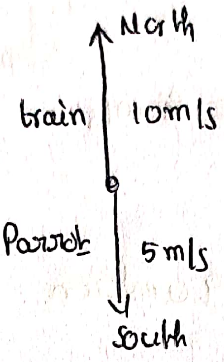
8th advanced ws-7

Tbask.

1

Direction of motion of train = 10 m/s towards north




$\hat{j}, -\hat{j}$ are unit vectors along North and south.

$\therefore$ The Relative velocity of Parrot with respect to train

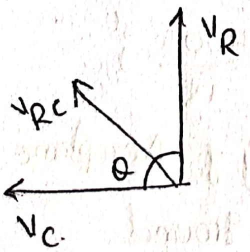
$V_{PG} = -5\hat{j}$ m/s

$$V_{Pt} = V_{PG} + V_{tG}$$
$$= +5\hat{j} + 10\hat{j}$$
$$= 15\hat{j}$$
$$\Rightarrow |\vec{V}_{Pt}| = 15 \text{ m/s}.$$

$\therefore$ Time taken $= \dfrac{\text{distance}}{\text{Velocity}}$

$$= \frac{150}{15} = 10 \text{ sec.}$$

2




Here $V_R \to$ velocity of rocket

$V_C \to$ Velocity of Car $= 6$ m/s.

$V_{RC} \to$ velocity of rocket with respect to car driver. $= 10$ m/s

we know that $V_{RC} = \sqrt{V_R^2 + V_C^2 + 2V_RV_C\cos\theta}$ [Here $\theta = 90^\circ$]

$$\Rightarrow V_{RC} = \sqrt{V_R^2 + V_C^2 + 2V_RV_C\cos 90}$$
$$\Rightarrow V_{RC} = \sqrt{V_R^2 + V_C^2}$$
$$\Rightarrow 10 = \sqrt{V_R^2 + 6^2}$$

on squaring both sides we get

$$10^2 = 6^2 + V_R^2$$

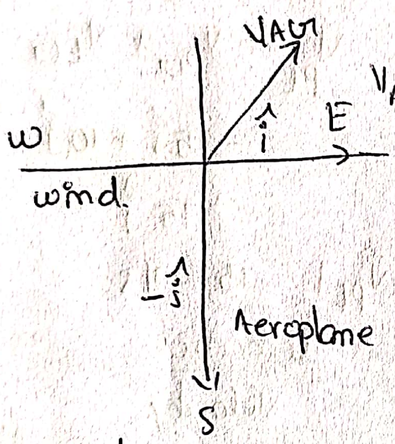
$$\Rightarrow 100 = 36 + V_R^2$$

$$\Rightarrow 100 - 36 = V_R^2$$

$$\Rightarrow V_R^2 = 64$$

$$\Rightarrow V_R = \sqrt{64} = 8 \text{ m/s}$$

(3) According to given question




$V_{AW} = V_{Aa}$ = velocity of aeroplane with respect to air = 800 kmph

$= 800 \times \frac{5}{18}$

$= \frac{4000}{18}$ m/s

$V_{wind} = 15$ m/s

$V_{AG} = 15\hat{i}$ m/s

$V_{AW} = \cancel{vel}\ V_{AG} - V_{WG}$

$$\Rightarrow -\frac{4000}{18}\hat{j} = -15\hat{i} + V_{AG}$$

$$\Rightarrow V_{AG} = 15\hat{i} + \frac{4000}{18}\hat{j}$$

$\therefore$ $|\vec{V}_{AG}|$ = Magnitude of velocity of Aeroplane with respect to ground

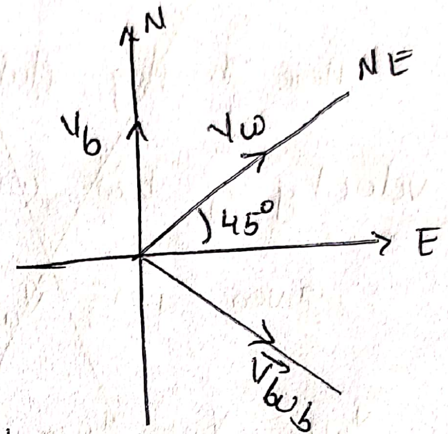
$$= \sqrt{(15)^2 + \left(\frac{4000}{18}\right)^2}$$

$$= \sqrt{225 + 49{,}372} = \sqrt{49{,}597}$$

$$= 222.7 \text{ m/s.}$$

(4)

Since the flag flutters in a boat in NE direction we could conclude that the velocity of wind is in NE direction




when the boat sail towards north $= V_B = 51\hat{j}$ kmph

The flag would flutter along the direction of relative velocity with respect to ~~wind~~ boat.

