NDA 1 2025

LIVE

MATHS

VECTOR ALGEBRA

CLASS 1

NAVJYOTI SIR

Crack
EXAMS

31 Oct 2024 Live Classes Schedule

8:00AM	OCTOBER 2024 MONTHLY CURRENT AFFAIRS	RUBY MA'AM
9:00AM	OCTOBER 2024 MONTHLY DEFENCE UPDATES	DIVYANSHU SIR

NDA 1 2025 LIVE CLASSES

11:30AM	GK - ANCIENT HISTORY - CLASS 2	RUBY MA'AM
1:00PM	CHEMISTRY MCQ - CLASS 1	SHIVANGI MA'AM
4:00PM	MATHS - VECTOR ALGEBRA - CLASS 1	NAVJYOTI SIR
5:30PM	ENGLISH - CLOZE TEST - CLASS 2	ANURADHA MA'AM

CDS 1 2025 LIVE CLASSES

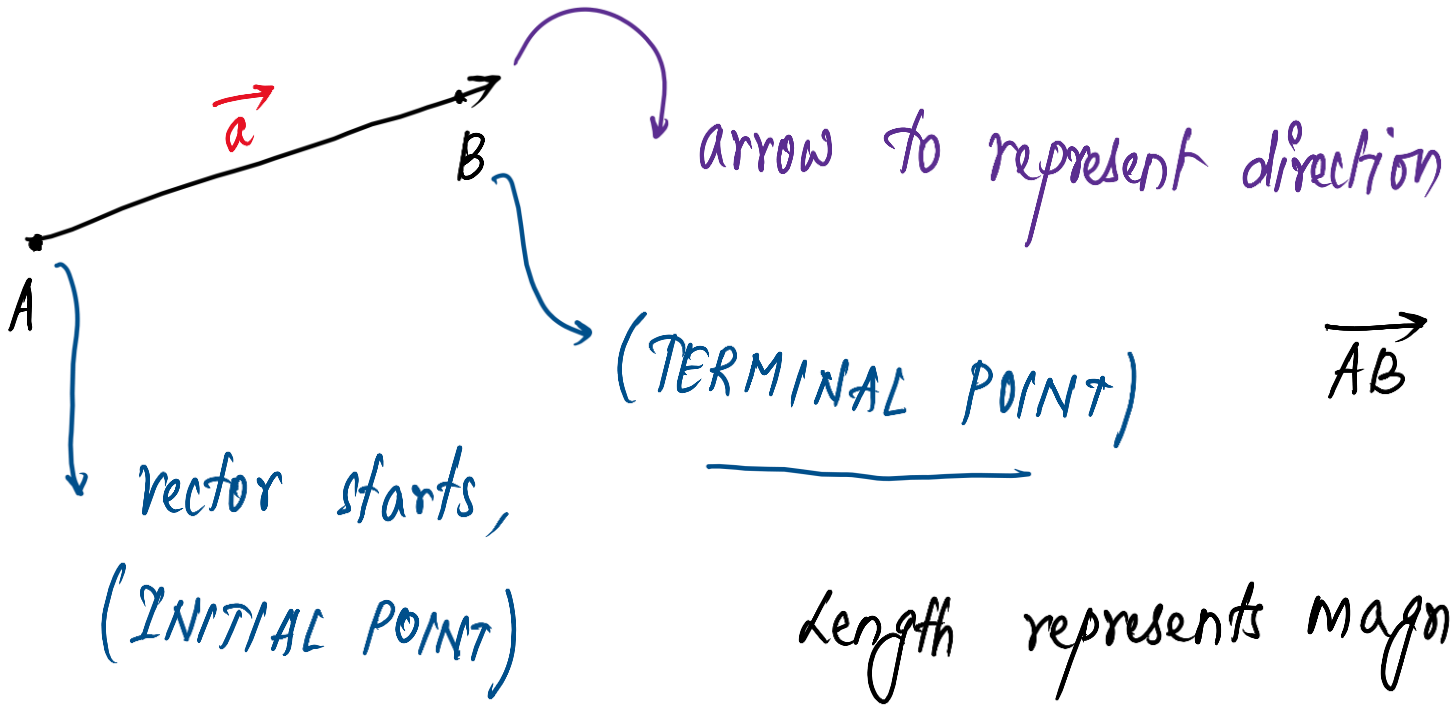
11:30AM	GK - ANCIENT HISTORY - CLASS 2	RUBY MA'AM
1:00PM	CHEMISTRY MCQ - CLASS 1	SHIVANGI MA'AM
5:30PM	ENGLISH - CLOZE TEST - CLASS 2	ANURADHA MA'AM

