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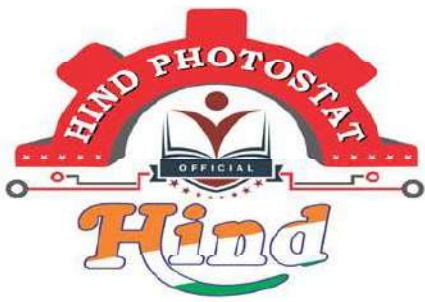
IES MASTER

Civil Engineering
Toppers Handwritten Notes
Engineering Mechanics

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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* Engg. Mechanics *

→ Study of Motion of rigid bodies under the action of forces.

Statics (rest)

- force & moment
- Equilibrium
- plane Trusses
- principle of virtual work

Dynamics (motion)

kinematics
(motion)

$(\vec{r}, \vec{v}, \vec{a})$

kinetic
(motion a
with cause
of motion
 $(\vec{r}, \vec{v}, \vec{a})$

* Dynamics →

• Vector Algebra →

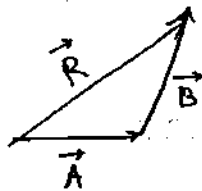
* Vector →

"Those physical quantities which have mag. as well as dirn and follows triangle law of vector addition." are called vector quantities."

e.g. $\vec{V}, \vec{\omega}, \vec{P}, \vec{L}, \vec{F}, \vec{T}$ etc.

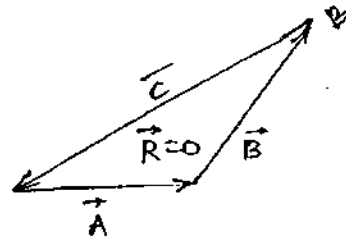
* Triangle law of vector addition →

$$\vec{R} = \vec{A} + \vec{B}$$



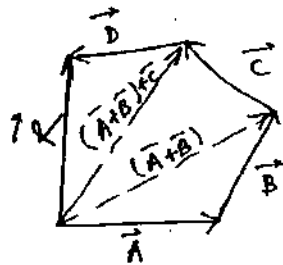
$$\vec{A} + \vec{B} + \vec{C} = 0$$

$$\vec{C} = -(\vec{A} + \vec{B})$$

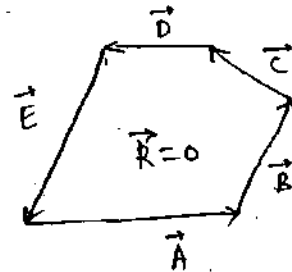


• polygon Rule →

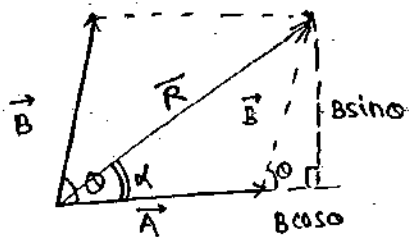
$$\vec{R} = \vec{A} + \vec{B} + \vec{C} + \vec{D}$$



$$\vec{A} + \vec{B} + \vec{C} + \vec{D} + \vec{E} = 0$$



* parallelogram law →



→ (most used condⁿ)
(outward vectors)



$$\therefore R^2 = (A + B \cos \theta)^2 + (B \sin \theta)^2$$

$$\therefore R = \sqrt{A^2 + B^2 + 2AB \cos \theta}$$

$$\therefore \tan \alpha = \frac{B \sin \theta}{A + B \cos \theta}$$

Vector = mag (dirⁿ)

unif vector = (1) (dirⁿ) = dirⁿ

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

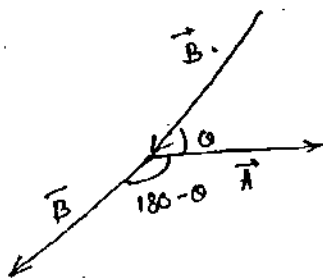
$$|\vec{A}| = \sqrt{A_x^2 + A_y^2 + A_z^2}$$

Note: [IF head-head
OR Tail-Tail.

then (+ sign in)
2AB cos theta term

[IF head-tail
then,
(-ve) sign]

eg ①

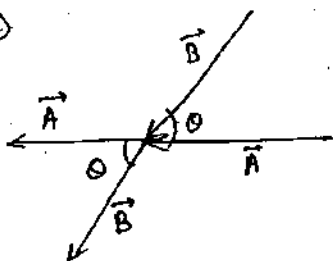


$$\therefore R = \sqrt{A^2 + B^2 + 2AB \cos(180 - \theta)}$$

$$= \sqrt{A^2 + B^2 + 2AB (-\cos \theta)}$$

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

②



$$R = \sqrt{A^2 + B^2 + 2AB \cos \theta}$$

Que.: Resultant of two vectors A & B is R . If B is doubled then the new resultant is \perp ar to \vec{A} . then.

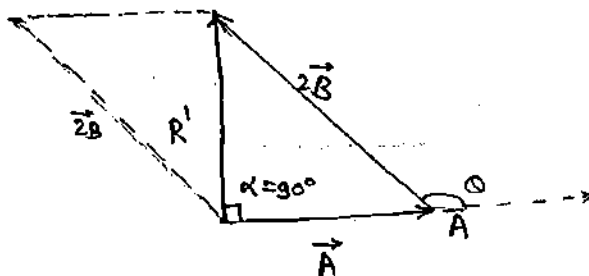
- a) $A=B$
- b) $A=R$
- ✓ c) $B=R \rightarrow$ Ans
- d) None.

\rightarrow $\underbrace{A \ \& \ B}_{\theta} \rightarrow R$

$$\therefore R^2 = A^2 + B^2 + 2AB \cos \theta \quad \text{--- (1)}$$

$\underbrace{A \ \& \ 2B}_{\theta} \rightarrow R'$

$$\tan \alpha = \frac{B \sin \theta}{A + B \cos \theta}$$



$$\therefore \tan \alpha = \frac{2B \sin \theta}{A + 2B \cos \theta}$$

$$\tan 90^\circ = \infty$$

$$\therefore A + 2B \cos \theta = 0$$

$$\cos \theta = \frac{-A}{2B} \quad \text{--- (2)}$$

\therefore from (1) & (2)

$$A^2 + B^2 + 2AB \left(\frac{-A}{2B} \right) = R^2$$

$$\therefore \boxed{B=R}$$