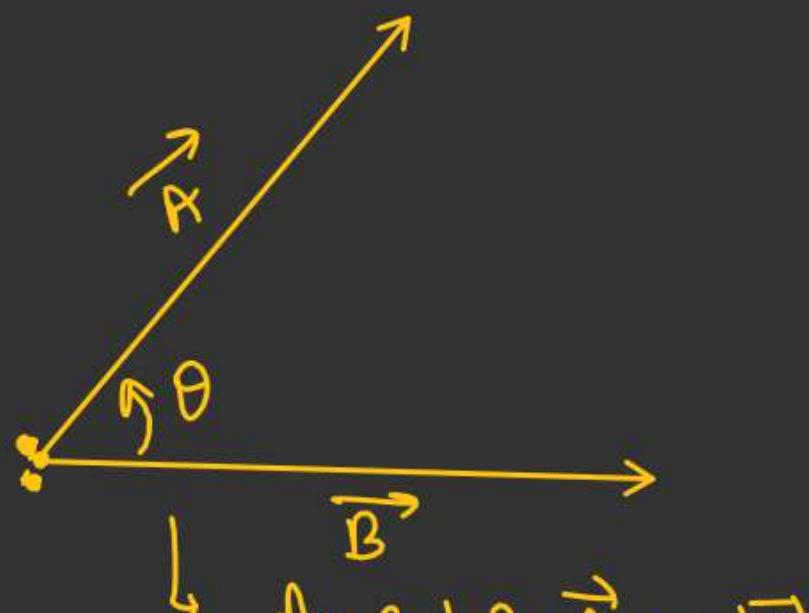


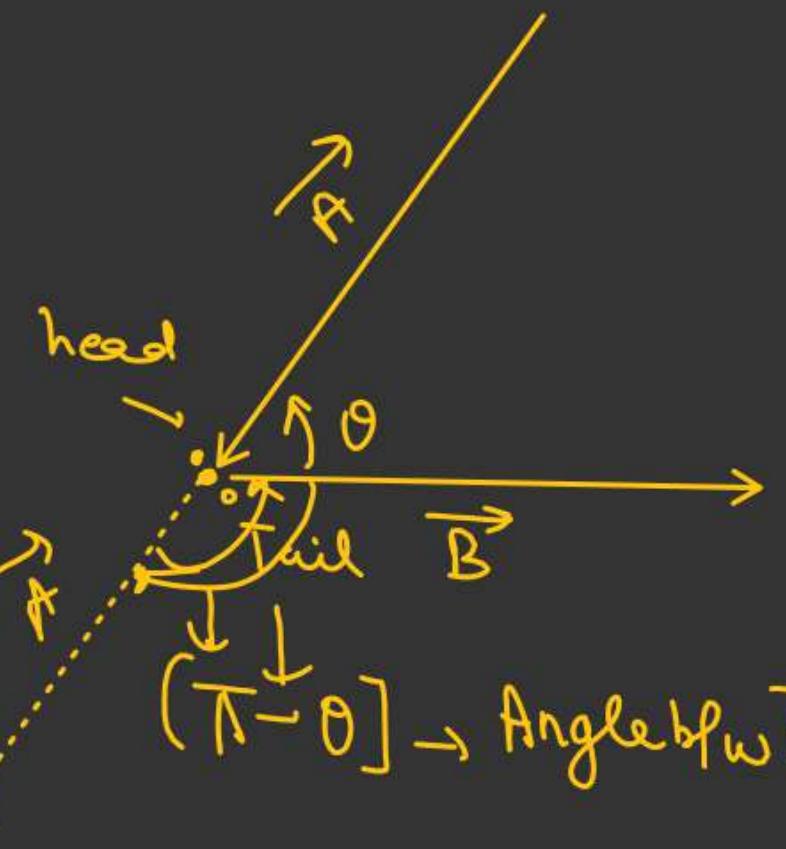
$$R = \sqrt{A^2 + B^2 + 2AB \cos \theta}$$

$\theta \rightarrow$ Angle b/w \vec{A} and \vec{B}

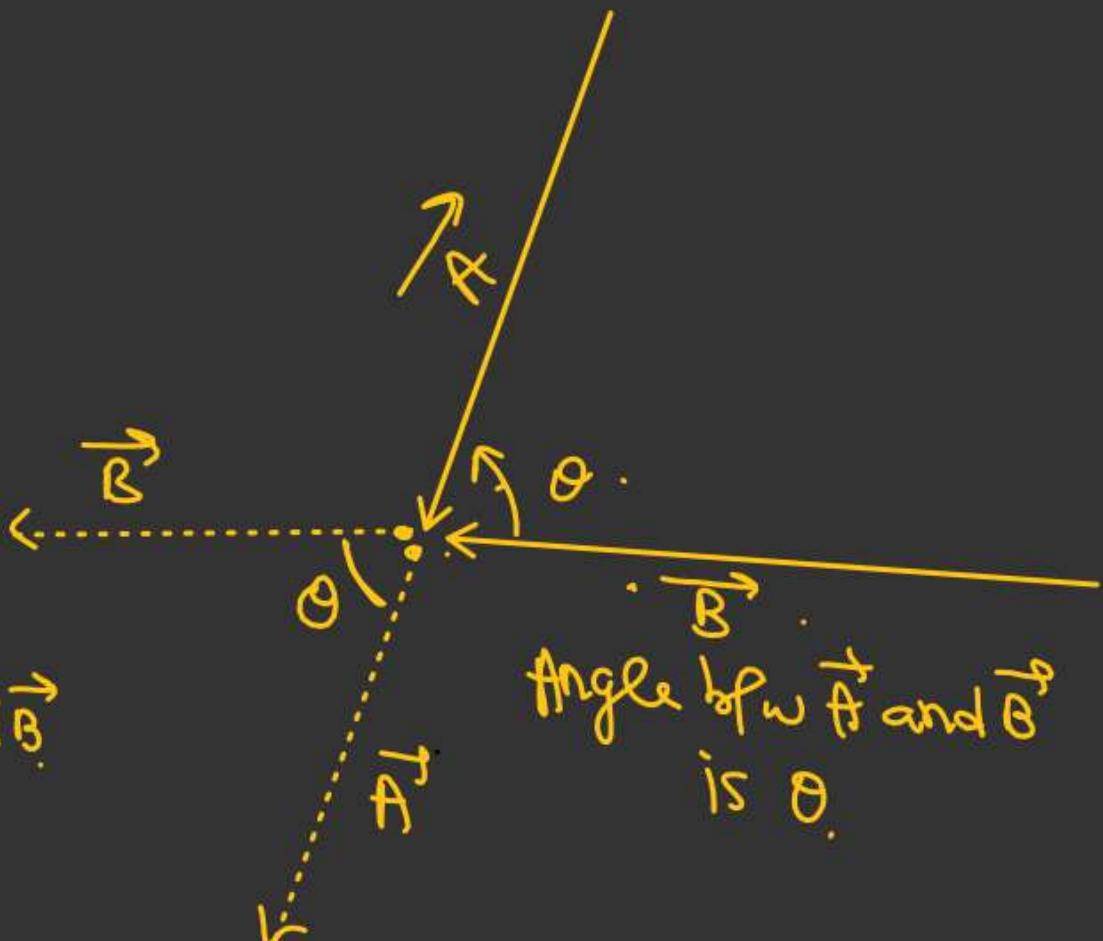
Vertex formed by
tail of vectors or head of vector