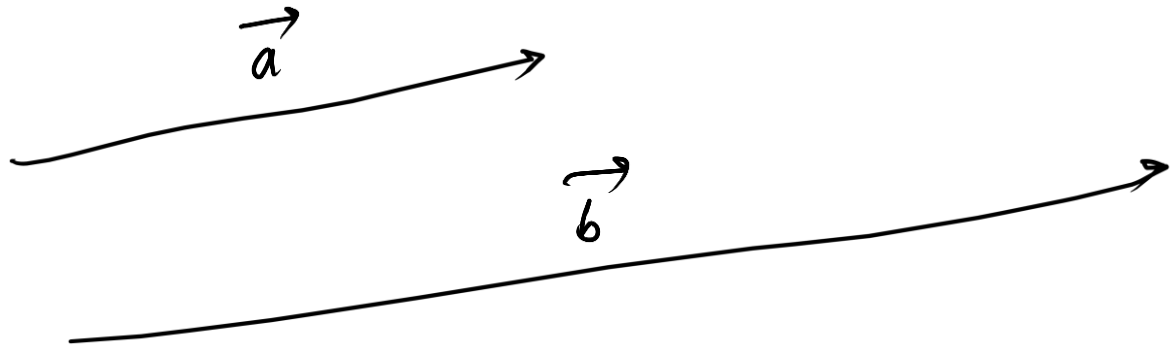
AFCAT 1 2025 LIVE CLASSES

4:00PM	STATIC GK - INDIA & UNO	DIVYANSHU SIR
5:30PM	ENGLISH - CLOZE TEST - CLASS 2	ANURADHA MA'AM
7:00PM	MATHS - SDT & CLOCKS	NAVJYOTI SIR

VECTOR

→ Quantity having magnitude as well as direction.

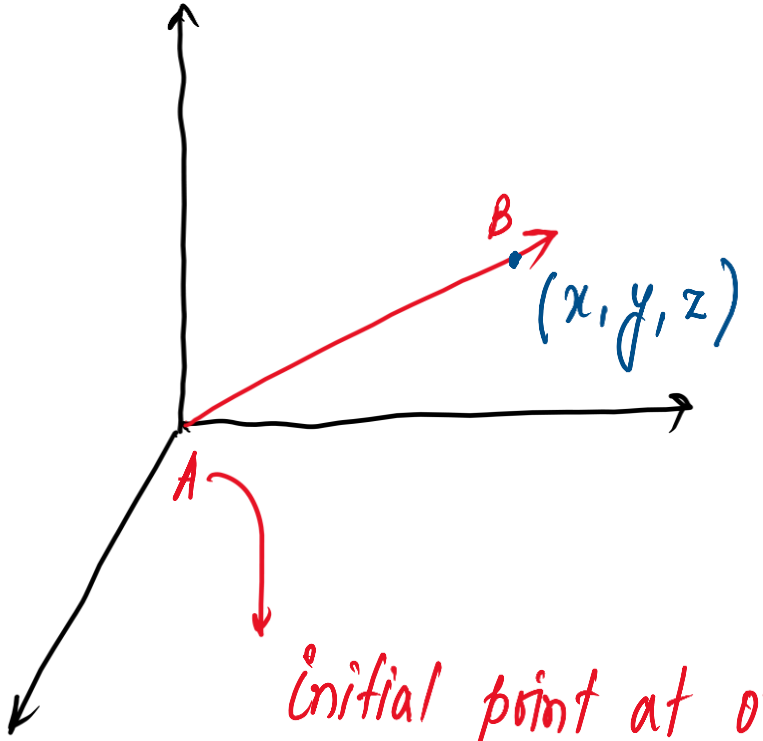




b / $|\vec{b}|$ ⟶ magnitude of $\vec{b}$ a / $|\vec{a}|$ ⟶ magnitude of $\vec{a}$

$|\vec{b}| > |\vec{a}|$ $(b > a)$

POSITION VECTOR



$\overrightarrow{AB}$ is position vector.

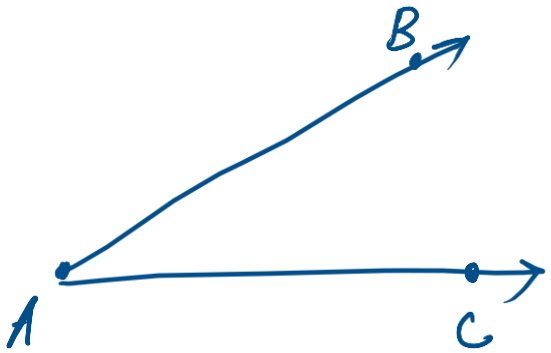
initial point at origin

Every point in space represents position and is so, a vector.

TYPES OF VECTORS

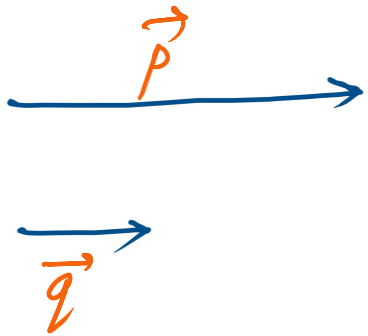
(1) Zero vector — no magnitude, no direction.

(2) Co-initial vectors



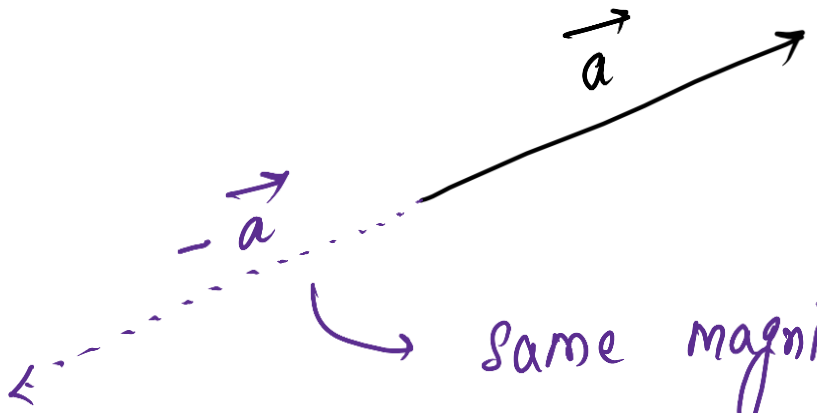
$\overrightarrow{AB}$ and $\overrightarrow{BC}$ are coinitial vectors.