Velocity of Flag $V_F = V_W = 72$ kmph in NE

$= 72\cos\theta\,\hat{i} + 72\sin\theta\,\hat{j}$

$\therefore \vec{V}_{WB} = \vec{V}_W - \vec{V}_B$

Here $\theta = 45°$

$\Rightarrow [72\cos 45\,\hat{i} + 72\sin 45\,\hat{j}] - 51\hat{j}$

$\Rightarrow \frac{72}{\sqrt{2}}\hat{i} + \frac{72}{\sqrt{2}}\hat{j} - 51\hat{j}$

$\Rightarrow 50.91\,\hat{i} + (50.91 - 51)\hat{j}$

$\Rightarrow 50.91\,\hat{i} - 0.09\,\hat{j}$

Angle made by the vector $\vec{V}_{WB}$ with x-axis is

$$\tan\alpha = \frac{\text{y-component}}{\text{x-componen}} = \frac{-0.09}{50.91}$$

$\alpha = 0.1°$ with x axis ie) with East

$\therefore$ Direction of fluttering of Flag is almost towards east

⑤

Given wind is flowing from south. ies it is flowing towards north $\therefore V_{WG} = 10\hat{j}$ m/s

But to the cyclist it appears to blow from the east at 10 m/s

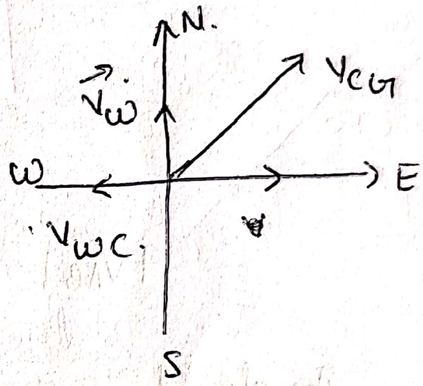
so velocity of wind relative to the cyclist is 10 m/s from east to west.

$$\vec{V}_{WC} = -10\hat{i}$$

$$\Rightarrow \vec{V}_{WG} - \vec{V}_{CG} = -10\hat{i}$$

$$\Rightarrow \vec{V}_{CG} = \vec{V}_{WG} + 10\hat{i}$$

$$\vec{V}_{CG} = 10\hat{j} + 10\hat{i}$$

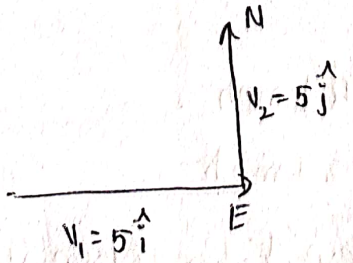



$$\therefore \quad |\vec{V}_{CG}| = \sqrt{10^2 + 10^2} = 10\sqrt{2} \text{ m/s}$$

Here $\hat{i}, \hat{j}$ are unit vectors along east & north directions.

⑥

According to given question




$\therefore$ Velocity of the Particle $= v_1\hat{i} + v_2\hat{j}$
$= 5\hat{i} + 5\hat{j}$

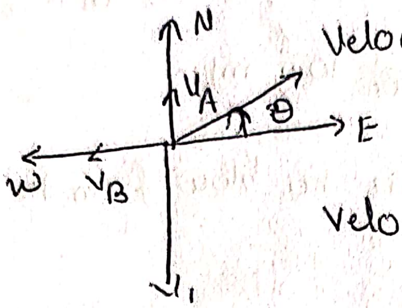
$$\Rightarrow |\vec{v}| = \sqrt{5^2 + 5^2} = 5\sqrt{2} \text{ m/s}$$

time of change $t = 10$ sec

$$\therefore \text{Acceleration } a = \frac{|\vec{v}|}{t} = \frac{\cancel{5}\sqrt{2}}{\cancel{10}\,2} = \frac{\sqrt{2}}{2} = \frac{1}{\sqrt{2}} \text{ NE}$$

(7)

According to given data




Velocity of A = 8 kmph toward north

$= 8\hat{j}$ kmph

Velocity of B = 6 kmph toward west

$= 6(-\hat{i})$ kmph

$\therefore$ velocity of A with respect to B

$$\vec{V}_{AB} = \vec{V}_A - \vec{V}_B$$

$$= 8\hat{j} - 6(-\hat{i})$$

$$\vec{V}_{AB} = 8\hat{j} + 6\hat{j}$$

$$\therefore |\vec{V}_{AB}| = \sqrt{8^2+6^2} = \sqrt{64+36} = \sqrt{100} = 10 \text{ kmph}$$

