HW 1

Chapter - 2

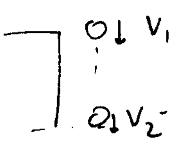
18.) a) $V_{avg} = \frac{\Delta x}{\Delta t} = \frac{2.5}{2} = 1.25 \ m/s$.

b) $V_{avg} = \frac{\Delta x}{\Delta t} = \frac{0}{4} = 0$

c) $V_{avg} = \frac{\Delta x}{\Delta t} = \frac{-2-0}{6} = -\frac{1}{3} \ m/s$

d) $V_{avg} = \frac{\Delta x}{\Delta t} = \frac{0-3}{4-3} = -3 \ m/s$

30.) Falling →

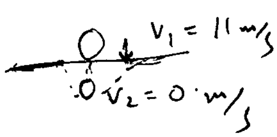


$$|a_{avg}| = \frac{|V_2 - V_1|}{t_2 - t_1} = \frac{|11 - 0| \ m/s}{1.12 - 0 \ s}$$

$$= 9.82 \ m/s^2$$

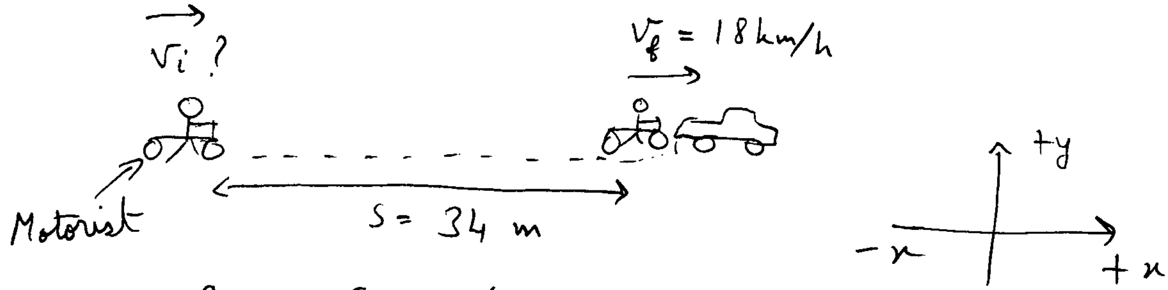
Deceleration while stopping →

$$|a_{avg}| = \frac{|V_2 - V_1|}{t_2 - t_1} = \frac{|0 - 11| \ m/s}{0.131 - 0 \ s}$$



$$= 83.97 \ m/s^2.$$

52.)



$a = -6.3\ m/s^2$

$t = ?$

a) $v_f^2 = v_i^2 + 2as$

$V_f = 18\ km/h = \frac{18 \times 1000}{3600}\ m/s$

$= 5\ m/s$

$\therefore\ 5^2 = V_i^2 + 2(-6.3)\,34$

$\Rightarrow V_i = 21.29\ m/s$

or

$V_i = 76.65\ km/h$

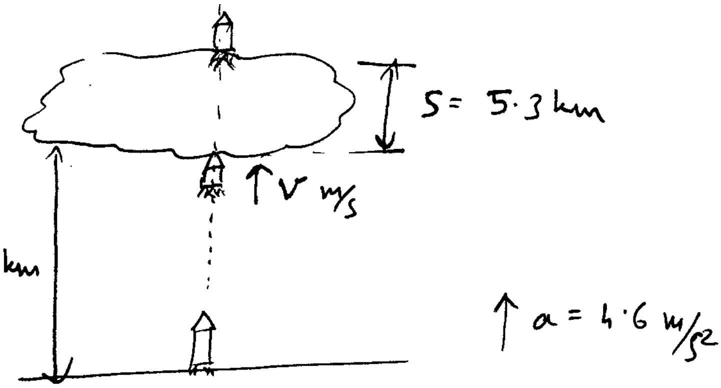
b) $V_f = V_i + at$

$\Rightarrow 5 = 21.29 + (-6.3)\,t$

$\Rightarrow t = \frac{5 - 21.29}{-6.3}\ s$

$\Rightarrow t = 2.59\ s$

78.)