(3) Parallel vectors



$\vec{p}$ and $\vec{q}$ are parallel vectors.

(4) Negative vector –



same magnitude but opposite in direction.

(5) Reciprocal vector

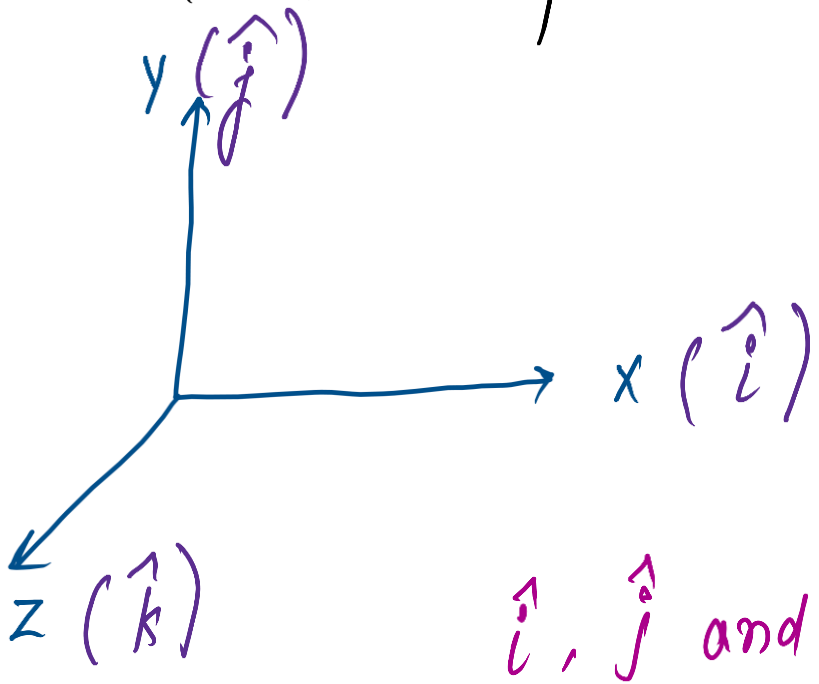
$|\vec{a}| = a$ $\quad$ $|\vec{a}^{-1}| = \frac{1}{a}$

reciprocal of magnitude; direction is same.

UNIT VECTOR

→ Vector having magnitude as 1.

→ Used to represent direction.

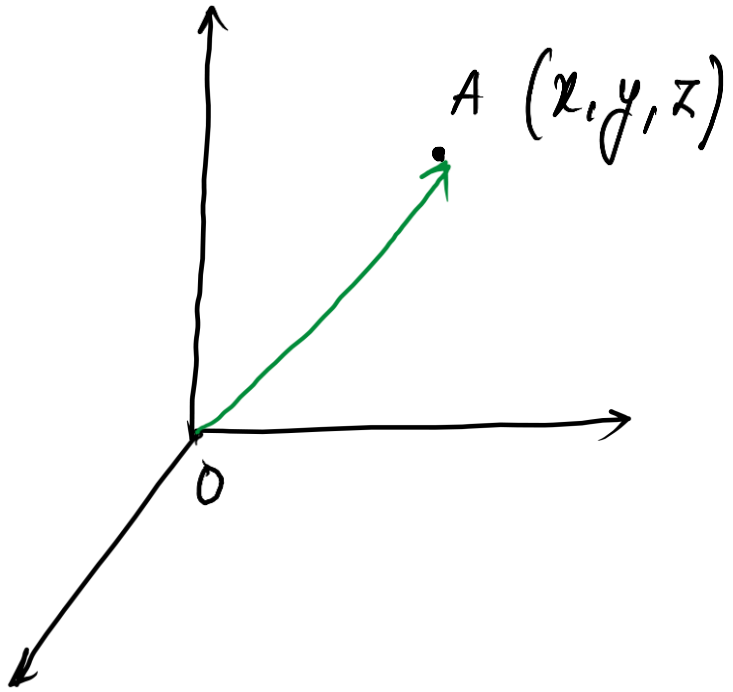


Unit vector for $\vec{a}$

$$\hat{a} = \frac{\text{vector}}{\text{its magnitude}}$$

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

$\hat{i}$, $\hat{j}$ and $\hat{k}$ are unit vectors along x, y & z-axis.