The direction of $\vec{V}_{AB}$ with x-axis (or) East is

$$\tan\theta = \frac{y\text{-component}}{x\text{-component}}$$

$$\Rightarrow \tan\theta = \frac{8}{6} = \frac{4}{3}$$

$$\Rightarrow \theta = \tan^{-1}\left(\frac{4}{3}\right) \text{ North of East.}$$

(8) Velocity of rain $V_R = 4$ kmph

velocity of person $V_P = 3$ kmph

Velocity of rain with respect to Person $V_{RP} = \sqrt{V_R^2 + V_P^2}$

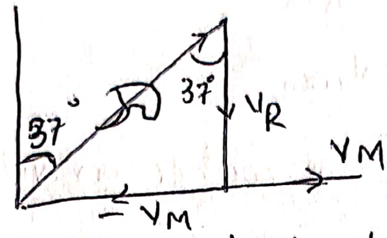
$$\Rightarrow V_{RP} = \sqrt{4^2+3^2}$$

$$= \sqrt{16+9} = \sqrt{25}$$

$$V_{RP} = 5 \text{ Kmph}$$

(9)

Velocity of a man in a car




$V_M = 10 \cdot 8$ kmph

$= \cancel{10 \cdot 8}^{0.6} \times \frac{5}{\cancel{18}}$

$= 3$ m/s.

Always the umbrella should be hold in a direction of relative velocity of rain with respect to man.

From Fig $\tan 37° = \frac{V_M}{V_R}$

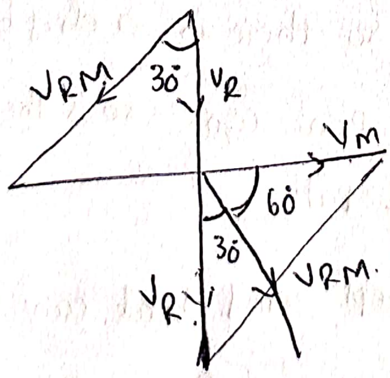
$\Rightarrow \frac{\cancel{3}}{4} = \frac{\cancel{3}}{V_R}$

$\Rightarrow V_R = 4.$

(10)

Given velocity of man $= 4$ m/s

He finds that rain is falling slant wise in to his face → this is the Relative velocity of rain with respect to him. $V_{RM} = 4$ m/s




$\vec{V}_{RM} = \vec{V}_{RG} + \vec{V}_{MG}$

$\Rightarrow \vec{V}_{RG} = \vec{V}_{RM} + \vec{V}_{MG}$ [Angle b/w $\vec{V}_{MG}$ and $\vec{V}_{RM}$ is 60°]

$\Rightarrow |\vec{V}_{RG}| = \sqrt{V_{RM}^2 + V_{MG}^2 - 2V_{RM}V_{MG}\cos\theta}$

$= \sqrt{4^2 + 4^2 - 2\times4\times4\times\cos 60°}$

$= \sqrt{4^2+4^2 - \cancel{2}\times4^2\times\frac{1}{\cancel{2}}} = \sqrt{4^2+\cancel{4^2}-\cancel{4^2}}$

$= \sqrt{4^{\cancel{2}}} = 4$ m/s

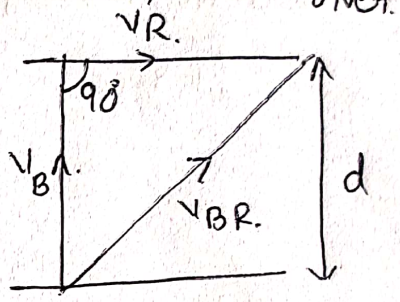
13

Given $V_{BW} = n V_{RG}$ (or)

$V_{BW} = n V_{WG}$

where $V_W$ = velocity of water (or) velocity of river

$V_{BW}$ = velocity of Boat with respect to water (or) river.




$\therefore \vec{V}_{BR} = \vec{V}_{BG} - \vec{V}_{RG}$

$\Rightarrow \vec{V}_{BG} = \vec{V}_{BR} + \vec{V}_{RG}.$

$\Rightarrow |\vec{V}_{BR}| = \sqrt{(\vec{V}_{BG})^2 + (V_{RG})^2 - 2 V_{BG}(V_{RG}) \cos 90}$

$\vec{V}_{BR} = \sqrt{V_{BG}^2 + (V_{RG})^2} \Rightarrow V_{BG}^2 = V_{BR}^2 - V_{RG}^2 \rightarrow ①$

Drift $x = d \times \frac{V_{RG}}{V_{BW}} = d \times \frac{V_{RG}}{n V_{RG}}$

$x = \frac{d}{n} \rightarrow ②$ Here d is width of river

(b) For $n=1 \Rightarrow x = d$ so there is a drift.