Angle b/w \vec{A} and \vec{B}
is θ .



($\pi - \theta$) \rightarrow Angle b/w \vec{A} and \vec{B}



Angle b/w \vec{A} and \vec{B}
is θ .

Addition of vector

Q. A particle is initially at point A(2,4,6) m moves finally to the point B(3,2,-3) m.
Write the initial position vector, final position vector, and displacement vector of the particle.

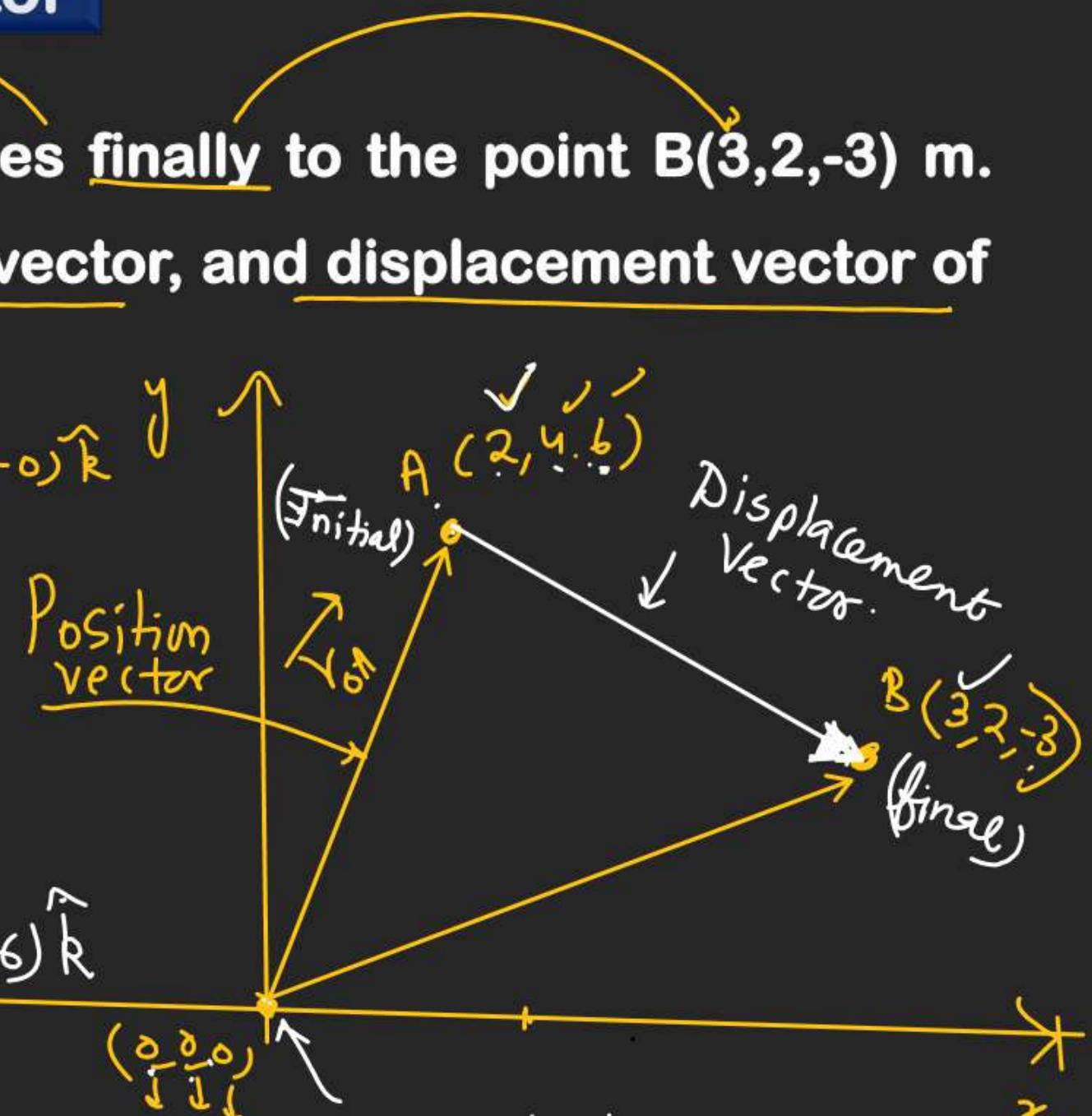
$$\begin{array}{l} \text{(Position} \\ \text{vector of A)} \end{array} \leftarrow \vec{r}_{OA} = (2-0)\hat{i} + (4-0)\hat{j} + (6-0)\hat{k} = 2\hat{i} + 4\hat{j} + 6\hat{k}$$