Length of vector along x-axis : x

" " " y-axis : y

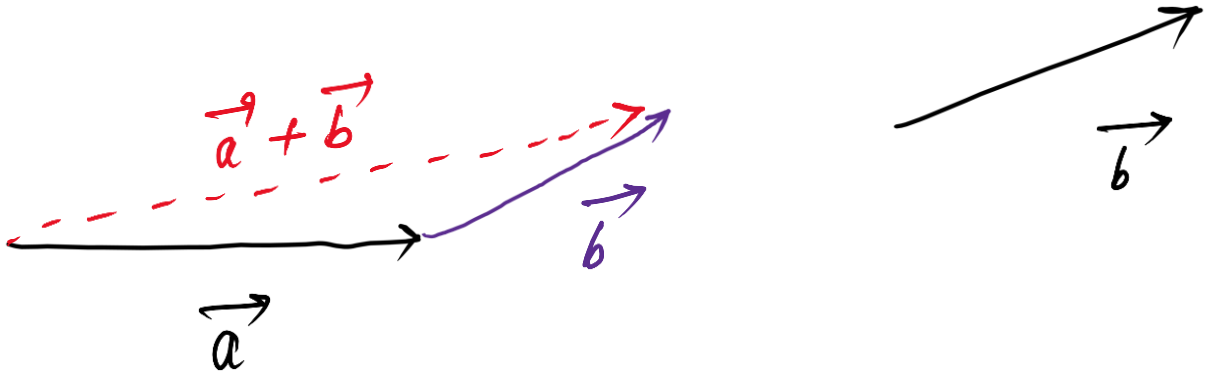
" " " z-axis : z

} components of vector

$$\overrightarrow{OA} = x\hat{i} + y\hat{j} + z\hat{k}$$

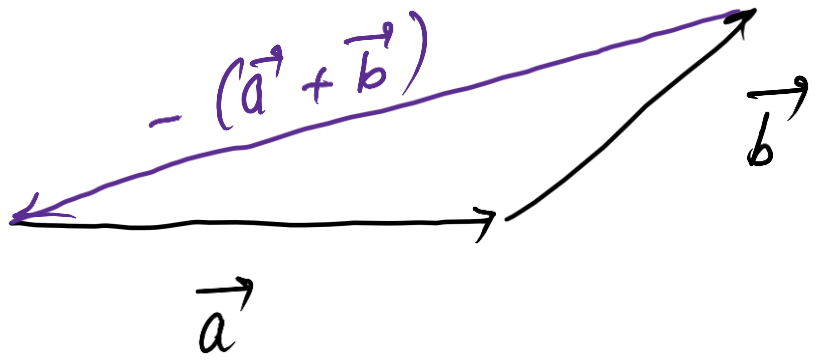
$$|\overrightarrow{OA}| = \sqrt{x^2 + y^2 + z^2}$$

ADDITION OF VECTORS



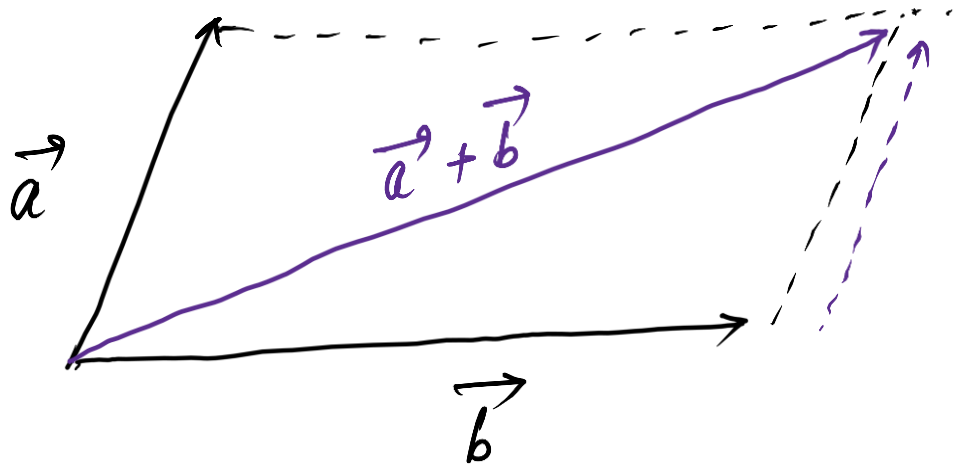
(Triangle law) →

- Two sides of triangle represent the two vectors
- Third side, in opposite manner, represent their sum.



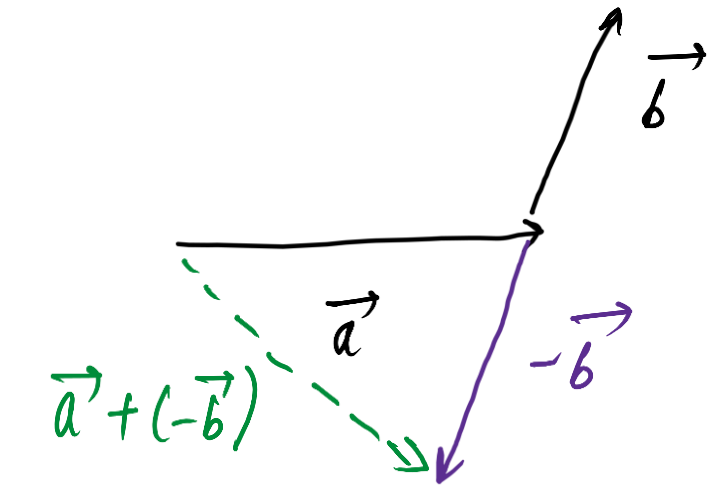
$$\vec{a} + \vec{b} - (\vec{a} + \vec{b}) = 0$$

If sum is taken in cyclic manner, then sum is 0.