(c) For $n>1 \Rightarrow x < d$ Boat can cross the river along shortest path

(d) For any value of $n$ [Except zero] boat can cross the river

From ① $V_{BG}^2 = (n V_{RG})^2 - V_{RG}^2 = (n^2-1) V_{RG}^2$

$\Rightarrow V_{BG} = V_{RG}\sqrt{n^2-1}$ For $n>0$ : $V_{BG}>0$, so the boat can cross the river in shortest path.

6

14

let $x \to$ be the drift suffered by the boat

$\Rightarrow x = d \times \frac{V_R}{V_{BR}}$ and we know that $V_B^2 = V_{BR}^2 - V_R^2$

$\Rightarrow V_{BR}^2 = V_B^2 + V_R^2$

(a) $d = 1000m$ ; $V_R = 2 m/s$ ; $V_B = 4 m/s$

$\Rightarrow V_{BR}^2 = 4^2 + 2^2$

$\Rightarrow V_{BR} = \sqrt{20} = 2\sqrt{5}$ m/s

$\therefore x_1 = 1000 \times \frac{2}{2\sqrt{5}} = \frac{1000}{\sqrt{5}}$ m

(b) $d = 500m$ ; $V_R = 1$ ; $V_B = 6$ m/s

$\Rightarrow V_{BR}^2 = 6^2 + 1^2 = 36 + 1 = 37$

$\Rightarrow V_{BR} = \sqrt{37}$

$\therefore x_2 = 500 \times \frac{1}{\sqrt{37}}$ m

(c) $d = 1000m$ ; $V_R = 6$ m/s ; $V_B = 6$ m/s

$\Rightarrow V_{BR}^2 = 6^2 + 6^2 = 36 + 36 = 72$

$\Rightarrow V_{BR} = \sqrt{72} = 6\sqrt{2}$

$\therefore x_3 = 1000 \times \frac{6}{6\sqrt{2}} = \frac{1000}{\sqrt{2}}$ m

$\therefore x_3 > x_1 > x_2$

increasing order b, a, c

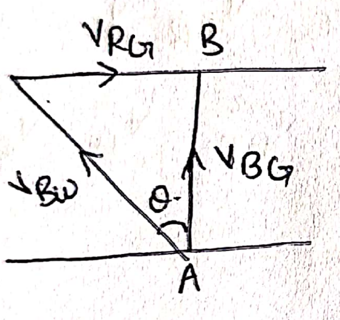
(15)

Velocity of boat in still water $V_{BW} = 5$ kmph

width of river $d = 1$ km

Time of crossing $t = 15$ min $= \frac{15}{60}$ hr

$= \frac{1}{4}$ hr




AB = width of river

Time taken to cross in shortest path

$$t = \frac{d}{V_{BG}}$$

clearly

$$V_{BG}^2 + V_{RG}^2 = V_{BW}^2$$

$$\Rightarrow V_{BG} = \sqrt{V_{BW}^2 - V_{RG}^2}$$

$$= \sqrt{5^2 - V_{RG}^2}$$

$$\Rightarrow \frac{1}{4} = \frac{1}{\sqrt{5^2 - V_{RG}^2}}$$

$$\Rightarrow \sqrt{5^2 - V_{RG}^2} = 4$$

$$\Rightarrow 5^2 - V_{RG}^2 = 4^2$$

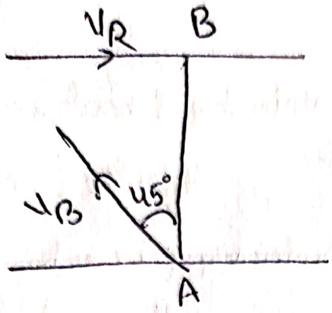
$$\Rightarrow 25 - V_{RG}^2 = 16$$

$$\Rightarrow V_{RG}^2 = 25 - 16$$

$$\Rightarrow V_{RG} = \sqrt{9} = 3 \text{ kmph}$$

(16) VR R

(16)




A is starting point and B is exactly opposite point

velocity of water $= V_R = V$.

From fig $\sin\theta = \frac{V_R}{V_B}$

$\Rightarrow \sin 45^\circ = \frac{V}{V_B}$

$\Rightarrow \frac{1}{\sqrt{2}} = \frac{V}{V_B}$

$\Rightarrow V_B = \sqrt{2}\,V$

(17)