Applying Newton's ~~First~~ Third Equation of Motion for Launching - Reaching Cloud part.

$$v^2 = 0^2 + 2as$$

$$\Rightarrow v = \sqrt{2 \times 4.6 \times 1.9 \times 10^3}$$

$$\Rightarrow v = 132.21 \text{ m/s}.$$

Now, Newton's Second Equation of Motion for Reaching Cloud - Crossing Cloud part

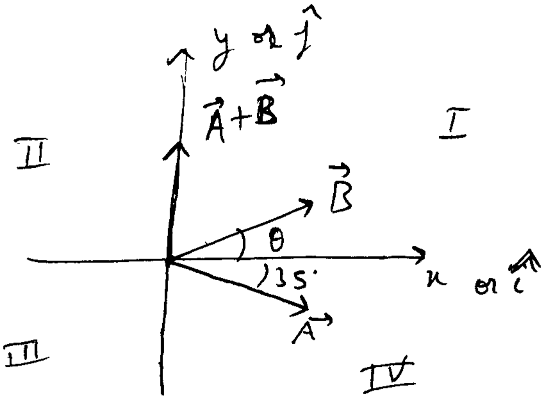
$$s = vt + \frac{1}{2}at^2$$

$$\Rightarrow 5.3 \times 10^3 = 132.21\, t + \frac{1}{2}(4.6)\, t^2$$

on solving,

$$t = 27.21 \text{ s}$$

Chapter - 3



8.) $\vec{A}+\vec{B}$ should be vertical.

$\therefore \quad (\vec{A}+\vec{B}) \cdot \hat{i} = 0.$

$\Rightarrow \quad A_x + B_x = 0.$

$\Rightarrow \quad B_x = -A_x$

$\Rightarrow \quad |B| \cos\theta = -|A| \cos(-35^\circ)$

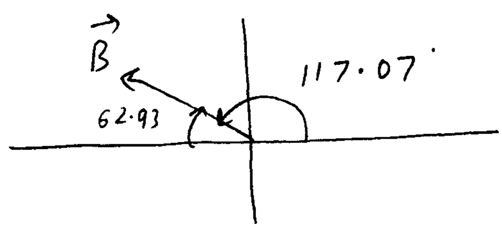
$\Rightarrow \quad \cos\theta = -\dfrac{1}{1.8} \cos 35^\circ$

Negative sign just implies that $\theta \in [90^\circ, 270^\circ]$, i.e. it is in III or IV quadrant.

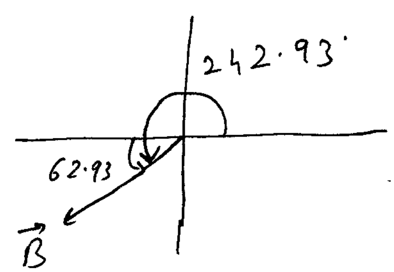
Solve $\quad \cos\theta = \left| \dfrac{1}{1.8} \cos 35^\circ \right|$

$\Rightarrow \quad \theta = 62.93^\circ$

$\therefore$ 2 Answers,

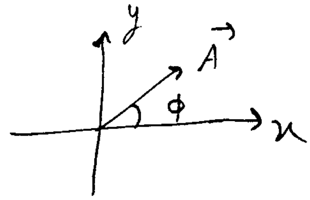


or



$\therefore \quad 117.07^\circ$ or 242.93°.

