Varsity ‘Ka’ Admission Program-2020

PHYSICS

Lecture : P-01

Chapter 2 : Vector

উদ্ভাস
একাডেমিক এন্ড এডমিশন কেয়ার

QUANTITY

The physical things that can be measured in physics are called quantities.

SCALAR QUANTITY

In physics, physical quantities that have values but no directions are called scalar quantities. Ex: Mass, length, Work etc.

VECTOR QUANTITY

The physical quantities of physics that require both values and directions to be fully expressed are called vector quantities. Ex: Weight, velocity, etc.
Force

Poll Question 01

Which one is a vector quantity ?

(a) Luminous Intensity

(b) Time

(c) Current Flow

(d) Displacement

SOME VECTORS

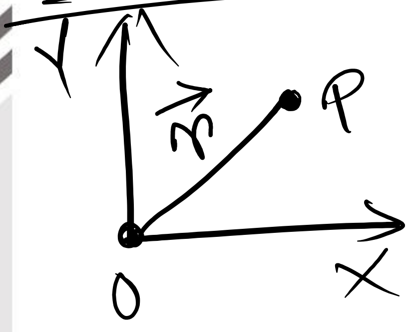
Unit vector:

$$\hat{a} = \frac{\vec{A}}{|\vec{A}|}$$

Zero vector:

$\vec{0}$, 0 , **0**

Position: (Radius vector)



$\vec{OP} = \vec{r}$

$\vec{A}$

Initial

Terminal

Equal vector:

$\vec{A}$

$\vec{B}$

Opposite Vector:

$\vec{A}$

$\vec{B}$

Like vector:

$\vec{A}$

$\vec{B}$

$\vec{A} > \vec{B}$

Unlike vector:

$\vec{A}$

$\vec{B}$

 # Co-linear Vector:

$\vec{A}$ $\vec{B}$

 # Proper vector:

whose value is not 0.

 # Free and localised Vector:

$\vec{A}$

$\vec{B}$

Poll Question 02

The vector whose value is one unit is known as-

(a) Zero vector

(b) Like vector

(c) Unlike vector

(d) Unit vector

Poll Question 03

If A and B are like vectors then which one is correct? –

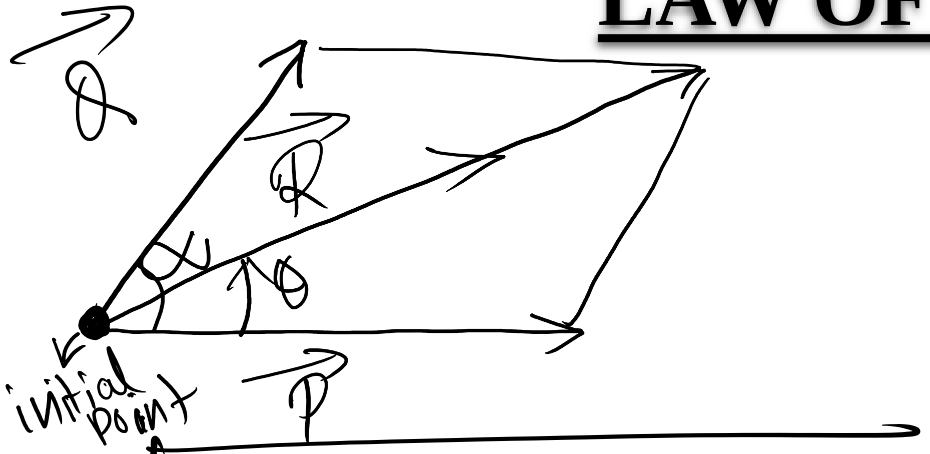
(a) $\vec{A} = -\vec{B}$

(b) $\vec{B} = \overrightarrow{-A}$

(c) $\vec{A} > \vec{B}$

(d) B < A

LAW OF PARALLELOGRAM



$$R=\sqrt{P^2+Q^2+2.P.Q\cos\alpha}$$

Direction, $\tan\theta = \dfrac{Q\sin\theta}{P+Q\cos\theta}$

Case-01 | $\alpha = 0^\circ$

$$R=\sqrt{P^2+Q^2+2PQ\cos 0^\circ}=\sqrt{P^2+Q^2+2PQ}$$
$$=\sqrt{(P+Q)^2}=P+Q$$
$$\therefore \boxed{R_{max}=P+Q}$$

Direction: $\tan\theta = \dfrac{Q\sin 0^\circ}{P+Q\cos 0^\circ} = \dfrac{0}{P+Q} = 0$

$\therefore \theta = \tan^{-1}(0) = 0^\circ$

Case-02 | $\alpha = 90^\circ$

$$R=\sqrt{P^2+Q^2+2PQ\cos 90^\circ}$$
$$\boxed{\therefore R=\sqrt{P^2+Q^2}}$$

Direction: $\theta = \tan^{-1}\dfrac{Q\sin 90^\circ}{P+Q\cos 90^\circ} = \dfrac{Q}{P}$

$$\boxed{\theta=\tan^{-1}\left(\frac{Q}{P}\right)}$$

Case-03 | $\alpha = 180^\circ$

$$R=\sqrt{P^2+Q^2+2PQ\cos 180^\circ}$$
$$R=\sqrt{P^2+Q^2-2PQ}=\sqrt{(P-Q)^2} \Rightarrow R_{min}=P-Q$$
$$\boxed{R_{min}=P\sim Q}$$

$$\therefore \theta=\tan^{-1}\left(\frac{Q\sin 180^\circ}{P+Q\cos 180^\circ}\right)=\tan^{-1}\left(\frac{0}{P-Q}\right)=\tan^{-1}(0)$$
$$=180^\circ, \text{[Ans]}$$

Poll Question 04

If the internal angle between $\vec{p}$ & $\vec{Q}$ is 90^0, then the direction of the resultant would be :-