Velocity of Boat with respect to water $V_{BW} = 2\hat{i} + 3\hat{j}$ m/s

velocity of river with respect to ground $V_{WG} = 3\hat{i} + 2\hat{j}$ m/s

$\therefore \vec{V}_{BW} = \vec{V}_{BG} - \vec{V}_{WG}$

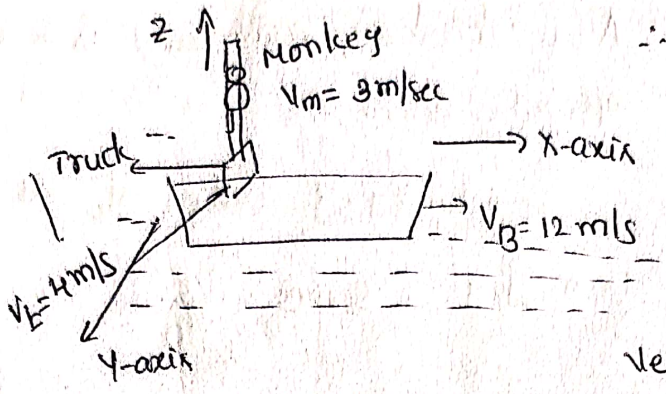
$\Rightarrow 2\hat{i} + 3\hat{j} = \vec{V}_{BG} - (3\hat{i} + 2\hat{j})$

$\Rightarrow 2\hat{i} + 3\hat{j} = \vec{V}_{BG} - 3\hat{i} - 2\hat{j}$

$\Rightarrow \vec{V}_{BG} = 2\hat{i} + 3\hat{j} + 3\hat{i} + 2\hat{j}$

$\vec{V}_{BG} = 5\hat{i} + 5\hat{j}$ m/s

(18)




$\therefore$ Velocity of boat is along X-axis

$V_B = 12\hat{i}$ m/s

Velocity of truck

$V_t = 4\hat{j}$ m/s

Velocity of monkey

$V_m = 3\hat{k}$ m/s

$\therefore$ velocity of monkey as observed by a man on the shore = Resultant velocity of monkey due to motion of truck & boat

$= V_B + V_t + V_m$

$= 12\hat{i} + 4\hat{j} + 3\hat{k}$

$= \sqrt{12^2+4^2+3^2} = \sqrt{144+16+9} = \sqrt{169} = \underline{13 m/s}$

(19)

let 'v' be the speed of the bus running between town A and B

speed of cyclist $u = 20$ kmph

Relative speed of the bus moving in the direction of cyclist $= v - u = (v-20)$ kmph

The bus went past the cyclist every 18 min $= \frac{18}{60}$ hr

$\therefore$ Distance covered by the bus = speed x time

$= (v-20) \times \frac{18}{60} \rightarrow (1)$

Since one bus leaves after every T min, then

The distance travelled by the bus will be equal to

$$= V \times \frac{T}{60} \rightarrow (2)$$

Both equations (1) and (2) are equal

$$\therefore (V-20)\times\frac{18}{\cancel{60}} = \frac{VT}{\cancel{60}}$$

$$\Rightarrow (V-20)\times\frac{18}{60} = \frac{VT}{60} \rightarrow (3)$$

Relative speed of bus moving in opposite direction of the cyclist $= (V+20)$ kmph

Time taken by the bus to go past the cyclist $= 6\text{ min} = \frac{6}{60}\text{ hrs} = \frac{1}{10}\text{ hr}$

The distance travelled by the bus $= (V+20)\times\frac{6}{60} \rightarrow (4)$

$$\Rightarrow \frac{VT}{60} = (V+20)\frac{6}{\cancel{60}}$$

From (3) and (4)

$$\Rightarrow (V+20)\frac{\cancel{6}}{\cancel{60}} = (V-20)\times\frac{\cancel{18}^{\,3}}{\cancel{60}}$$

$$\Rightarrow V+20 = 3V-60 \Rightarrow 2V = 80$$

$$\Rightarrow V = 40\text{kmph}$$

sub 'v' value in (4) $\quad \frac{40\times T}{\cancel{60}} = (40+20)\frac{6}{\cancel{60}}$