12.) $\vec{A} = 34\hat{i} + 13\hat{j}$ m



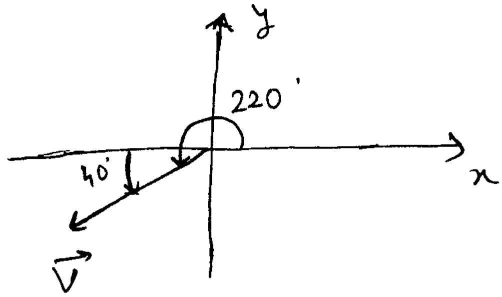
$|\vec{A}| = \sqrt{34^2 + 13^2}$

$= 36.4$ m

$\tan\phi = \frac{A_y}{A_x} = \frac{13}{34}$

$\Rightarrow \phi = \tan^{-1}\frac{13}{34} = 20.92^\circ$

28.)



$|\vec{V}| = 18$ m/s

$V_x = |\vec{V}| \cos\theta = |\vec{V}| \cos 220^\circ$

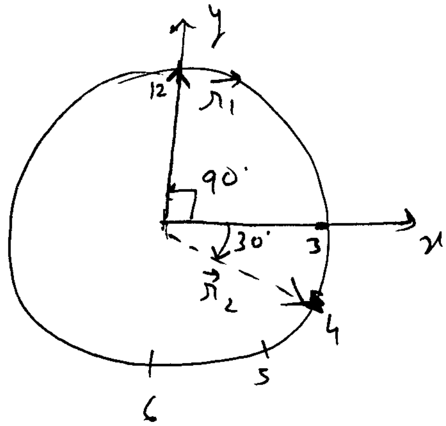
$\Rightarrow V_x = -18 \cos 40^\circ = 13.79$ m/s

$V_y = |\vec{V}| \sin 220^\circ$

$= -18 \sin 40^\circ$

$= 11.57$ m/s.

32.) $$\vec{V}_{avg} = \frac{\Delta \vec{r}}{\Delta t}$$



$$\vec{r}_1 = |\vec{r}_1| (\cos\theta_1 \hat{i} + \sin\theta_1 \hat{j})$$

where $\theta_1 = 90°$

$$\therefore \vec{r}_1 = 5.5 \hat{j} \text{ cm}$$

$$\vec{r}_2 = |\vec{r}_2| (\cos\theta_2 \hat{i} + \sin\theta_2 \hat{j})$$

$$= 5.5 (\cos(-30°) \hat{i} + \sin(-30°) \hat{j})$$

$$\{\because \theta_2 = -30°\}$$

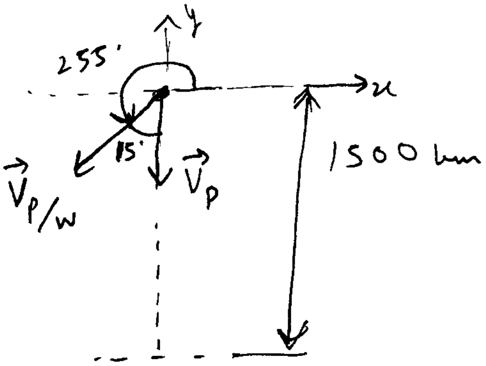
$$\therefore \vec{r}_2 = \left(\frac{5.5\sqrt{3}}{2} \hat{i} - \frac{5.5}{2} \hat{j}\right) \text{ cm}$$

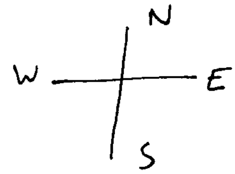
$$\therefore \vec{V}_{avg} = \frac{\Delta \vec{r}}{\Delta t} = \frac{\vec{r}_2 - \vec{r}_1}{t_2 - t_1}$$

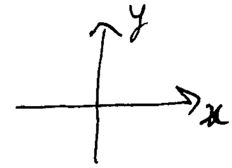
$$= \frac{\left(\frac{5.5\sqrt{3}}{2} \hat{i} - 5.5\left(\frac{3}{2}\right) \hat{j}\right) \text{ cm}}{20 \text{ min}}$$

$$= 0.238 \hat{i} - 0.4125 \hat{j} \text{ cm/min}$$

46.)