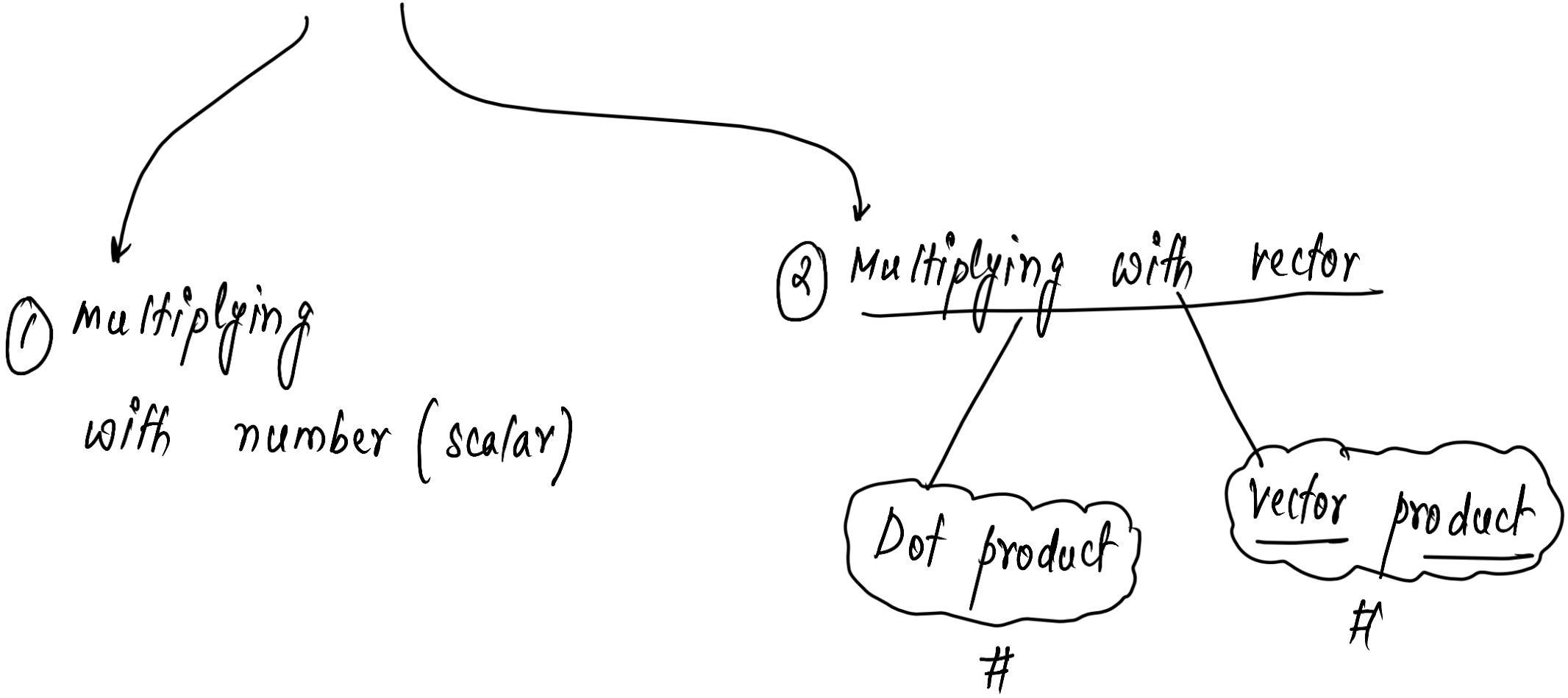
if two adjacent sides of parallelogram represent two vectors, diagonal represents their sum.