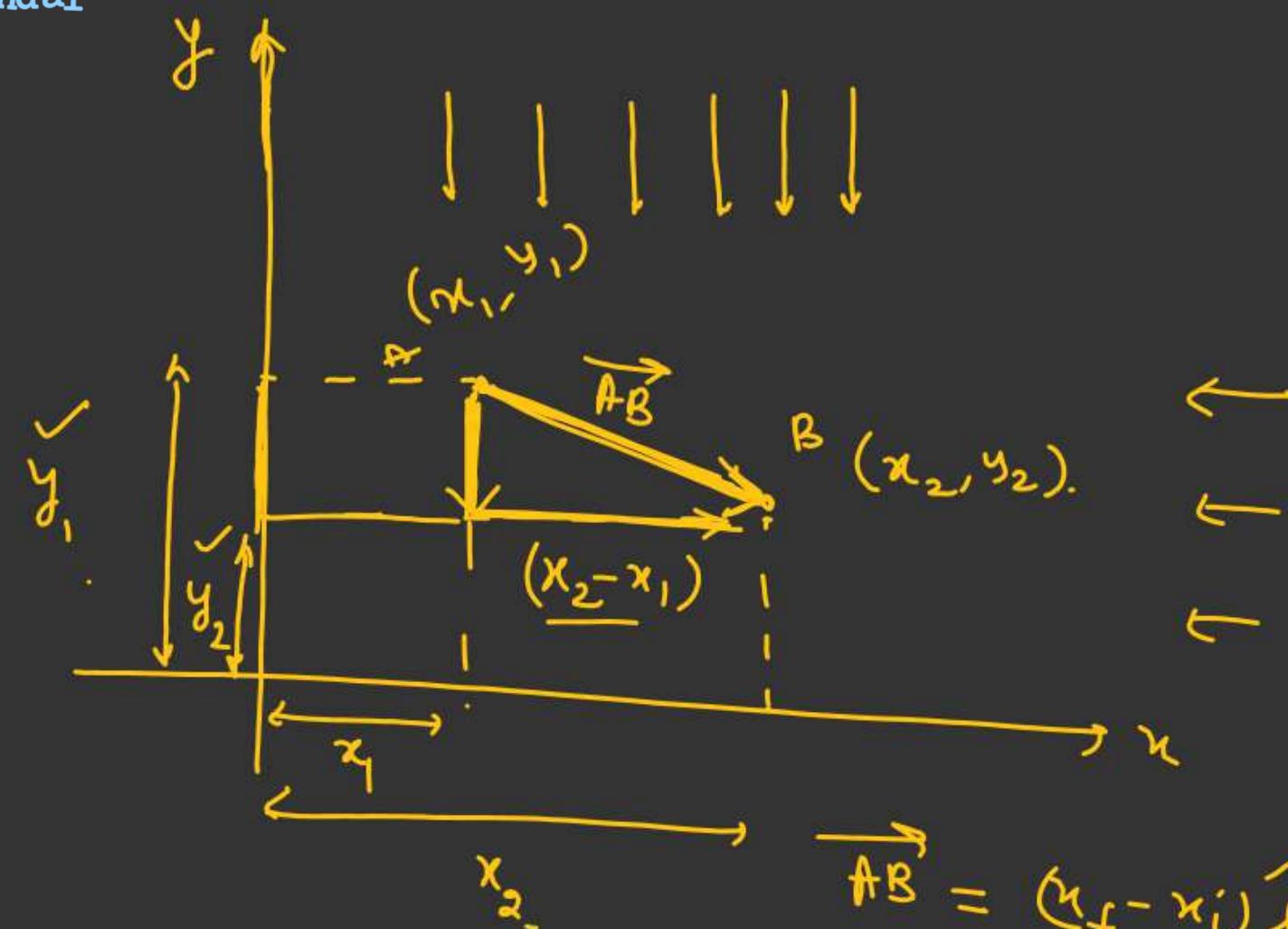
$$\begin{array}{l} \text{(Position} \\ \text{vector of B.)} \end{array} \leftarrow \vec{r}_{OB} = (3\hat{i} + 2\hat{j} - 3\hat{k})$$

$$\vec{AB} = (3-2)\hat{i} + (2-4)\hat{j} + (-3-6)\hat{k}$$

$$\vec{AB} = (\hat{i} - 2\hat{j} - 9\hat{k})$$

$$|\vec{AB}| = \sqrt{(1)^2 + (-2)^2 + (-9)^2} = \sqrt{1+4+81} = \sqrt{86} \text{ m}$$