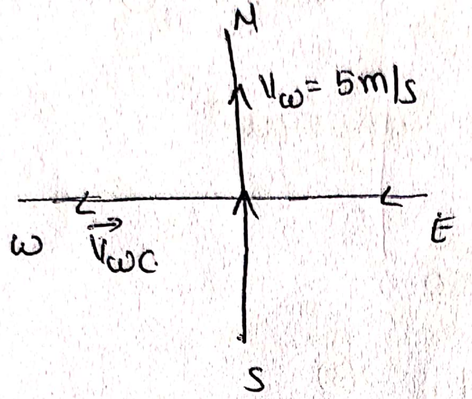
$$\Rightarrow 40T = 60\times 6$$

$$\Rightarrow T = \frac{360}{40} = \cancel{3\text{hrs } 90\text{m}}$$

$$T = 9\text{ min}$$

LTask

① wind is blowing from south to North




ie $\vec{V}_{wG} = 5\hat{j}$ m/s

To cyclist it appears to blow from ~~west to~~ east to west

i.e) Relative velocity of wind with respect to cyclist is

$\vec{V}_{wc} = 5(-\hat{i})$ m/s

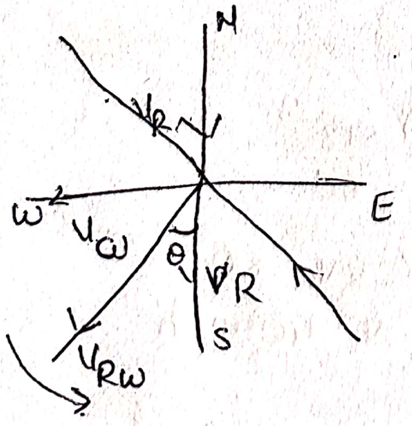
$\therefore \quad \vec{V}_{wc} = \vec{V}_{wG} - \vec{V}_{cG}$

$\Rightarrow -5\hat{i} = 5\hat{j} - \vec{V}_{cG}$

$\Rightarrow \vec{V}_{cG} = 5\hat{j} + 5\hat{i}$

$\Rightarrow |\vec{V}_{cG}| = \sqrt{5^2+5^2} = 5\sqrt{2}$ m/s N-W.

② According to Given question




Velocity of Rain $V_{RG} = -30\hat{j}$ m/s $\Rightarrow |\vec{V}_{RG}| = 30$ m/s

Velocity of women $V_{wG} = -12\hat{i}$ m/s $\Rightarrow |\vec{V}_{wG}| = 12$ m/s

woman has to hold umbrella in the direction opp of Relative velocity $[V_{Rw}]$

~~$V_{Rw}$~~ From fig $\tan\theta = \frac{V_w}{V_R} = \frac{\cancel{12}^2}{\cancel{30}_5}$

$\tan\theta = \frac{2}{5}$

$\theta = \tan^{-1}(\frac{2}{5})$ with vertical towards west

(3)

$V_{pw}$ = velocity of person with respect to water = 5 m/s

$V_R$ or $V_w$ = velocity of river or water = 3 m/s

Time taken for upstream $t_u = \frac{d}{U_{pw} \cancel{+} V_w}$

Time taken for downstream $t_d = \frac{d}{U_{pw}+V_w}$

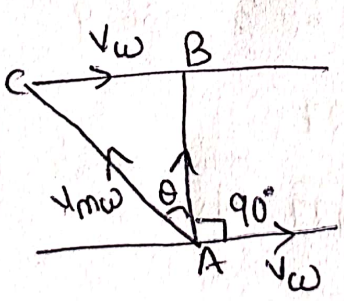
$$\therefore \frac{t_d}{t_u} = \frac{\frac{d}{U_{pw}+V_w}}{\frac{d}{U_{pw}-V_w}} = \frac{U_{pw}-U_w}{V_{pw}+V_w}$$

$$\Rightarrow \frac{t_d}{t_u} = \frac{5-3}{5+3} = \frac{2}{8} = \frac{1}{4}$$

(4)

$V_{mw}$ = velocity of man in still water = 6 kmph

$V_w$ = velocity of river = 3 kmph




From fig $\sin\theta = \frac{V_w}{V_{mw}}$

$\Rightarrow \sin\theta = \frac{\cancel{3}}{\cancel{6}_2} = \frac{1}{2}$

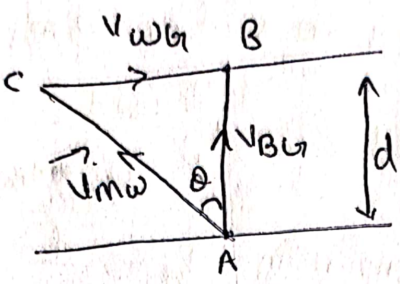
$\Rightarrow \sin\theta = \frac{1}{2}$

$\Rightarrow \theta = 30^\circ$

∴ The man has to swim in a direction $(90+\theta) = 90+30 = 120^\circ$ with flow of water.

(5)

velocity of man in water $V_{mw} = 6$ kmph




If the man wants to swim to reach exact opposite point (B) he has to swim along $\vec{AC}$.