(a) $\theta = tan^{-1}\left(\frac{Q}{p}\right)$

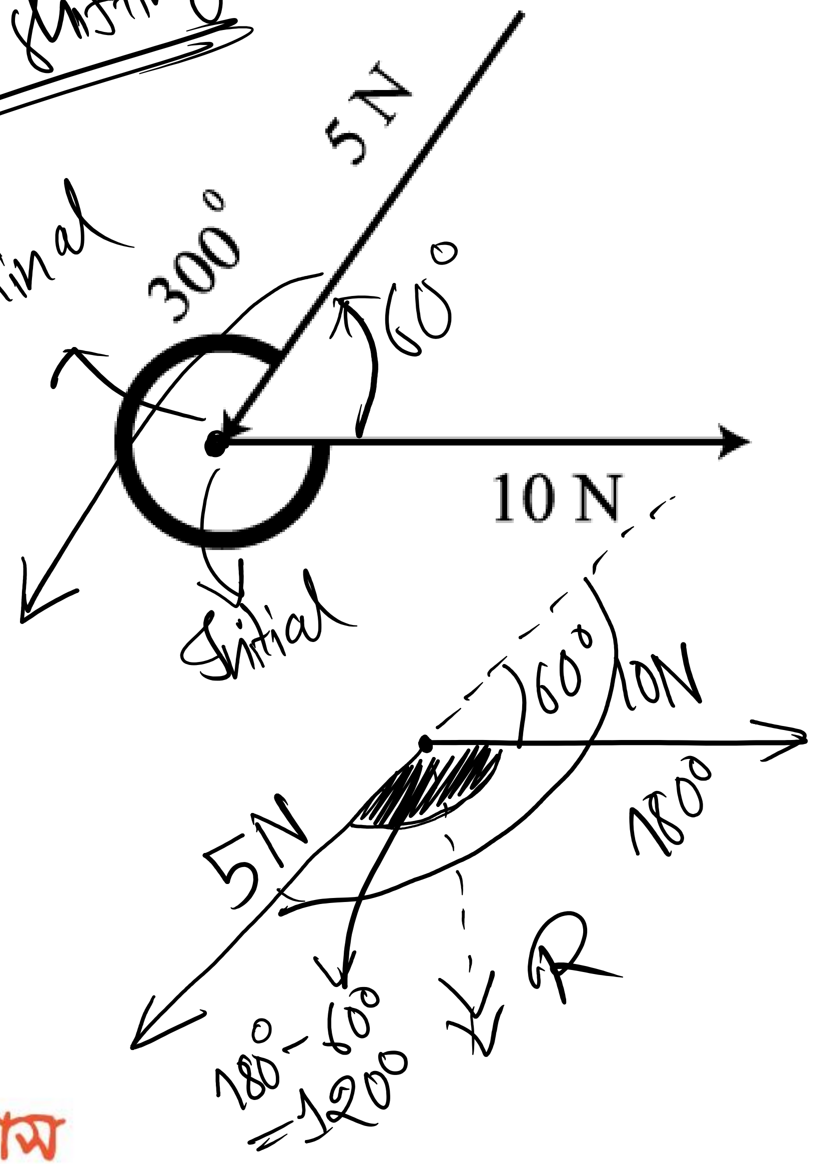
(b) $\theta = 12rad$

(c) $\theta = sin\left(\frac{Q}{p}\right)$

(d) $\theta = cos\left(\frac{Q}{p}\right)$

MATHEMATICAL PROBLEMS RELATED TO VECTORS

Vector shifting:



$$R=\sqrt{\cancel{5^2+10^2}+2.5.10.\cos 60^\circ}$$

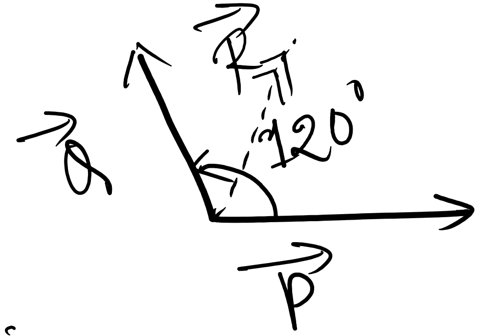
What is the value of the resultant vector?

$$R=\sqrt{5^2+10^2+2.5.10.\cos 120^\circ}$$

$$= 8.660 \text{ Unit}$$ [Ans]

MATHEMATICAL PROBLEMS RELATED TO VECTORS

\# The value of two vector each is 5 units. They operate at the same point at an angle of 120°. Determine the value and direction of their resultant vector.



$P = Q = 5$

We Know,

$$R = \sqrt{5^2 + 5^2 + 2.5.5.\cos 120^{\circ}} = \sqrt{25 + 25 + \overset{25}{\cancel{50}}\left(-\frac{1}{\cancel{2}}\right)}$$

$$= \sqrt{25} = 5 \text{ unit}$$

Shortcut:

$P = Q = 5$

$\alpha = 120^{\circ}$

$R = P = Q = 5$

$\theta = 60^{\circ}$

Direction:

$$\tan\theta = \frac{5\sin 120^{\circ} \rightarrow 0.87}{5 + 5\cos 120^{\circ} \rightarrow \left(-\frac{1}{2}\right)}$$

$$\therefore \theta = 60^{\circ}$$

Poll Question 05

The value of two vector each is 10 units. They operate at the same point at an angle of 120°. Determine the value of their resultant vector.

(a) 12
(b) 20
(c) 10
(d) 0

MATHEMATICAL PROBLEMS RELATED TO VECTORS

$\vec{Q}$ $90°$ $\vec{P}$

The largest resultant of two vectors is 28 units and the smallest resultant is 4 units. How do these two vectors interact with each other to get 5 times the value of the smallest resultant?

→ In which angle

$R_{max} = P + Q = 28 \; \ldots (i)$

$R_{min} = P - Q = 4 \; \ldots (ii)$

$(+)$

$2P = 32$

$\therefore P = 16$

$(i) \Rightarrow 16 + Q = 28$

$\therefore Q = 12$

Condition,

$R = 5(P - Q)$

$\Rightarrow R = 5 \times 4$; [(ii)