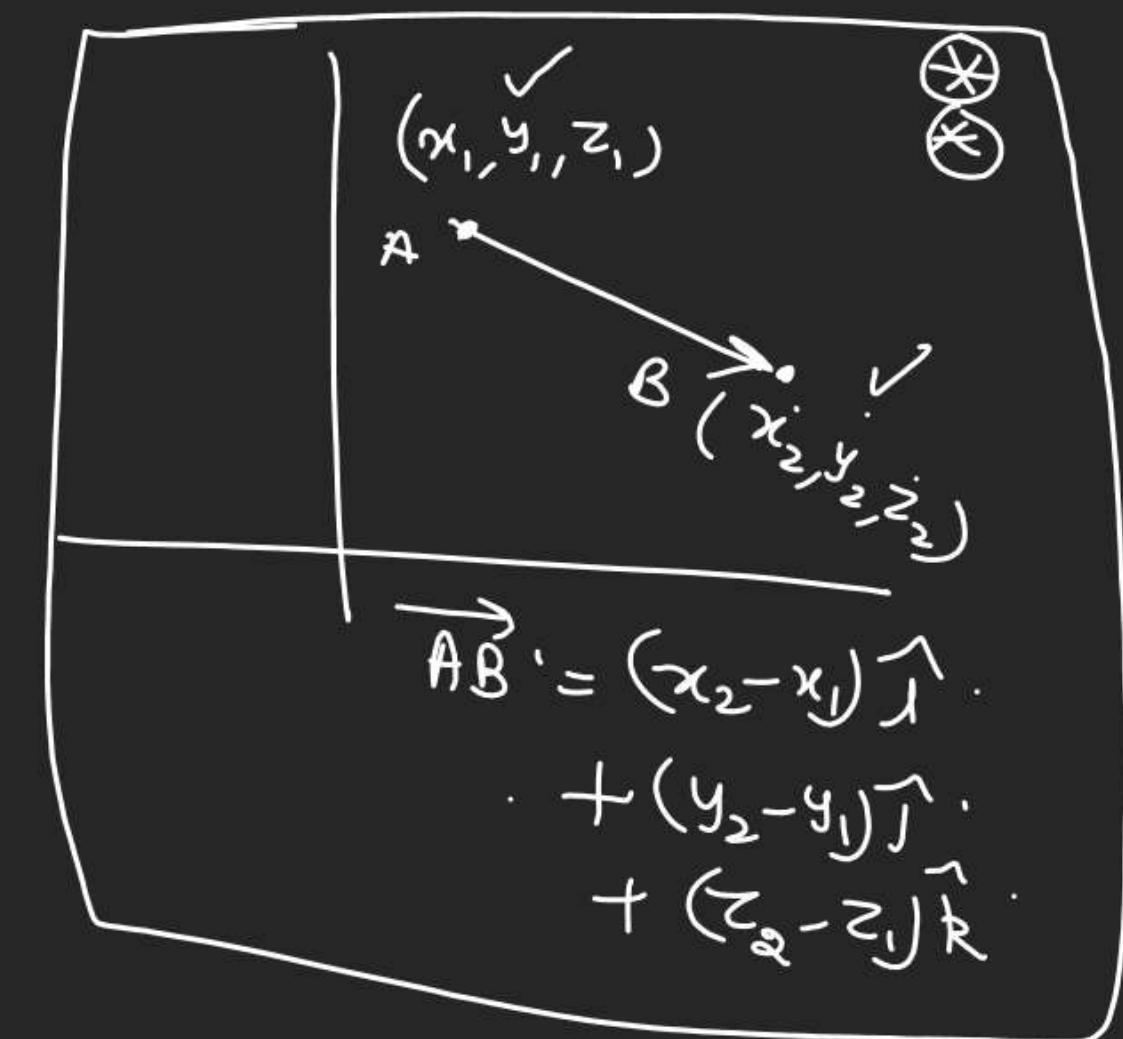
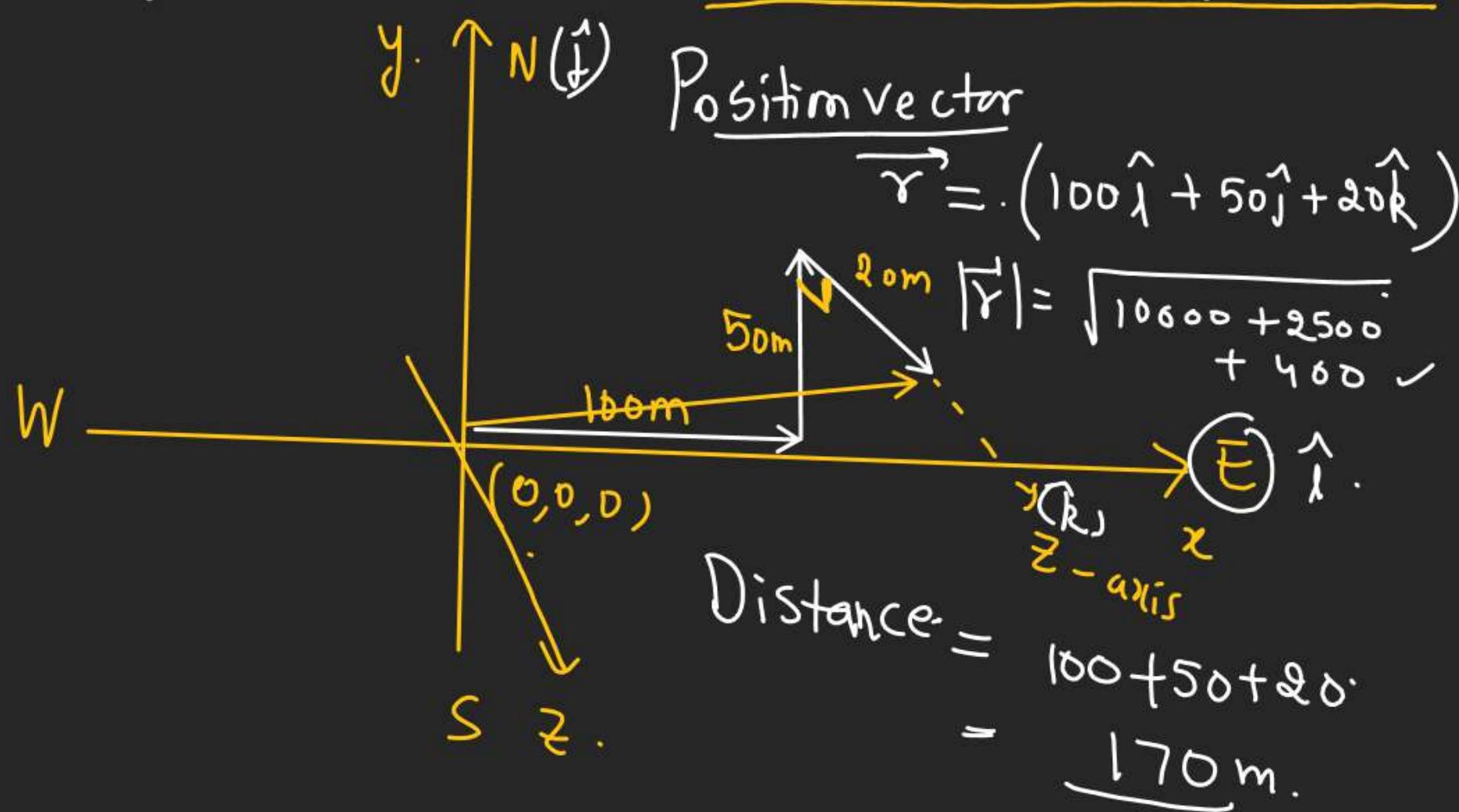
$$\vec{AB} = \underline{(x_f - x_i)}\hat{i} + \underline{(y_f - y_i)}\hat{j}$$

↓
Projection or
Component of \vec{AB}
along x-axis

↓
Projection or
Component of \vec{AB}
along y-axis

Addition of vector

Q. A bird flies due east through a distance of 100 m, then heading due north by a distance of 50 m, it flies vertically up through a distance of 20 m. Find the position of the bird relative to its initial position.



