}$

d] from part c

$v = \sqrt{v_x^2 + v_y^2} = \sqrt{(53.2 \text{ m/s})^2 + (-60.4 \text{ m/s}^2)} = \boxed{80.5 \text{ m/s}}$

e] $\theta = \tan^{-1} \frac{v_y}{v_x} = \tan^{-1} \frac{-60.4}{53.2} = \boxed{-49.6°}$ So below the horizon

f] $v_y^2 = v_{y_0}^2 + 2a_y (y - y_0) \rightarrow 0 = v_0^2 \sin^2\theta_0 - 2gy_{max}$

$$y_{max} = \frac{v_0^2 \sin^2\theta_0}{2g} = \frac{(65.0 \text{ m/s})^2 \sin^2 35.0°}{2(9.80 \text{ m/s}^2)} = \boxed{70.9 \text{ m}}$$

53] Launching angle is θ_a

$a_y = -g$ & $v_{y_0} = v_0 \sin\theta_0$

a] $v_y^2 = v_{y0}^2 + 2a_y(y - y_0)$ with $v_y = 0$ at the max

$y_{max} = 0 + \frac{v_y^2 - v_{y0}^2}{2a_y} = \frac{-v_0^2 \sin^2\theta_0}{-2g} = \frac{v_0^2 \sin^2\theta_0}{2g}$

$= \frac{(46.6\,m/s)^2 \sin^2 42.2°}{2(9.80\,m/s^2)} = \boxed{50.0\,m}$

b] total displacement of 0 for the ball to reach the ground, $y = y_0 + v_{y0}t + \frac{1}{2}a_y t^2 \rightarrow 0 = v_0 \sin\theta_0 t - \frac{1}{2}gt^2 \rightarrow$

$t = \frac{2v_0 \sin\theta_0}{g} = \frac{2(46.6\,m/s)\sin 42.2°}{(9.80\,m/s^2)} = \boxed{6.395}$ and $t = 0$

c] $\Delta x = v_x t = (v_0 \cos\theta_0)t = (46.6\,m/s)(\cos 42.2°)(6.395)$

$= \boxed{221\,m}$

d] $v_0 \cos\theta_0 = (46.6\,m/s)(\cos 42.2°) = 34.5\,m/s$

Vertical velocity $v_y = v_{y0} + at = v_0 \sin\theta_0 - gt$

$= (46.6\,m/s)\sin 42.2° - (9.80\,m/s^2)(1.50\,s) = 16.6\,m/s$

Speed of projectile is $v = \sqrt{v_x^2 + v_y^2} = \sqrt{34.5^2 + 16.6^2} = \boxed{38.3\,m/s}$

The direction above horizontal is given by $\theta = \tan^{-1}\frac{v_y}{v_x}$

$= \tan^{-1}\frac{16.6}{34.5} = \boxed{25.7°}$