Time taken for the boat to cross the river

$$t = \frac{d}{V_{BG}} \rightarrow (1)$$

$d$ = width of river = 2 km

$V_{WG}$ = velocity of river or water = 3 kmph

From fig $AC^2 = AB^2 + CB^2$

$$\Rightarrow V_{mw}^2 = V_{BG}^2 + V_{WG}^2$$

$$\Rightarrow 6^2 = V_{BG}^2 + 3^2$$

$$\Rightarrow V_{BG}^2 = 6^2 - 3^2 = 36 - 9$$

$$\Rightarrow V_{BG}^2 = 27$$

$$\Rightarrow V_{BG} = \sqrt{27} \text{ m/s}$$

∴ From (1)

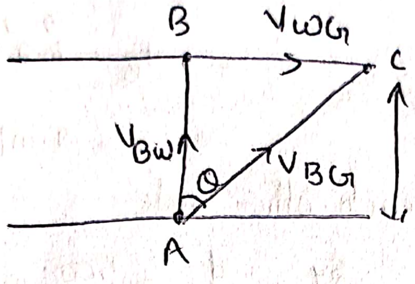
$$t = \frac{2}{27} \text{ hrs.}$$

6

Velocity of water $= V_w = 2$ kmph.

width of river $= d = 400$ m.

Velocity of Boat in still water $= V_{Bw} = 8$ kmph.




BC = drift = displacement

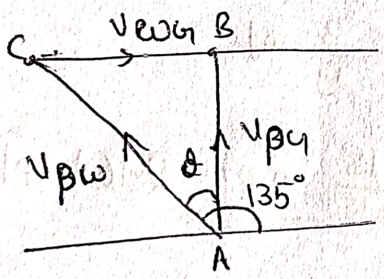
= velocity × time

$= V_w \times \frac{d}{V_{Bw}}$

$= \cancel{2} \times \frac{\cancel{400}\ 100}{\cancel{8}\ 4}$

BC = 100 m

7




Given that the Person swims at 135° to current flow

i.e $\theta = 45°$

~~From fig~~ $\cancel{\cos\theta =} \frac{V_{PG}}{V_{WG}}$ $\cancel{\sin 135°} = \frac{V_P}{V_W}$

$\Rightarrow \cancel{\cos 45°}$ $\Rightarrow$

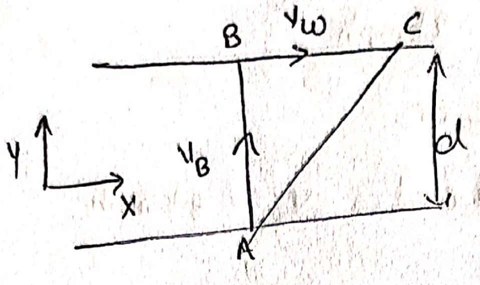
From fig $\sin 135° = \frac{V_{WG}}{V_{PG}}$

$\Rightarrow \frac{1}{\sqrt{2}} = \frac{V_{WG}}{V_{PG}}$

$\Rightarrow \frac{V_{PG}}{V_{WG}} = \frac{\sqrt{2}}{1}$

Scanned with OKEN Scanner

(8)




BC = 150 m.

width of river d = 500 m.

Given Velocity of Boat $V_B = 7.2$ kmph

$\Rightarrow V_B = \cancel{7.2}^{0.4} \times \frac{5}{\cancel{18}}$ m/s

$= 2$ m/s

Time taken to reach other side

$$t = \frac{S_y}{V_y} = \frac{d}{V_B} = \frac{500}{2} = 250 \text{ sec.}$$

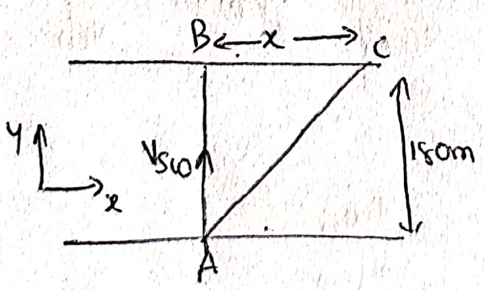
Drift BC = $V_W \times$ time taken

$\Rightarrow 150 = V_W \times 250$

$\Rightarrow V_W = \frac{15}{25} = \frac{3}{5}$ m/s

$= \frac{3}{5} \times \frac{18}{5}$ kmph $= 2.16$ kmph

(9)




Velocity of river (or) water $V_W = 0.85$ m/s

width of river d = 180m

Velocity of Swimmer in water $V_{SW} = 1.65$ m/s

Time taken to cross river $t = \frac{S_y}{V_y}$ [y-direction]

$\Rightarrow t = \frac{180}{1.65} = 109$ sec.

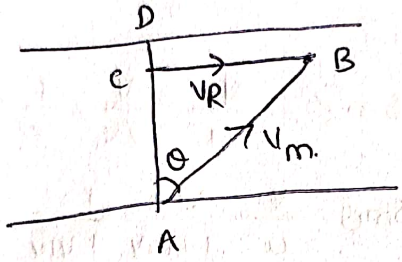
drift $x = V_W \times t$

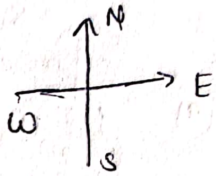
$= 0.85 \times 109 \Rightarrow 92.7$ m.