Addition of vector

Q. Let $\vec{A} = 2\hat{i} + \hat{j}$, $\vec{B} = 3\hat{j} - \hat{k}$ and $\vec{C} = 6\hat{i} - 2\hat{k}$. Find the value of $\vec{A} - 2\vec{B} + 3\vec{C}$.

$$\begin{aligned}
 \vec{A} - 2\vec{B} + 3\vec{C} &= (2\hat{i} + \hat{j}) - 2(3\hat{j} - \hat{k}) + 3(6\hat{i} - 2\hat{k}) \\
 &= \cancel{2\hat{i}} + \hat{j} - \cancel{6\hat{j}} + 2\hat{k} + \cancel{18\hat{i}} - \cancel{6\hat{k}} \\
 &= \underline{\underline{20\hat{i} - 5\hat{j} - 4\hat{k}}} \quad \text{Ans}
 \end{aligned}$$

Addition of vector

Q. Find the vector that must be added to the vector $\hat{i} - 3\hat{j} + 2\hat{k}$ and $3\hat{i} + 6\hat{j} - 7\hat{k}$ so that the resultant vector is a unit vector along the y-axis.

$$\vec{v}_1 = a\hat{i} + b\hat{j} + c\hat{k}$$

$$\vec{v}_2 = \hat{i} - 3\hat{j} + 2\hat{k}$$

$$\vec{v}_3 = 3\hat{i} + 6\hat{j} - 7\hat{k}$$

$$\vec{v}_4 = -4\hat{i} - 2\hat{j} + 5\hat{k}$$

$$\vec{R} = a\hat{i} + b\hat{j} + c\hat{k} + \hat{i} - 3\hat{j} + 2\hat{k} + 3\hat{i} + 6\hat{j} - 7\hat{k}$$

$$[0\hat{i} + 0\hat{j} + 0\hat{k}] + [a\hat{i} + b\hat{j} + c\hat{k}] = (4+a)\hat{j} + (3+b)\hat{j} + (-5+c)\hat{k}$$

$$\begin{cases} 4+a=0 \\ a=-4 \end{cases}$$

$$\begin{cases} 3+b=1 \\ b=-2 \end{cases}$$

$$\begin{cases} c-5=0 \\ c=5 \end{cases}$$

Addition of vector

~~Q.~~ The resultant of two forces has magnitude 20 N. One of the forces is of magnitude $20\sqrt{3}$ N and makes an angle of 30° with the resultant. Then what is the magnitude of the other force?



$$F_R = \sqrt{F_1^2 + F_2^2 + 2F_1 F_2 \cos \theta}$$

Addition of vector

Q.

~~The resultant of \vec{P} and \vec{Q} is \vec{R} . If \vec{Q} is doubled, \vec{R} is doubled, when \vec{Q} is reversed, \vec{R} is again doubled, find $P:Q:R$.~~

$$\cos 120^\circ = \cos(180 - 60^\circ) = -\cos 60^\circ = -\frac{1}{2}$$

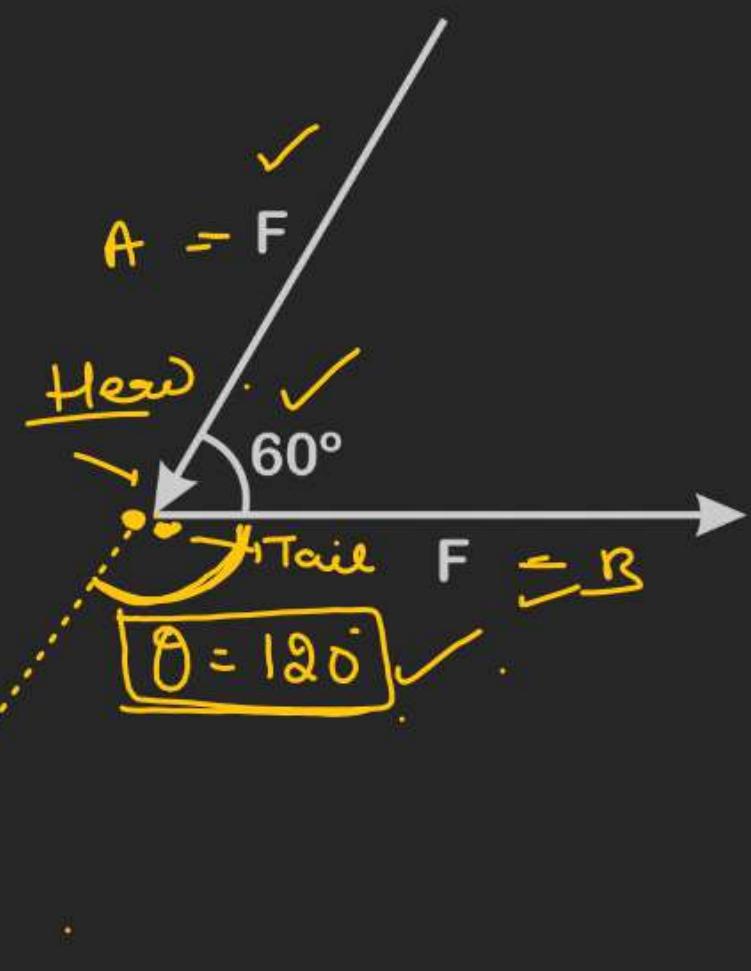
(A) $F/2$ (B) F (C) $\sqrt{3}F$ (D) $\sqrt{5}F$