$\Rightarrow R = 20$

We Know,

$R^2 = P^2 + Q^2 + 2PQ\cos\alpha$

$\Rightarrow 20^2 = 16^2 + 12^2 + 2.16.12\cos\alpha$

$\Rightarrow 400 - 256 - 144 = 2.16.12\cos\alpha$

$\Rightarrow 0 = 2.16.12\cos\alpha$

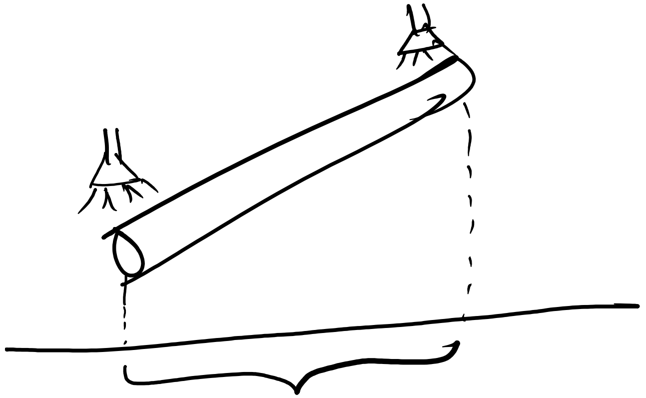
$\Rightarrow \cos\alpha = 0$

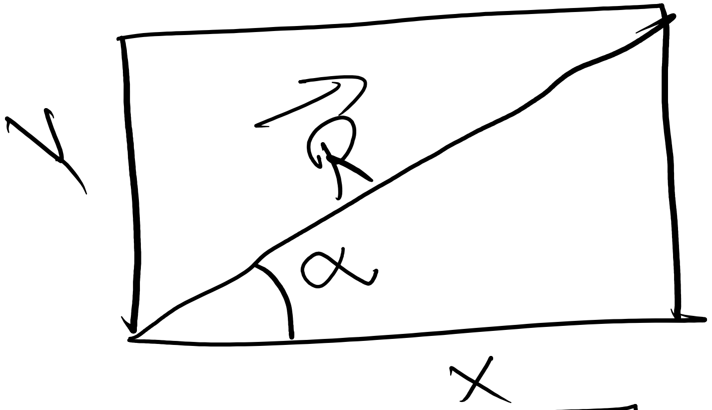
$\Rightarrow \alpha = \cos^{-1}(0)$

$\therefore \alpha = 90°$,

[Ans]

THEORY OF VECTOR COMPONENTS AND PROJECTION.





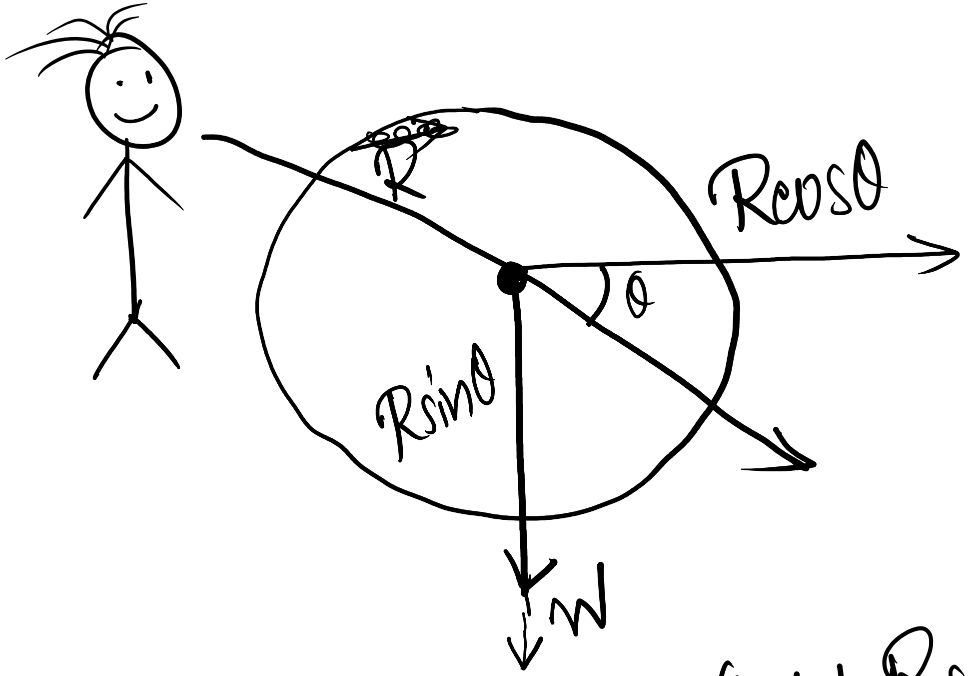
$$\therefore\ \boxed{\begin{aligned} X &= R\cos\alpha \\ Y &= R\sin\alpha \end{aligned}}$$

$$\therefore\ x = \frac{R\sin\beta}{\sin(\alpha+\beta)}$$

$$\therefore\ y = \frac{R\sin\alpha}{\sin(\alpha+\beta)}$$

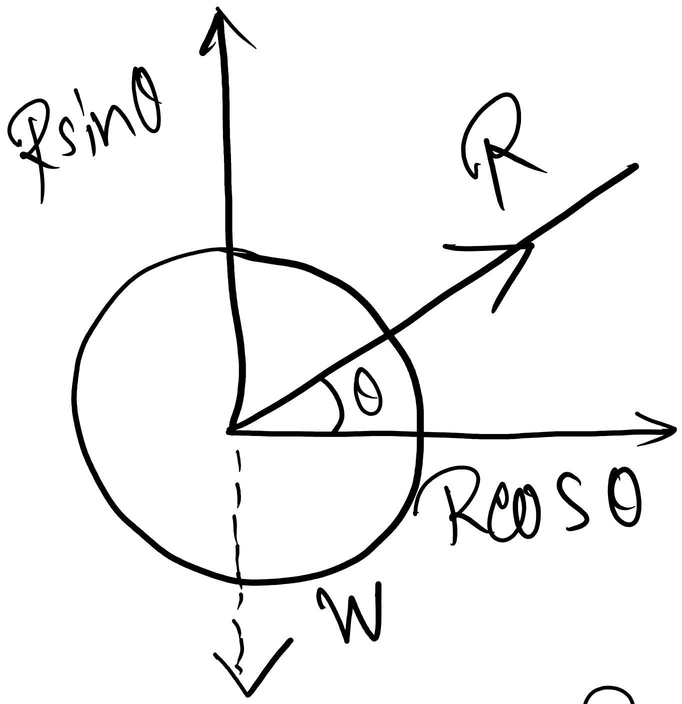
PRACTICAL USE OF VECTOR COMPONENTS

Pulling a lawn roller is easier than pushing:



$\therefore$ Total Weight $= (W + R\sin\theta)$

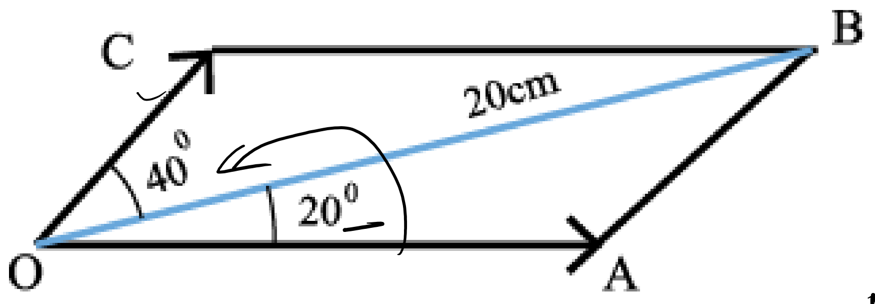
$R\cos\theta \rightarrow$ Go forward



$\therefore$ Total Weight $= (W - R\sin\theta)$

$R\cos\theta \rightarrow$ Go forward

MATHEMATICAL PROBLEMS RELATED TO VECTOR COMPONENTS AND PROJECTION



What is the length of OA and OC?

$$|\vec{OA}| = \frac{20 \sin 40^0}{\sin(40^0+20^0)} = \frac{20 \times 0.64}{\sin 60^0} = 14.84 \text{ cm}, \text{[Ans]}$$

$\sin 40^0 \to 0.64$

$\to 0.87$

$$|\vec{OC}| = \frac{20 \sin 20^0}{\sin(40^0+20^0)} = 7.89 \text{ cm [Ans]}$$

$\sin 30^0 = \frac{1}{2} = 0.5$

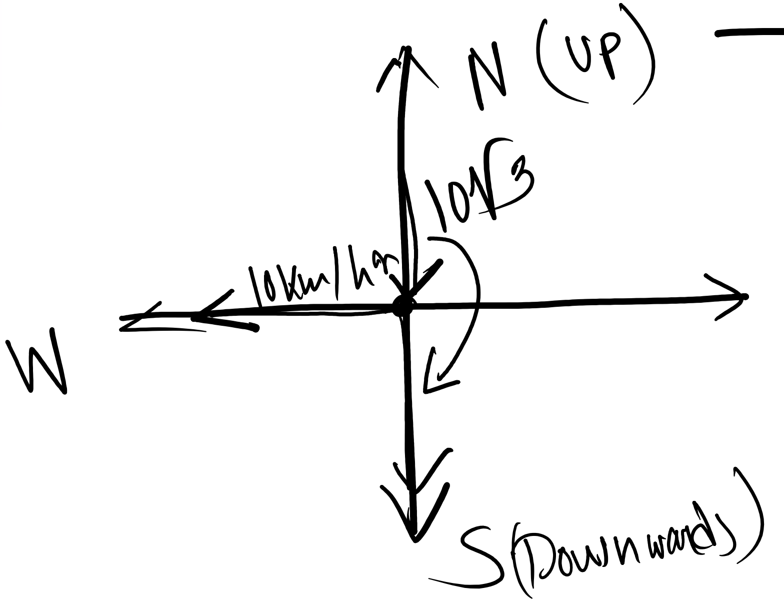
$\sin 45^0 = \frac{1}{\sqrt{2}} = 0.707$

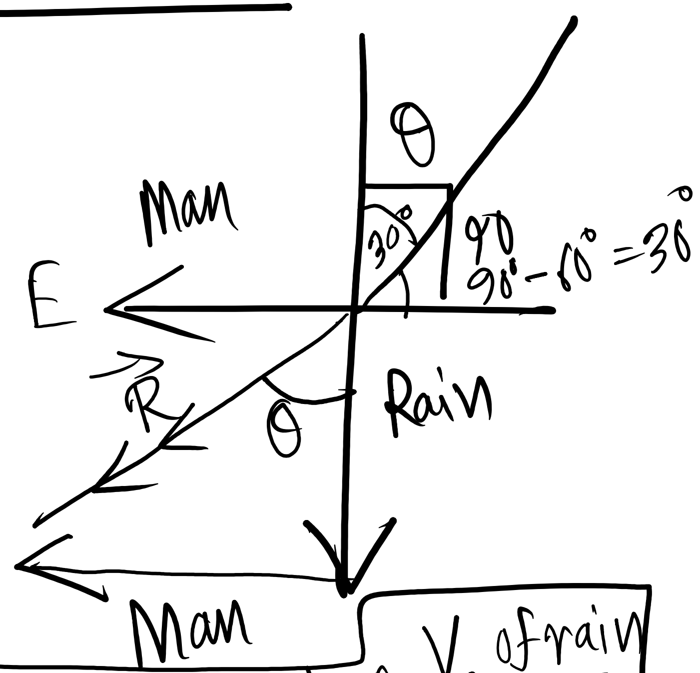
$\sin 40^0 = ?$

(a) 0.50
(b) 0.707
(c) 0.64
(d) 0.87

MATHEMATICAL PROBLEMS RELATED TO RELATIVE VELOCITY

\# A man is moving along the west side at a speed of 10Km / hr. Rain is falling directly on his head at a speed of 10√3Km / hr. At which angle the man will hold the umbrella with the horizontal?





$$\tan\theta = \frac{\text{~~Man~~ Velocity of man}}{\text{Velocity of rain}}$$

$$\Rightarrow \tan\theta = \frac{10}{10\sqrt{3}}$$

$$\Rightarrow \theta = \tan^{-1}\left(\frac{\cancel{10}\ 1}{\cancel{10}\sqrt{3}}\right)$$

$$\therefore \theta = 30^\circ$$

$\therefore$ With the horizontal $= 90^\circ - 30^\circ = 60^\circ$

Shortcut:

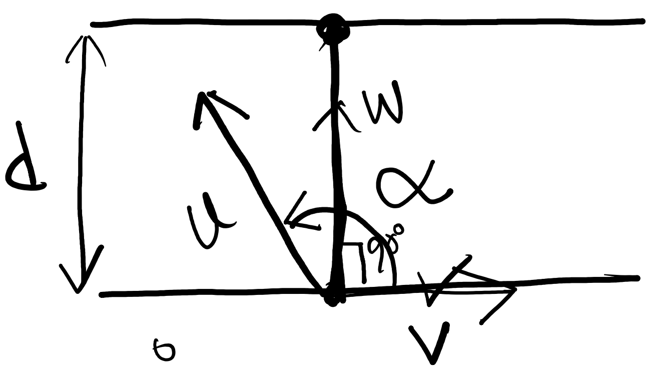
Horizontal ⇒ $\tan\theta = \frac{\text{V. of rain}}{\text{V. of man}}$

$\tan\theta = \frac{10\sqrt{3}}{10}$

$\therefore \theta = 60^\circ$.