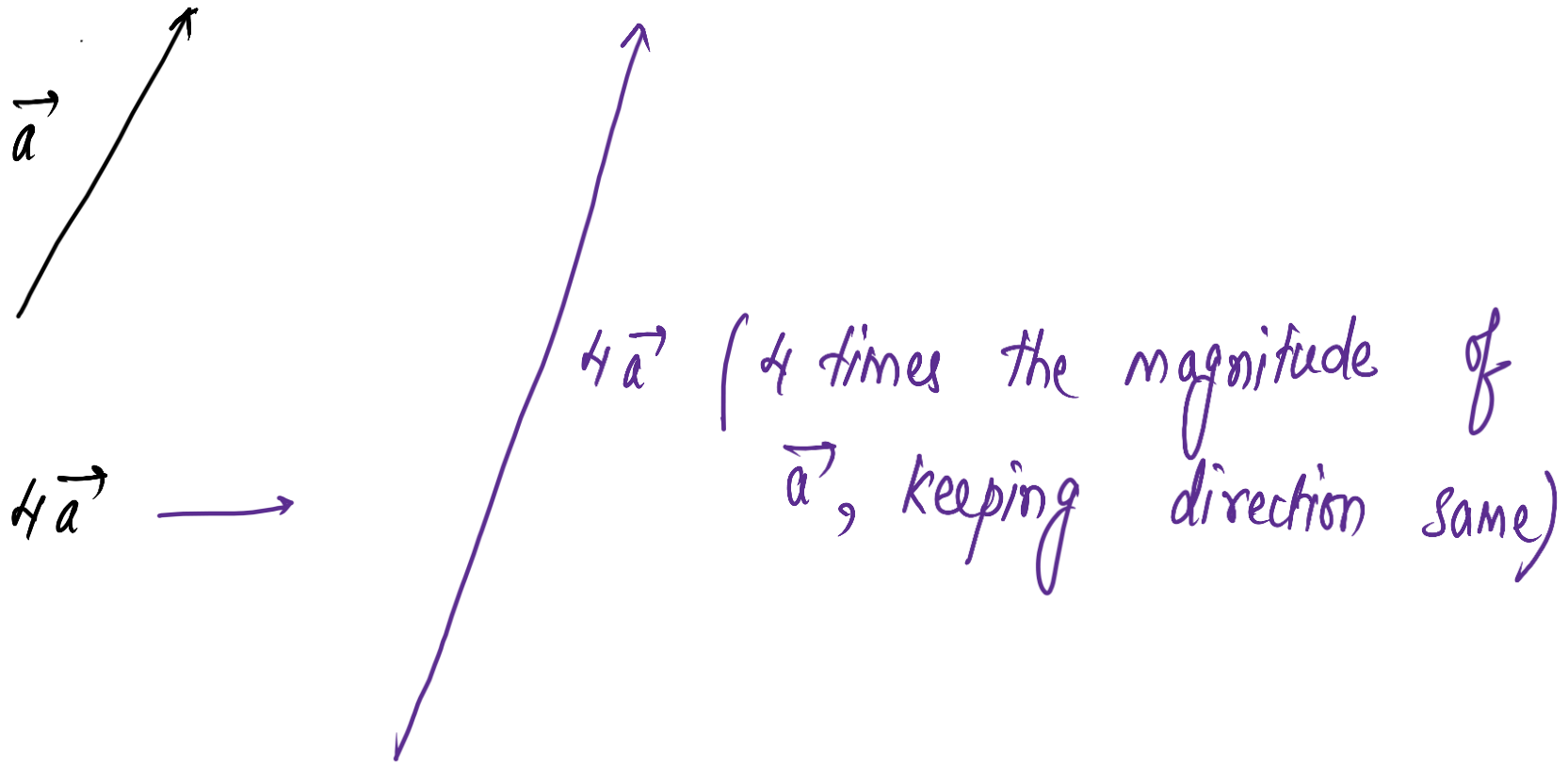
SUBTRACTION



$$\vec{a} - \vec{b} = a + (-\vec{b})$$

MULTIPLICATION





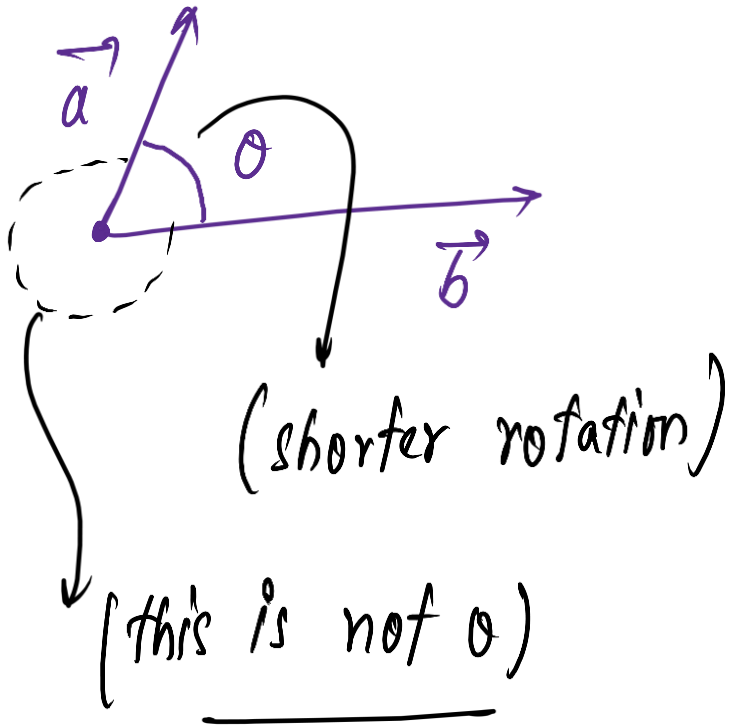
(i) Multiplying with number

(2) Multiplying with a vector

- scalar (dot) product
- vector (cross) product

Scalar product

$$\vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}| \cos\theta$$



→ gives number as a result

→ $\vec{a} \cdot \vec{b} = \vec{b} \cdot \vec{a}$

→ if $\vec{a}$ is perpendicular to $\vec{b}$

$\theta = 90^\circ \Rightarrow \cos\theta = 0 \Rightarrow \vec{a} \cdot \vec{b} = 0$

If $\vec{a} \cdot \vec{b} = 0 \Rightarrow \vec{a} \perp \vec{b}$.

$\hat{i} \cdot \hat{i} = (1 \times 1)\cos 0^\circ = 1$

$\hat{j} \cdot \hat{j} = 1$

$\hat{k} \cdot \hat{k} = 1$

$\hat{i} \cdot \hat{j} = (1 \times 1)\cos 90^\circ = 0$

$\hat{j} \cdot \hat{i} = 0$

$\hat{i} \cdot \hat{k} = 0$

$\hat{k} \cdot \hat{i} = 0$

$\hat{j} \cdot \hat{k} = 0$

$\hat{k} \cdot \hat{j} = 0$

$$\vec{a} = a_1 \hat{i} + a_2 \hat{j} + a_3 \hat{k}$$

$$\vec{b} = b_1 \hat{i} + b_2 \hat{j} + b_3 \hat{k}$$

$$\vec{a} \cdot \vec{b} = \left(a_1 \hat{i} + a_2 \hat{j} + a_3 \hat{k}\right) \cdot \left(b_1 \hat{i} + b_2 \hat{j} + b_3 \hat{k}\right)$$