Find Resultant force ??

$$F_R = \sqrt{f^2 + F^2 + 2F(f) \cdot \cos 120^\circ}$$

$$F_R = \sqrt{2F^2 - 2f^2 \times 1}$$

$$> \boxed{F}$$



Addition of vector

Q. The resultant of two vectors \vec{A} and \vec{B} is perpendicular to the vector \vec{A} and its magnitude is equal to half of the magnitude of vector \vec{B} . Fig. The angle between \vec{A} and \vec{B} is

(A) 120°

(B) 150°

(C) 135°

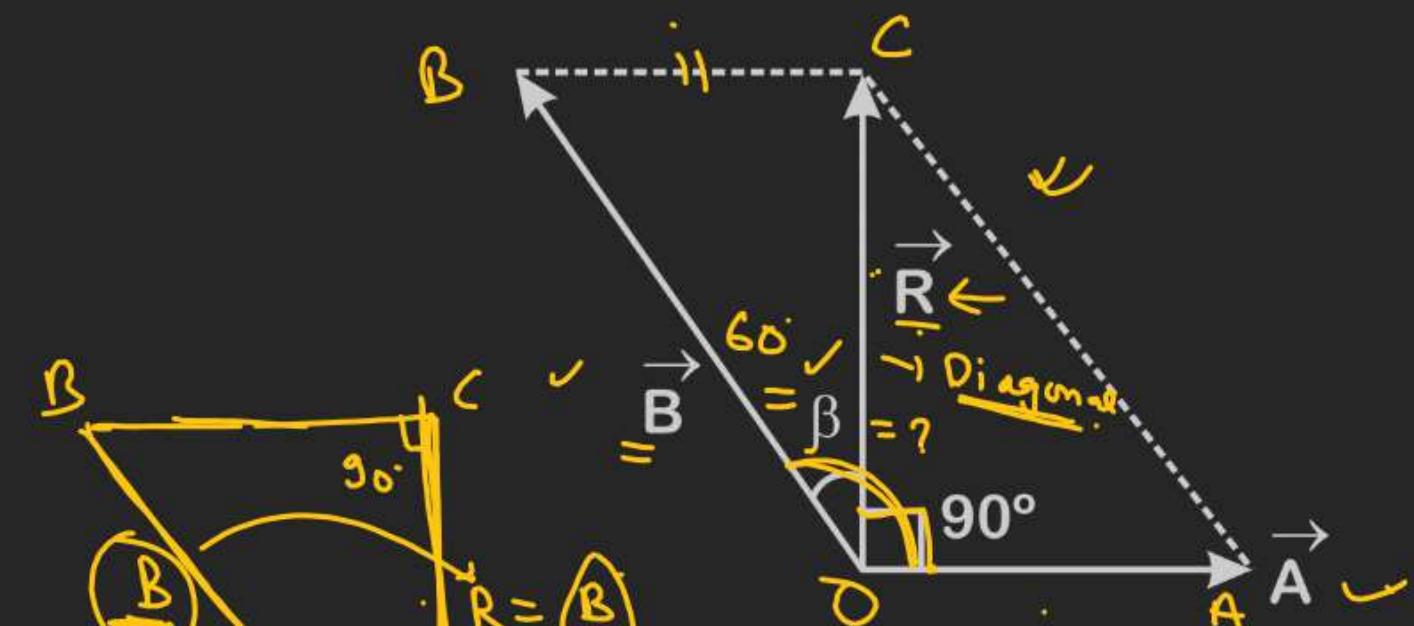
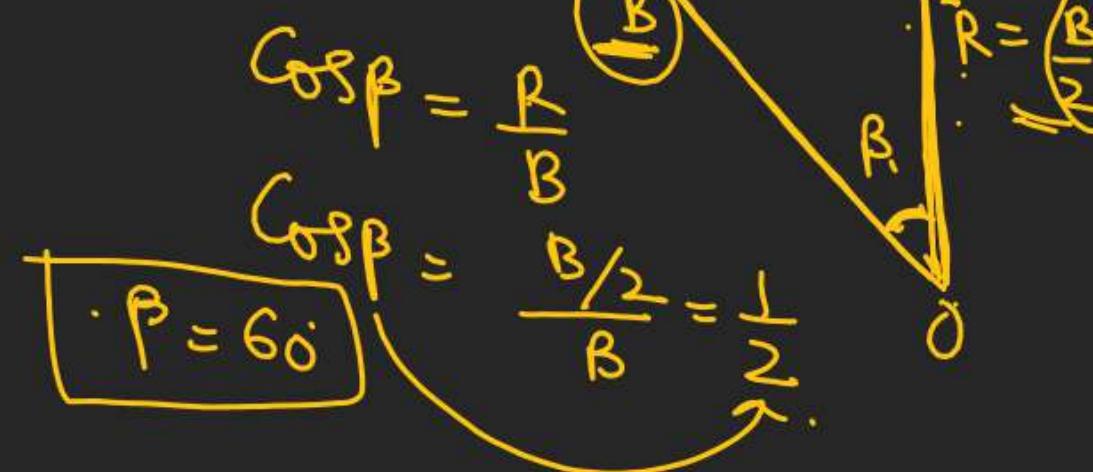
(D) None of these

$$\begin{aligned} \text{Angle b/w } & \vec{A} \text{ and } \vec{B} \\ & = (90 + \beta) \\ & = 150^\circ \end{aligned}$$