(10)

Given that velocity of river from west to east $= 5\ m/min$

velocity of the person from south bank to the river in still water $(V_{man}) = 10\ m/min$




Here AC is shortest distance for the person to cross the river from the south bank of the river.

The component of velocity of the person along shortest path $= V_{man} \cos\theta$.

Now, the time taken by the person to cross the river along shortest path is given as $t = \dfrac{AC}{V_{man} \cos\theta}$

The time will be minimum, when the denominator will be max.

i.e. $\cos\theta = $ maximum

Maximum value of $\cos\theta = 1$

$\therefore \cos\theta = \cos 0°$

$\Rightarrow \theta = 0°$ that is in the north direction, thus the direction in which the swimmer should move will be in north direction.

(13)

$U$ = velocity of boat in still water.

$V$ = velocity of river.

The angle made by the boat with river flow

$$\sin\theta = \frac{V_R}{V_B}$$

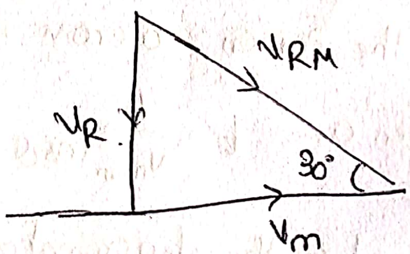
(a) If $U = 2V$ $\Rightarrow \sin\theta = \frac{V}{U} = \frac{V}{2V} = \frac{1}{2} \Rightarrow \theta = 30^\circ$

(b) If $U = 1.414V$ $\Rightarrow \sin\theta = \frac{V}{U} = \frac{V}{1.414V} = \frac{1}{1.414} = \frac{1}{\sqrt{2}} \Rightarrow \theta = 45^\circ$

(c) If $U = V$ $\Rightarrow \sin\theta = \frac{V}{U} = \frac{V}{V} = 1 \Rightarrow \theta = 90^\circ$

(15)

According to given data

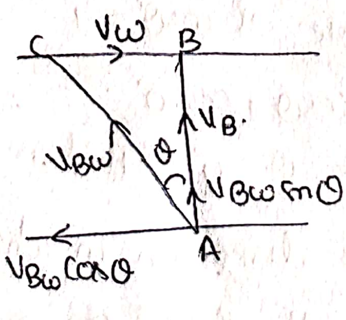



$V_M$ = velocity of man = 5 kmph

From fig $\tan 30^\circ = \frac{V_R}{V_m}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{V_R}{5} \Rightarrow V_R = \frac{5}{\sqrt{3}} = 2.9$ kmph

(11)




~~From fig $\sin\theta = \frac{V_w}{V_{Bw}}$~~

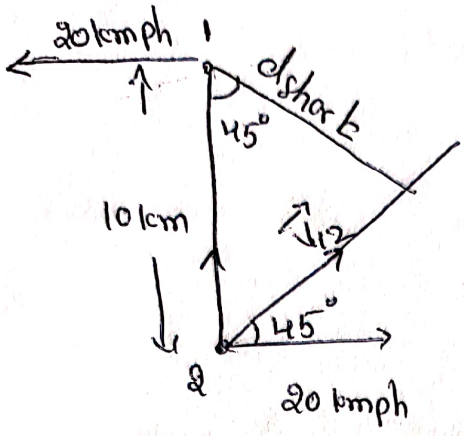
$\Rightarrow \sin 60 = \frac{V_w}{V_{Bw}} \Rightarrow \boxed{\cancel{\frac{\sqrt{3}}{2} = \frac{V_w}{V_{Bw}}}}$

From fig $V_{Bw} \cos 60 = V_w$

$\Rightarrow V_{Bw} \frac{1}{2} = V_w$

$\Rightarrow V_{Bw} = 2 V_w$

(16)




The velocity components of both ships 1 and 2 are equal.

Hence the angle between the two vectors is 45°

From fig $\sin 45° = \frac{d_{short}}{10 \text{ km}}$

$\Rightarrow d_{short} = 10 \sin 45°$

$= 10 \times \frac{1}{\sqrt{2}}$

$= 5\sqrt{2}$ km

Time taken to reach the point (distance of closest approach)

$t = \frac{d_{short}}{|\vec{v}_{21}|} = \frac{5\sqrt{2}}{20\sqrt{2}} = \frac{1}{4}$ hrs $= 15$ min

$\vec{v}_{21} = \vec{v}_2(-\hat{i}) + v_1(\hat{j})$

$= -20\hat{i} + 20\hat{j}$

$|\vec{v}_{21}| = \sqrt{(-20)^2 + (20)^2} = 20\sqrt{2}$ kmph