$$= a_1 b_1 + a_2 b_2 + a_3 b_3$$

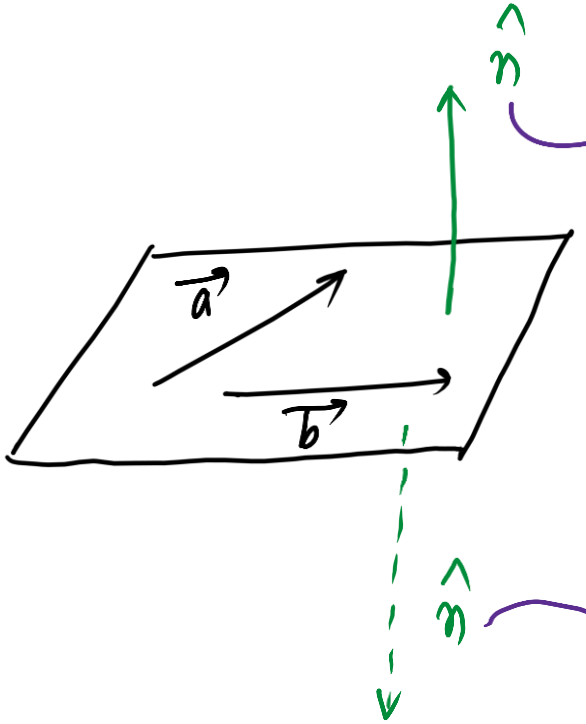
$$\vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}| \cos\theta$$

$$\cos\theta = \frac{\vec{a} \cdot \vec{b}}{|\vec{a}||\vec{b}|}$$

Vector product

$\vec{a} \times \vec{b} = |\vec{a}||\vec{b}| \sin\theta \cdot \hat{n}$

($\hat{n}$ → unit vector representing direction perpendicular to the plane containing $\vec{a}$ and $\vec{b}$).



→ $|\vec{a} \times \vec{b}| = |\vec{b} \times \vec{a}| = |\vec{a}||\vec{b}| \sin\theta$

$\vec{a} \times \vec{b} \neq \vec{b} \times \vec{a}$ (because direction of $\hat{n}$ are different)

$\hat{i} \times \hat{i} = 1 \times 1 \times \sin 0^\circ = 0$

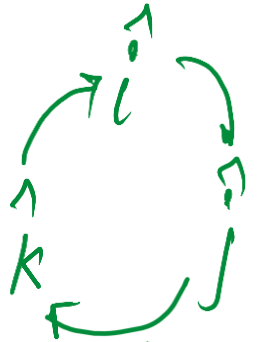
$\hat{j} \times \hat{j} = 0$

$\hat{k} \times \hat{k} = 0$

$\hat{i} \times \hat{j} = \hat{k}$

$\hat{j} \times \hat{k} = \hat{i}$

$\hat{k} \times \hat{i} = \hat{j}$

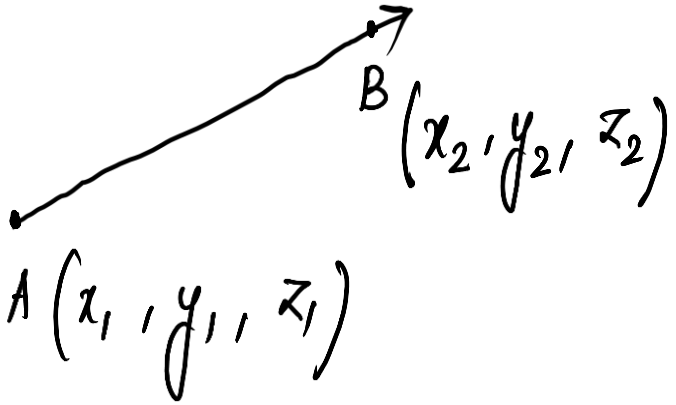


$\hat{j} \times \hat{i} = -\hat{k}$

$\hat{k} \times \hat{j} = -\hat{i}$

$\hat{i} \times \hat{k} = -\hat{j}$

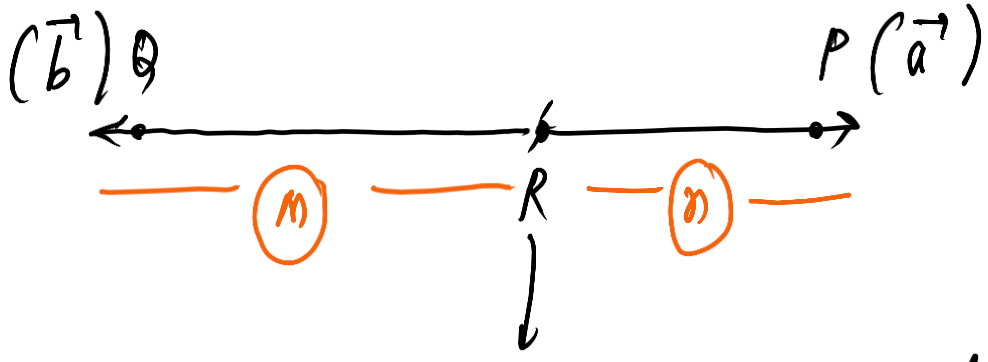
VECTOR JOINING TWO POINTS IN SPACE



$$\overrightarrow{AB} = (x_2 - x_1)\,\hat{i} + (y_2 - y_1)\,\hat{j} + (z_2 - z_1)\,\hat{k}$$

$$|\overrightarrow{AB}| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$ (distance between 2 points)

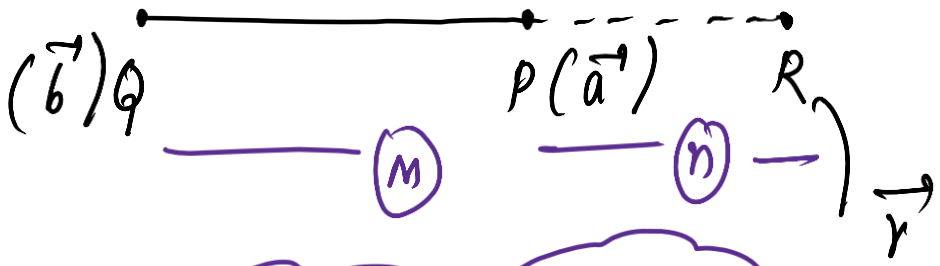
SECTION FORMULA



(position vector for $\vec{r}$)

$$\vec{r} = \frac{m\vec{a} - n\vec{b}}{m-n}$$

(Internal division)



$$\vec{r} = \frac{m\vec{a} - n\vec{b}}{m-n}$$

(External division)