MATHEMATICAL PROBLEMS RELATED TO RIVER AND STREAM

(1) In which direction → shortest distance



Velocity of Boat = u

" of stream = V

Resultant velocity = W

$W \cancel{\cos} 90^\circ = V\cos 0^\circ + u\cos\alpha$

$\Rightarrow 0 = V + u\cos\alpha$

$\Rightarrow \cos\alpha = -\frac{V}{u} \quad \ldots (i)$

$\boxed{\therefore \alpha = \cos^{-1}\left(-\frac{V}{u}\right)}$

(2) Resultant velocity:

$W = \sqrt{u^2 + V^2 + 2.u.V\cos\alpha}$

$\Rightarrow W = \sqrt{u^2 + V^2 + 2\cancel{u}.V\left(-\frac{V}{\cancel{u}}\right)}$

$\Rightarrow W = \sqrt{u^2 + V^2 - 2V^2}$

$\boxed{\therefore W = \sqrt{u^2 - V^2} \quad \ldots (ii)}$

(3) Required time → shortest distance:

$s = Vt$

$\Rightarrow d = Wt$

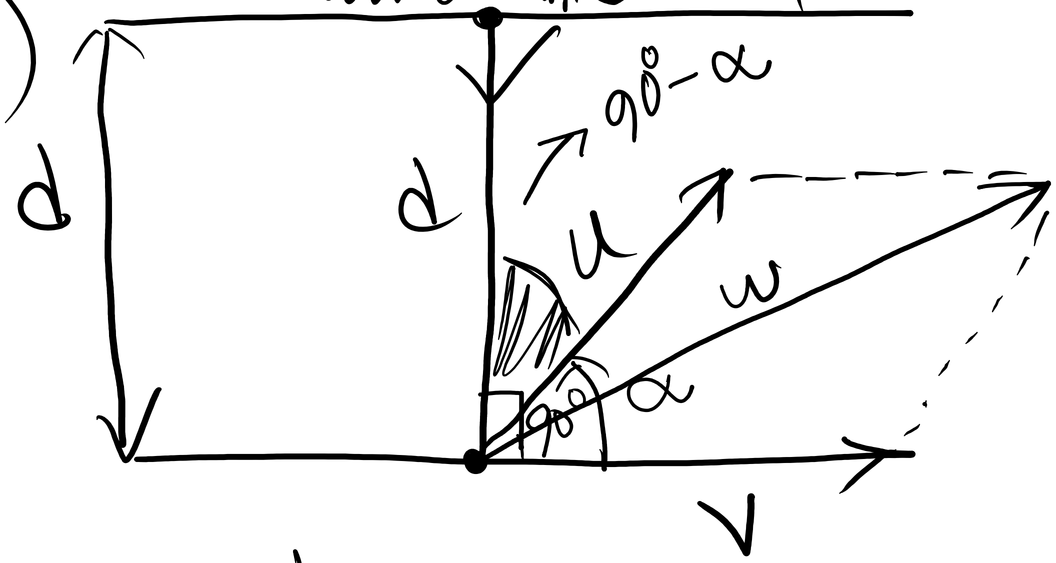
$\Rightarrow t = \frac{d}{W}$

$\boxed{\therefore t = \frac{d}{\sqrt{u^2 - V^2}}} \quad \ldots (3)$

MATHEMATICAL PROBLEMS RELATED TO RIVER AND STREAM

#Shortest time → which direction

(4)



$s = vt$

$\Rightarrow d = \{v\cos 90^\circ + u\cos(90^\circ-\alpha)\}t$

$\Rightarrow d = (u\sin\alpha)\,t$

$\therefore \boxed{\downarrow t = \frac{d}{u\sin\alpha}} \uparrow$

$\sin\alpha \rightarrow \max$

$\sin\alpha = 1$

$\Rightarrow \sin\alpha = \sin 90^\circ$

$\therefore \alpha = 90^\circ$

$\therefore \boxed{\text{Direction, } \alpha = 90^\circ}$

(5) $\downarrow t = \frac{d}{u\sin\alpha} \uparrow$

$\Rightarrow \boxed{t_{min} = \frac{d}{u}}$ $[\sin\alpha = 1 \Rightarrow \alpha = 90^\circ]$

MATHEMATICAL PROBLEMS RELATED TO RIVER AND STREAM

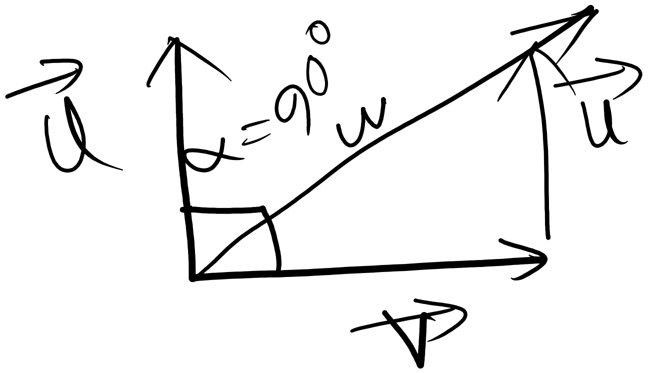
Shortest time → Distance

(6) $S = Vt$

$S = wt_{min}$

$\Rightarrow \cancel{t} \; t_{min} = S$

$$\Rightarrow \boxed{S = \sqrt{u^2+v^2} \cdot \frac{d}{u}}$$



$w = \sqrt{u^2+v^2}$

MATHEMATICAL PROBLEMS RELATED TO RIVER AND STREAM

\# The speed of current and boat in a river is 6km / hr and 12km / hr respectively. The width of the river is 10Km.