$$\vec{R} \perp \vec{A}$$

$$|\vec{R}| = |\vec{B}|$$

$$R = \frac{B}{2}$$



Addition of vector

Q. If $|\vec{A} + \vec{B}| = |\vec{A}| = |\vec{B}|$, then the angle between \vec{A} and \vec{B} is

~~(A) 120°~~

~~(B) 60°~~

~~(C) 90°~~

~~(D) 0°~~

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

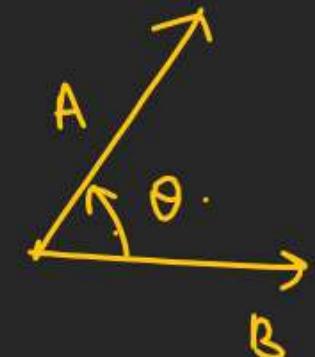
$$|\vec{R}| = |\vec{A}| = |\vec{B}|$$

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

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

$$A^2 = 2A^2 + 2A^2 \cos \theta$$

$$-A^2 = 2A^2 \cos \theta \Rightarrow \cos \theta = -\frac{1}{2}$$



$$\theta = 120^\circ$$

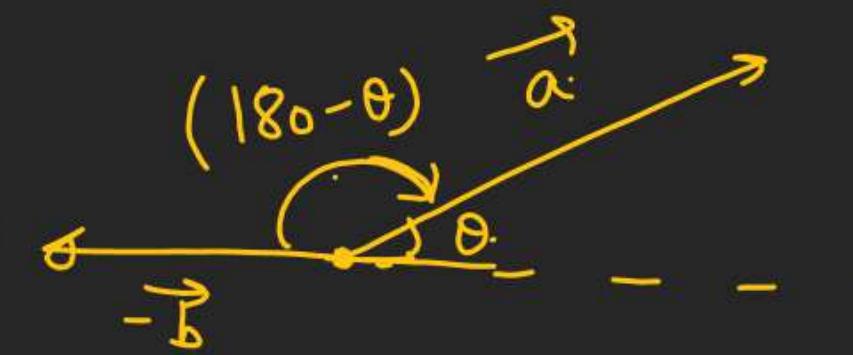
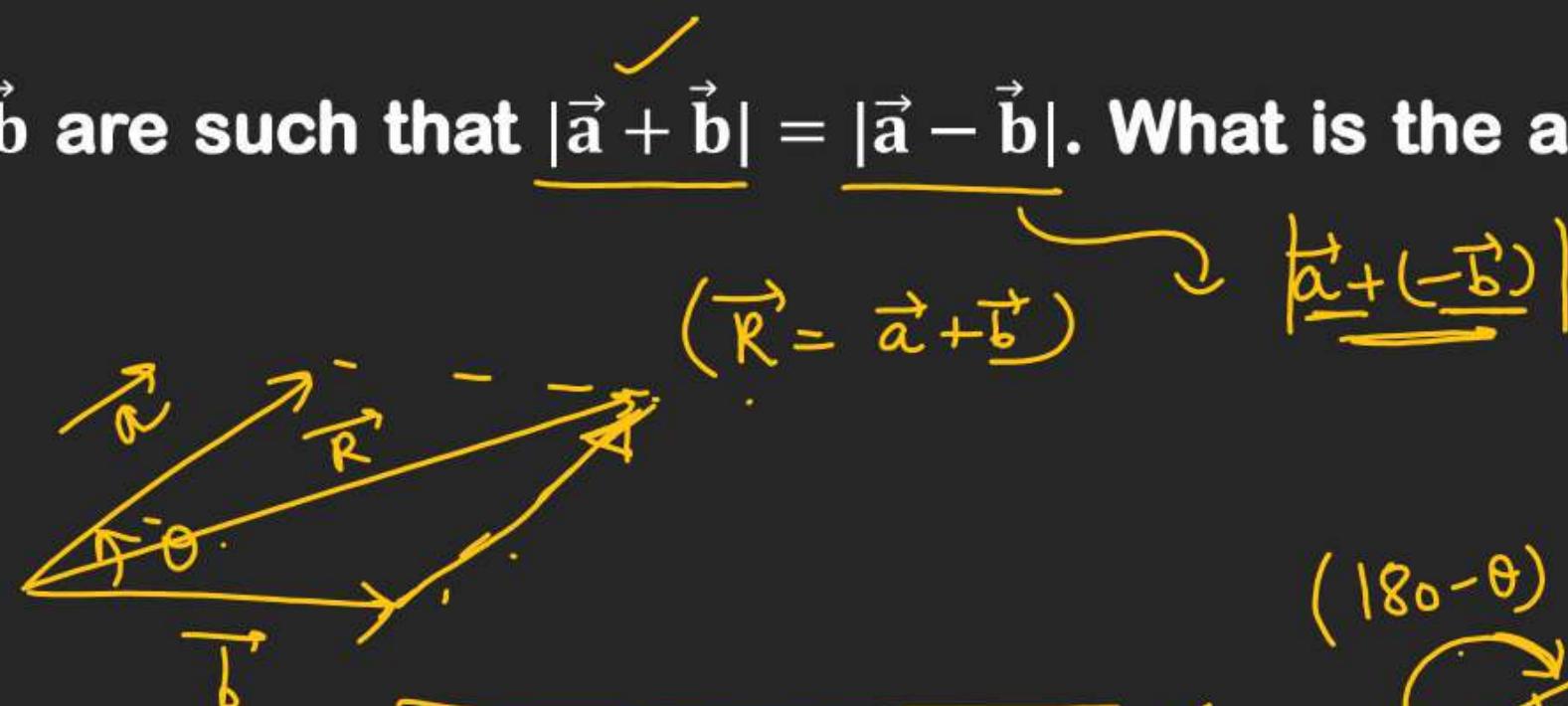
Addition of vector

- Q.** Given $|\vec{A}_1| = 2$, $|\vec{A}_2| = 3$ and $|\vec{A}_1 + \vec{A}_2| = 3$. Find the value of $(\vec{A}_1 + 2\vec{A}_2) \cdot (3\vec{A}_1 - 4\vec{A}_2)$.
- (A) -64
(B) 60
(C) -60
(D) 64

Addition of vector

Q. Two vectors \vec{a} and \vec{b} are such that $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$. What is the angle between \vec{a} and \vec{b} ?