Given:

$\vec{V}_P \rightarrow$ Velocity of Plane (final)

$\vec{V}_W \rightarrow$ Velocity of wind

$$\left|\vec{V}_{P/W}\right| = 1000 \text{ km/h}$$

Velocity of Plane with respect to wind

$$|\vec{V}_P| = \frac{d}{t} = \frac{1500 \text{ km}}{100 \text{ min}}$$

$$= \frac{15\cancel{00}}{1\cancel{00}} \times 60 \text{ km/h}$$

$$= 900 \text{ km/h}$$

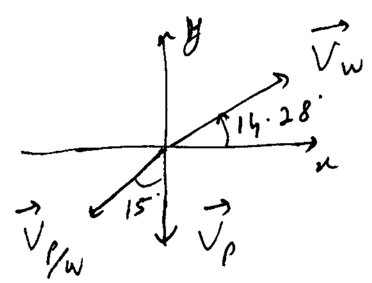
$$\therefore \quad \vec{V}_{P/W} = \vec{V}_P - \vec{V}_W$$

$$\Rightarrow \quad \vec{V}_W = \vec{V}_P - \vec{V}_{P/W}$$

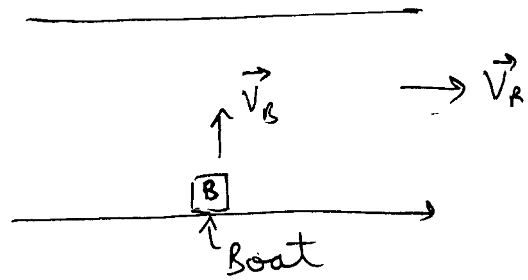
$$= -900\,\hat{j} \text{ km/h} - 1000\left[\cos(255°)\,\hat{i} + \sin(255°)\,\hat{j}\right]$$

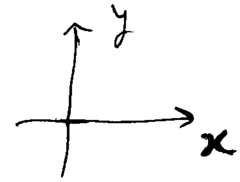
$$= (258.82\,\hat{i} + 65.92\,\hat{j}) \text{ km/h}$$

$\therefore$



48.)





Given :

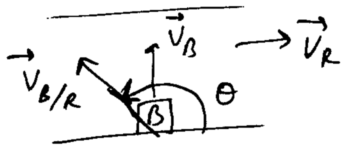
$\vec{V}_R = 0.57 \, m/s$ $\vec{V}_B$ should be vertical

Velocity of River

& $|\vec{V}_{B/R}| = 1.3 \, m/s$

a) To row straight across, $\vec{V}_{B/R}$ should be at some $\theta°$ to counter the flow of river

$$\vec{V}_B = \vec{V}_{B/R} + \vec{V}_R$$



But $(\vec{V}_B)_x = 0$.

x-component

$$\therefore \left(\vec{V}_{B/R} + \vec{V}_R\right)_x = 0$$

$$\Rightarrow |\vec{V}_{B/R}| \cos\theta + |\vec{V}_R| \cos 0° = 0$$

$$\Rightarrow \cos\theta = \frac{-|\vec{V}_R|}{|\vec{V}_{B/R}|} = \frac{-0.57}{1.3}$$

$$\Rightarrow \theta = 180 - 70°$$

$$\Rightarrow \theta = 110°$$

$\therefore$ 20° West of North if the river is flowing towards East.

48. b)

$$\vec{V}_B = \vec{V}_{B/R} + \vec{V}_R$$

$$= |\vec{V}_{B/R}| \cancel{\cos 110 \hat{i}} + |\vec{V}_{B/R}| \sin 110 \hat{j}$$

$$\cancel{+ |\vec{V}_R| \hat{i}}$$

$$= |\vec{V}_{B/R}| \sin 110 \cdot \hat{j}$$

$$= 1.22 \hat{j} \text{ m/s}$$

$$\therefore t = \frac{d}{|\vec{V}_B|} = \frac{63}{1.22} \text{ s}$$

$$\Rightarrow t = 51.64 \text{ s}$$