(A) In order to cross the river at the shortest distance, the boat has to run in which direction.

(B) What is the minimum distance?

(C) How long will it take in this case?

(D) Where should the boat be driven to cross the river in the shortest time?

(E) What will be the length of the path in this case?

(F) How long will it take in this case?

$d = 10Km$

(A) $\alpha = \cos^{-1}\left(-\frac{v}{u}\right) = \cos^{-1}\left(-\frac{6}{12}\right) = \cos^{-1}\left(-\frac{1}{2}\right) = 120^\circ$

(B) 10Km

(C) $t = \frac{d}{\sqrt{u^2 - v^2}} = \frac{10}{\sqrt{12^2 - 6^2}} = \frac{5}{3\sqrt{3}}\,h$

(d) $\alpha = 90^\circ$

(e) $S = w\,t_{min} = \sqrt{u^2+v^2} \cdot \dfrac{d}{u} = \sqrt{12^2+6^2} \cdot \dfrac{10}{12}$

$= 11'18 \text{ km}$, [Am]

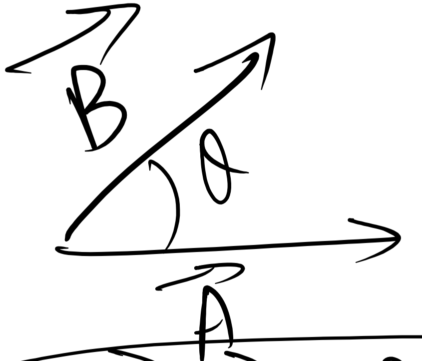
(f) $t_{min} = \dfrac{d}{u} = \dfrac{10}{12} = \dfrac{5}{6} \text{ h}$, [Am]

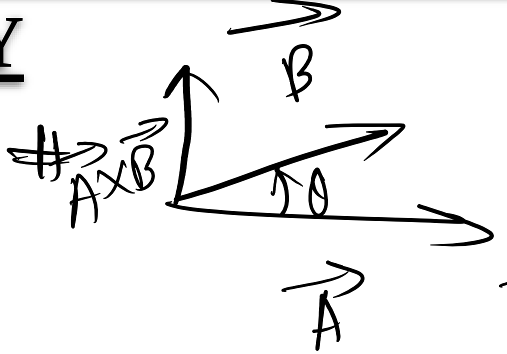
Poll Question 06

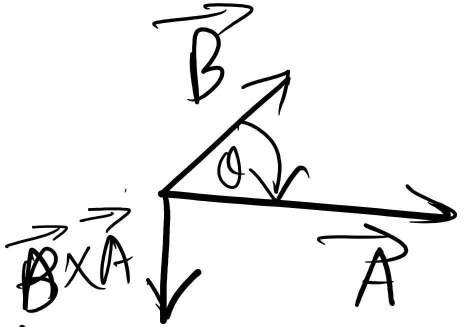
The speed of current and boat in a river is $10kmh^{-1}$ and $20kmh^{-1}$ respectively. In order to cross the river at the shortest distance, the boat has to run in which direction?:-

(a) 12^0
(b) 11^0
(c) 120^0
(d) 10^0

VECTOR DOT MULTIPLICATION AND CROSS MULTIPLICATION THEORY







$\therefore \boxed{\vec{A}\cdot\vec{B} = AB\cos\theta}$; $[0 \le \theta \le 180^\circ]$

$\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$

$\vec{B} = B_x\hat{i} + B_y\hat{j} + B_z\hat{k}$

$\therefore \boxed{\vec{A}\cdot\vec{B} = A_xB_x + A_yB_y + A_zB_z}$

$\vec{A}\times\vec{B} = AB\sin\theta\,\hat{n}$; $[0 \le \theta \le 180^\circ]$

$\vec{A}\times\vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$

$\therefore$ Unint Vector along the direction or parallel to $\vec{A}$ is going to be: $\hat{a} = \dfrac{\vec{A}}{|\vec{A}|} = \dfrac{A_x\hat{i} + A_y\hat{j} + A_z\hat{k}}{\sqrt{A_x^2 + A_y^2 + A_z^2}}$

VECTOR DOT MULTIPLICATION AND CROSS MULTIPLICATION MATHEMATICAL PROBLEMS

\# If $\vec{A} = 3\hat{\imath} + \hat{\jmath} - a\hat{k}$ and $\vec{B} = 4\hat{\imath} - a\hat{\jmath} + a\hat{k}$ are perpendicular to each other then what is the value of a?

$\vec{A} \perp \vec{B}$, $\therefore \vec{A}.\vec{B} = 0$

$\Rightarrow (3\hat{i} + \hat{j} - a\hat{k}).(4\hat{i} - a\hat{j} + a\hat{k}) = 0$

$\Rightarrow 12 - a - a^2 = 0$

$\Rightarrow (a-3)(a+4) = 0$

$a - 3 = 0$ | $a + 4 = 0$

$\Rightarrow a = 3$ | $\Rightarrow a = -4$

$\boxed{\text{Ans: } a = 3, -4}$

VECTOR DOT MULTIPLICATION AND CROSS MULTIPLICATION MATHEMATICAL PROBLEMS

\# If the sum and subtraction of two vectors are equal, what is the value of the angle between the two vectors?

$$|\vec{A}+\vec{B}| = |\vec{A}-\vec{B}|$$

$$\Rightarrow \sqrt{A^2+B^2+2AB\cos\alpha} = \sqrt{A^2+B^2-2AB\cos\alpha}$$

$$\Rightarrow \cancel{A^2}+\cancel{B^2}+2AB\cos\alpha = \cancel{A^2}+\cancel{B^2}-2AB\cos\alpha$$

$$\Rightarrow 4AB\cos\alpha = 0$$

$$\Rightarrow \cos\alpha = 0$$

$$\Rightarrow \alpha = \cos^{-1}(0)$$

$$\boxed{\therefore \alpha = 90^\circ}$$

Short cut:
If two vector,
sum = Substraction
$\alpha = 90^\circ$

VECTOR DOT MULTIPLICATION AND CROSS MULTIPLICATION MATHEMATICAL PROBLEMS

\# For which value of a $\vec{A} = 5\hat{i} + 2\hat{j} - 3\hat{k}$ *and* $\vec{B} = 15\hat{i} + a\hat{j} - 9\hat{k}$ vectors will be parallel to each other?