- (A) 0°
- (B) 90°
- (C) 60°
- (D) 180°



$$|\vec{a} + \vec{b}| = |\vec{R}| = \sqrt{a^2 + b^2 + 2ab \cos \theta}.$$

$$|\vec{R}| = |\vec{a} + (-\vec{b})| = \sqrt{a^2 + b^2 + 2ab \cos(180 - \theta)}$$

$$\begin{aligned} \sqrt{a^2 + b^2 + 2ab \cos \theta} &= \sqrt{a^2 + b^2 - 2ab \cos \theta} \\ 4ab \cos \theta &= 0 \Rightarrow \cos \theta = 0 \rightarrow \boxed{\theta = 90^\circ} \end{aligned}$$

Addition of vector

H.W ✓

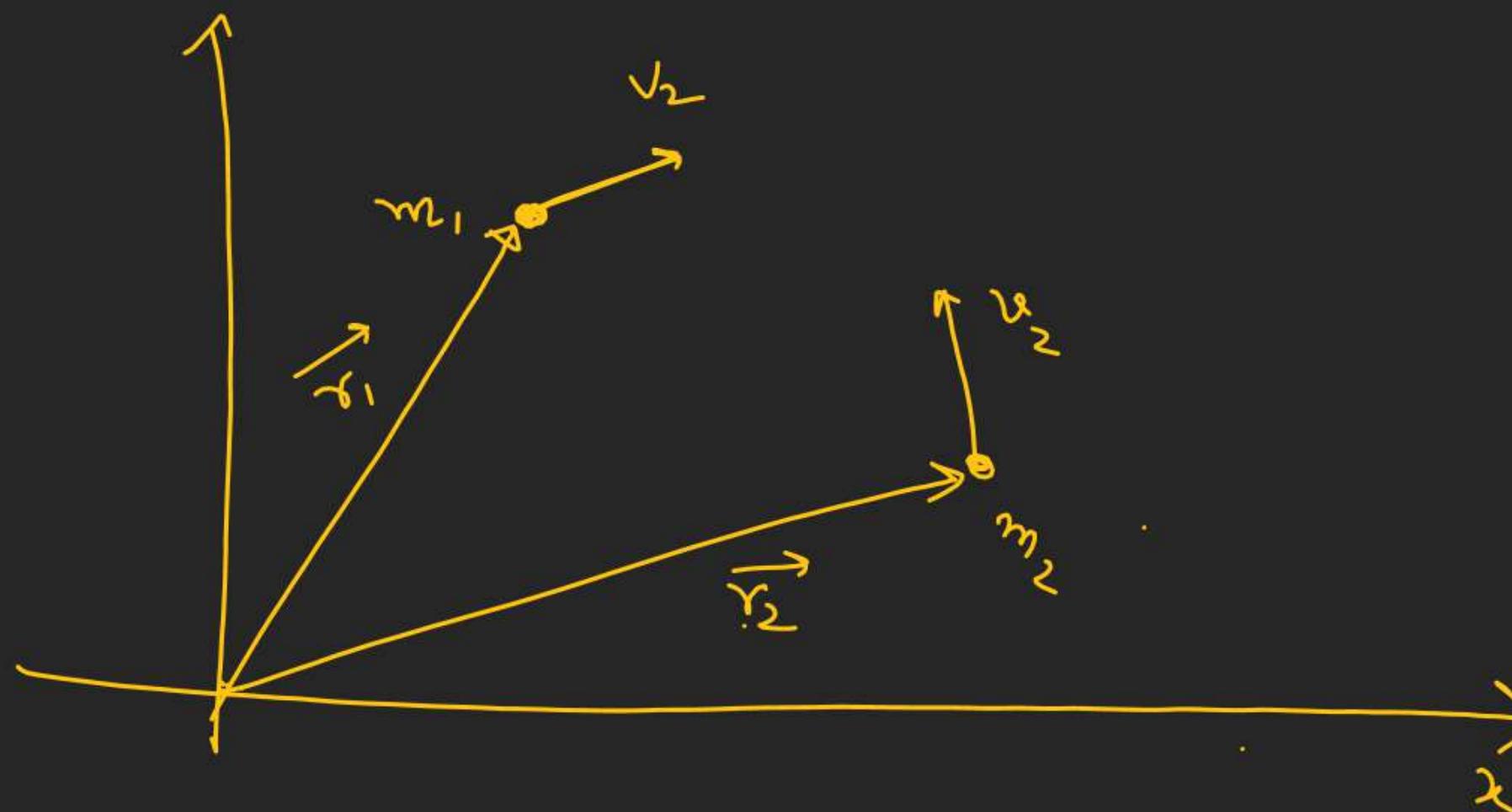
Q. Two point masses 1 and 2 move with uniform velocities \vec{v}_1 and \vec{v}_2 , respectively. Their initial position vectors are \vec{r}_1 and \vec{r}_2 , respectively. Which of the following should be satisfied for the collision of the point masses?

(A) $\frac{\vec{r}_1 - \vec{r}_2}{|\vec{r}_2 - \vec{r}_1|} = \frac{\vec{v}_2 - \vec{v}_1}{|\vec{v}_2 - \vec{v}_1|}$

(B) $\frac{\vec{r}_2 - \vec{r}_1}{|\vec{r}_2 - \vec{r}_1|} = \frac{\vec{v}_2 - \vec{v}_1}{|\vec{v}_2 - \vec{v}_1|}$

(C) $\frac{\vec{r}_2 - \vec{r}_1}{|\vec{r}_2 + \vec{r}_1|} = \frac{\vec{v}_2 - \vec{v}_1}{|\vec{v}_2 + \vec{v}_1|}$

(D) $\frac{\vec{r}_2 + \vec{r}_1}{|\vec{r}_2 + \vec{r}_1|} = \frac{\vec{v}_2 - \vec{v}_1}{|\vec{v}_2 + \vec{v}_1|}$



Addition of vector

DOT PRODUCT