SSBCrack EXAMS

QUESTION

The angle between the vectors $\hat{i}-\hat{j}$ and $\hat{j}-\hat{k}$ is

(A) $\frac{\pi}{3}$ (B) $\frac{2\pi}{3}$ ✓ (C) $\frac{-\pi}{3}$ (D) $\frac{5\pi}{6}$

$\vec{a} = \hat{i} - \hat{j}$ $\quad |\vec{a}| = \sqrt{x^2+y^2+z^2} = \sqrt{1^2+(-1)^2} = \sqrt{2}$

$(x\hat{i}+y\hat{j}+z\hat{k})$

$\vec{b} = \hat{j} - \hat{k}$ $\quad |\vec{b}| = \sqrt{1^2+(-1)^2} = \sqrt{2}$

$$\cos\theta = \frac{(\hat{i}-\hat{j})\cdot(\hat{j}-\hat{k})}{\sqrt{2}\cdot\sqrt{2}}$$

$$\cos\theta = \frac{0-1+0}{2} = \frac{-1}{2}$$ ✓

QUESTION

The 2 vectors $\hat{j}+\hat{k}$ and $3\hat{i}-\hat{j}+4\hat{k}$ represents the two sides AB and AC, respectively of a ΔABC. The length of the median through A is

(A) $\frac{\sqrt{34}}{2}$ (B) $\frac{\sqrt{48}}{2}$ (C) $\sqrt{18}$ (D) None of these

(PYQ – 2024 – I)

If a vector of magnitude 2 units makes an angle $\frac{\pi}{3}$ with $2\hat{i}$, $\frac{\pi}{4}$ with $3\hat{j}$ and an acute angle θ with $4\hat{k}$, then what are the components of the vector ?

(a) $(1, \sqrt{2}, 1)$

(b) $(1, -\sqrt{2}, 1)$

(c) $(1, -\sqrt{2}, -1)$

(d) $(1, \sqrt{2}, -1)$

Let $\vec{a}$ and $\vec{b}$ are two vectors of magnitude 4 inclined at an angle $\frac{\pi}{3}$, then what is the angle between $\vec{a}$ and $\vec{a}-\vec{b}$?

(a) $\frac{\pi}{2}$

(b) $\frac{\pi}{3}$

(c) $\frac{\pi}{4}$

(d) $\frac{\pi}{6}$

(PYQ – 2024 – I)

Let θ be the angle between two unit vectors $\vec{a}$ and $\vec{b}$. If $\vec{a}+2\vec{b}$ is perpendicular to $5\vec{a}-4\vec{b}$, then what is $\cos\theta+\cos 2\theta$ equal to?

(PYQ – 2024 – II)

(a) 0

(b) 1/2

(c) 1

(d) $\frac{\sqrt{3}+1}{2}$

$$(\vec{a}+2\vec{b})\cdot(5\vec{a}-4\vec{b})=0$$

$$|\vec{a}|=a$$

$$5a^2+10\vec{b}\cdot\vec{a}-8b^2-4\vec{a}\cdot\vec{b}=0$$

$$5a^2-8b^2+6\vec{a}\cdot\vec{b}=0$$

$$5-8+6ab\cos\theta=0$$

$$-3+6\cos\theta=0$$

$$\cos\theta=\frac{3}{6}=\frac{1}{2}$$

$$\theta=60^\circ$$

$$\cos 60^\circ+\cos 120^\circ$$

Let $ABCDEF$ be a regular hexagon. If $\overrightarrow{AD} = m\overrightarrow{BC}$ and $\overrightarrow{CF} = n\overrightarrow{AB}$, then what is mn equal to?

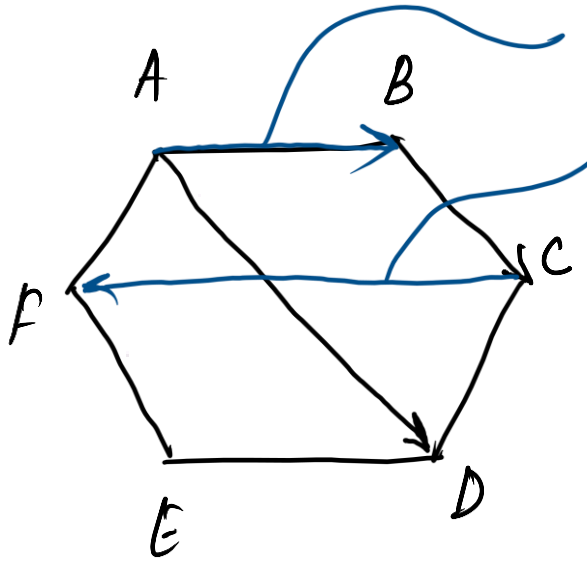
(PYQ – 2024 – II)

(a) –4

(b) –2

(c) 2

(d) 4



opposite dir.

$\overrightarrow{AD} = 2\overrightarrow{BC} \Rightarrow m = 2$

$\overrightarrow{CF} = -2\overrightarrow{AB} \Rightarrow n = -2$

$\{ mn = 2 \times -2 = -4 \}$

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