$A \parallel B$, $\vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 5 & 2 & -3 \\ 15 & a & -9 \end{vmatrix} \Rightarrow a = 6$

$\frac{15}{315} = \frac{2}{a}$

Shortcut: If $\vec{A}$ & $\vec{B}$ are parallel, $\Rightarrow \frac{A_x}{B_x} = \frac{A_y}{B_y} = \frac{A_z}{B_z}$ $\Rightarrow a = 3 \times 2$

$\Rightarrow \frac{5}{15} = \frac{2}{a} = \frac{-3}{-9}$ $\therefore a = 6$

VECTOR DOT MULTIPLICATION AND CROSS MULTIPLICATION MATHEMATICAL PROBLEMS

\# If $\vec{A} = 5\hat{j} + 3\hat{i}$ and $\vec{B} = 5\hat{i} + 3\hat{j}$ indicate the two diagonals of a parallelogram, then what is the area of the pralllelogram ?

$$\text{Area} = \frac{1}{2}|\vec{A} \times \vec{B}|$$

$$\therefore |\vec{A} \times \vec{B}| = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 5 & 0 \\ 5 & 3 & 0 \end{vmatrix} = \hat{i}(0-0) + \hat{j}(0-0) + \hat{k}(9-25)$$

$$= -16\hat{k}$$

$$\therefore \text{Area} = \frac{1}{2}|\vec{A} \times \vec{B}| = \frac{1}{2}\sqrt{0^2+0^2+(-16)^2} = \frac{1}{2}\sqrt{256}$$

$$= \frac{1}{2} \times 16 = 8 \text{ sq unit [Ans]}$$

VECTOR DOT MULTIPLICATION AND CROSS MULTIPLICATION MATHEMATICAL PROBLEMS

\# If $\vec{A} = 2\hat{\imath} + \hat{\jmath} - \hat{k}$, $\vec{B} = 3\hat{\imath} - 2\hat{\jmath} + 4\hat{k}$ and $\vec{C} = \hat{\imath} - 3\hat{\jmath} + 5\hat{k}$ then, show that they are on the same plane.

(1) If $(\vec{A} \times \vec{B}) \cdot \vec{C} = 0$, $\vec{A}, \vec{B}$ & $\vec{C}$ are on the same plane.

(2) Determinant: If
$$\begin{vmatrix} 2 & 1 & -1 \\ 3 & -2 & 4 \\ 1 & -3 & 5 \end{vmatrix} = 0$$
; $\vec{A}, \vec{B}$ & $\vec{C}$ " " " " ".

(3) shortcut: $\boxed{\vec{B} - \vec{A} = \vec{C}}$

$$\vec{B} = 3\hat{\imath} - 2\hat{\jmath} + 4\hat{k}$$
$$\vec{A} = 2\hat{\imath} - \hat{\jmath} - \hat{k}$$
$$\vec{C} = \hat{\imath} + 3\hat{\jmath} + 5\hat{k}$$

$\therefore \vec{A}, \vec{B}$ & $\vec{C}$ are on the same plane.

Poll Question 07

If $\vec{A} = \hat{\imath} - 2\hat{\jmath} + 2\hat{k}$, $\vec{B} = 3\hat{\imath} - 4\hat{\jmath} + 5\hat{k}$ and $\vec{c} = 2\hat{\imath} - 2\hat{\jmath} + a\hat{k}$ are working on the same plane, then what would be the value of "a"?

(a) 2
(b) 3
(c) 4
(d) 5

VECTOR DIFFERENTIATION

$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$

velocity: $\vec{v} = \frac{d\vec{r}}{dt} = \frac{d}{dt}(x\hat{i} + y\hat{j} + z\hat{k}) = \frac{d}{dt}x\hat{i} + \frac{d}{dt}y\hat{j} + \frac{d}{dt}z\hat{k}$

~~acceleration~~, $a = \frac{d\vec{v}}{dt} = \frac{d}{dt}\left(\frac{d\vec{r}}{dt}\right) = \frac{d^2\vec{r}}{dt^2} = \frac{d^2}{dt^2}(x\hat{i} + y\hat{j} + z\hat{k})$

$\vec{r} = 5t^2$, what's the velocity after 2s.

$\vec{v} = \frac{d\vec{r}}{dt} = \frac{d}{dt}(5t^2) = 5 \times 2t^{2-1} = 10t$

$\therefore$ velocity, $v = 10 \times 2 = 20\, ms^{-1}$, [Ans]

VECTOR CURL

\# Show that, $\vec{A} = (x + 2y + 4z)\hat{i} + (2x - 3y - z)\hat{j} + (4x - y + 2z)\hat{k}$ is a non-rotational vector.

$$\vec{\nabla} \times \vec{A} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\delta}{\delta x} & \frac{\delta}{\delta y} & \frac{\delta}{\delta z} \\ x+2y+4z & 2x-3y-z & 4x-y+2z \end{vmatrix} = \hat{i}\left[\frac{\delta}{\delta y}(4x-y+2z) - \frac{\delta}{\delta z}(2x-3y-z)\right]$$

$$+ \hat{j}\left[\frac{\delta}{\delta z}(x+2y+4z) - \frac{\delta}{\delta x}(4x-y+2z)\right] + \hat{k}\left[\frac{\delta}{\delta x}(2x-3y-z) - \frac{\delta}{\delta y}(x+2y+4z)\right]$$

$$= \hat{i}(-1+1) + \hat{j}(4-4) + \hat{k}(2-2) = \vec{0}$$

$\therefore \vec{A}$ vector is non-rotational.

Poll Question 08

If the value of Curl is zero then the vector would be–

(a) rotational
(b) non-rotational
(c) angular
(d) none of them

Poll Question 09

Which one is correct for the gradient of curl ?

(a) $\vec{\nabla} \cdot \left(\vec{\nabla} x \vec{A}\right) = 0$

(b) $\vec{\nabla} X \left(\vec{\nabla} x \vec{A}\right) = 0$

(c) $\vec{\nabla} \cdot \left(\vec{\nabla} . \vec{A}\right) = 0$

(d) $\vec{\nabla} \cdot \left(\vec{\nabla} x \vec{A}\right) = 1$

VECTOR DIVERGENCE

\# In (1,-1,1)position,determine the divergence of $\vec{A} = 3xyz^3\hat{\imath} + 2xy^2\hat{\jmath} - x^3y^2z\hat{k}$ vector.

$$\vec{\nabla} \cdot \vec{A} = \left(\frac{\delta}{\delta x}\hat{i} + \frac{\delta}{\delta y}\hat{j} + \frac{\delta}{\delta z}\hat{k}\right) \cdot \left(3xyz^3\hat{i} + 2xy^2\hat{j} - x^3y^2z\right)$$

$$= \frac{\delta}{\delta x}(3xyz^3) + \frac{\delta}{\delta y}(2xy^2) + \frac{\delta}{\delta z}(-x^3y^2z)$$

$$= 3yz^3 + 4xy - x^3y^2$$

$$(1,-1,1) \Rightarrow \vec{\nabla} \cdot \vec{A} = 3(-1)(1)^3 + 4(1)(-1) - (1)^3(-1)^2$$

$$= -3 - 4 - 1 = -8, \text{ [Ans]}$$

Poll Question 10

If the value of vector divergence is zero then it would represent–

(a) Solinoid
(b) Triangle
(c) Line
(d) None of them

VECTOR DIVERGENCE

\# For which value of b, vector $\vec{v} = (x + 3y)\hat{\imath} + (by - z)\hat{\jmath} + (x - 2z)\hat{k}$ would be solinoidal?

$$\vec{\nabla}\cdot\vec{v} = \left(\frac{\delta}{\delta x}\hat{i} + \frac{\delta}{\delta y}\hat{j} + \frac{\delta}{\delta z}\hat{k}\right)\cdot\left\{(x+3y)\hat{i} + (by-z)\hat{j} + (x-2z)\hat{k}\right\}$$

$$= \frac{\delta}{\delta x}(x+3y) + \frac{\delta}{\delta y}(by-z) + \frac{\delta}{\delta z}(x-2z)$$

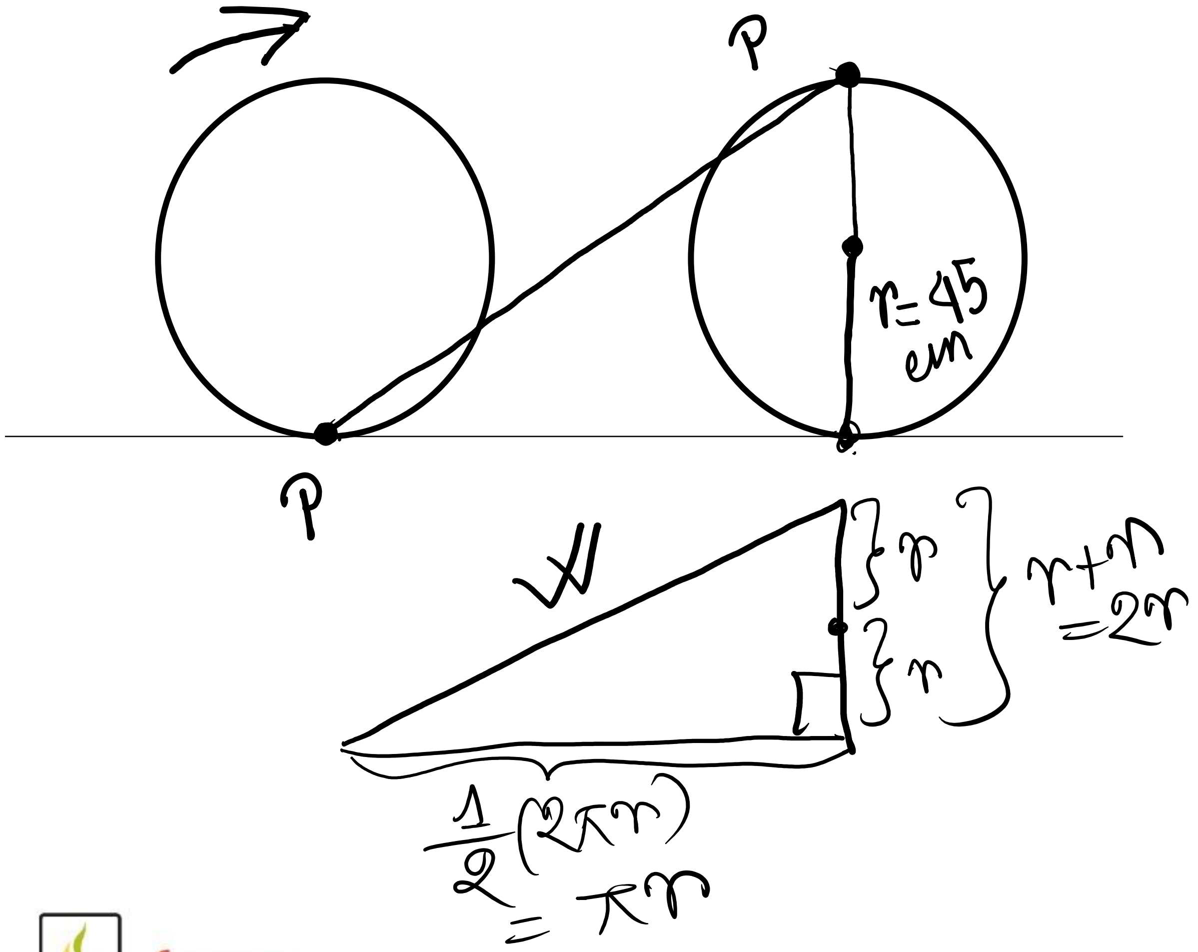
$$= 1 + b - 2$$

$$= b - 1$$

$$\therefore b - 1 = 0$$

$$\therefore \underline{b = 1}, \quad [\text{Am}]$$

COMPLEX PROBLEM



What is the displacement of P?

$$\text{displacement} = \sqrt{(2r)^2 + (\pi r)^2}$$

$$= \sqrt{(2\times 45)^2 + (\pi \times 45)^2}$$

$$= 167.6 \text{ cm}, \text{ [Ans]}$$

না বুঝে মুখস্থ করার অভ্যাস
প্রতিভাকে ধ্বংস করে।