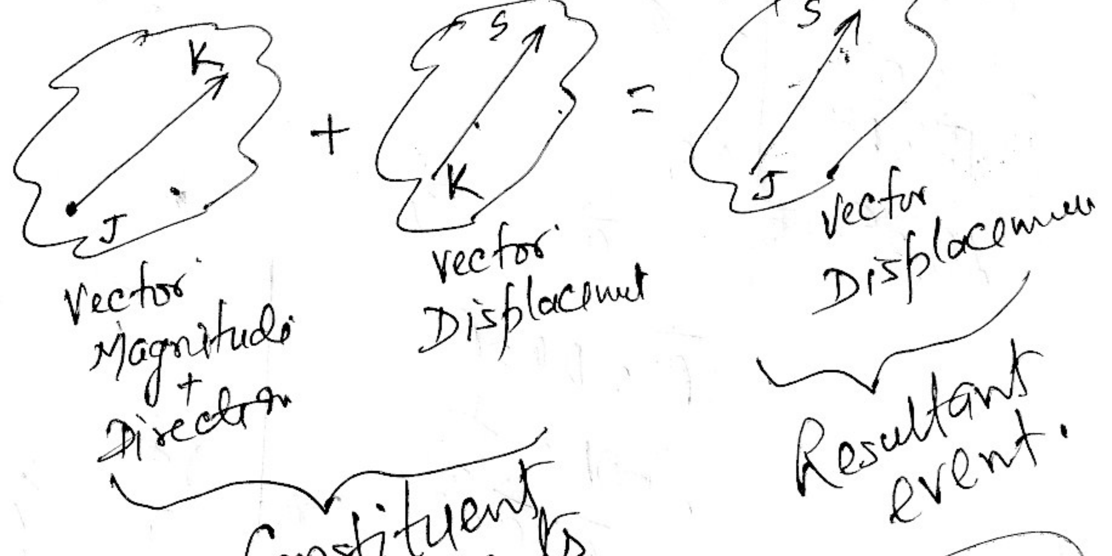
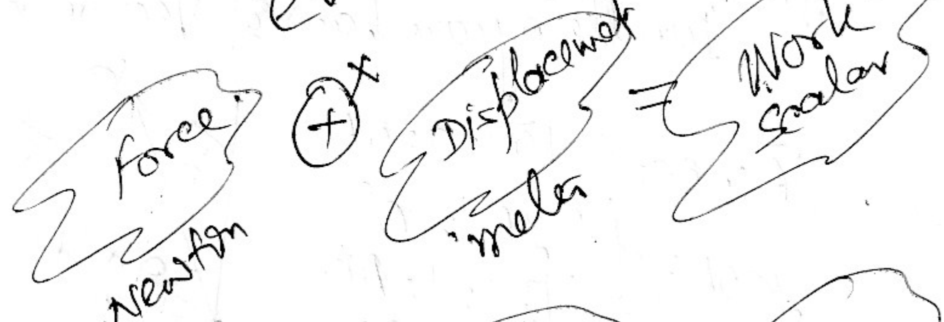
Hpc Pr 2025 – 2nd day – Vectors – 20-1-25

Vector Algebra. Page-1

Addition of Vectors:



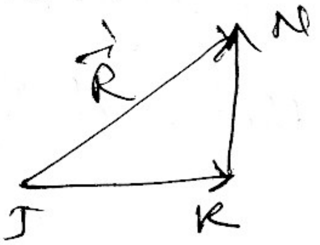


The mathematical operation defined to establish relation between Constituent events and resultant event is called addition of vectors if they are vectors and of same nature.

$$\vec{a} + \vec{b} = \vec{R}$$

HpcPr 2025 - 2nd day - Page-2

(a) Triangle Law of Vector Addition:

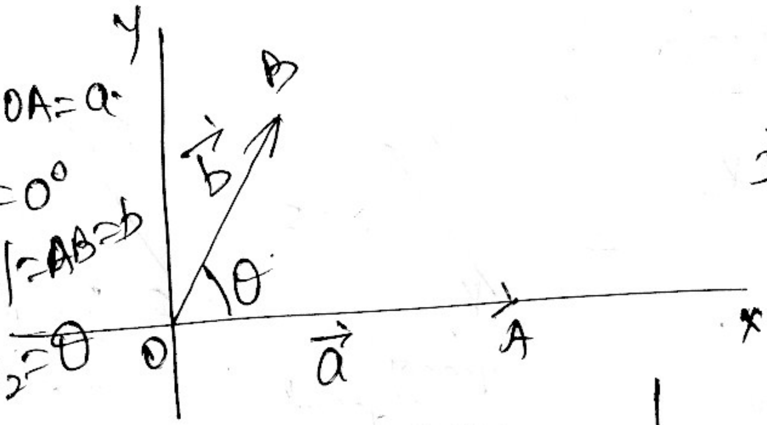


$|\vec{a}| = OA = a$

$\angle\theta_1 = 0^\circ$

$|\vec{b}| = AB = b$

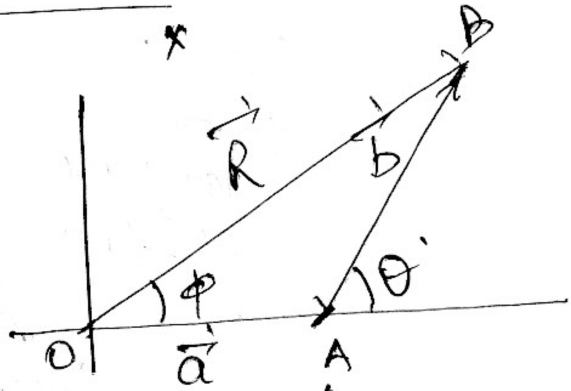
$\angle\theta_2 = \theta$



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

$\angle BOA = \phi$

$\vec{R} = \vec{a} + \vec{b}$



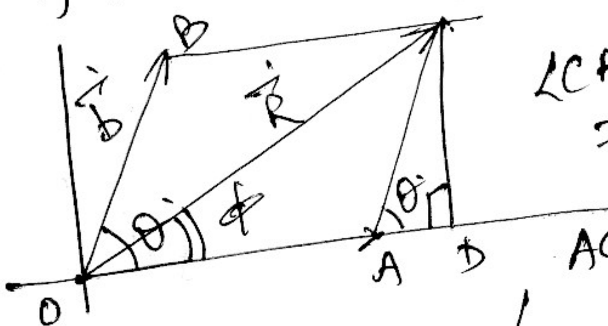
(b) Parallelogram Law of Vector Addition:

$|\vec{R}| = OC = ?$ $|\vec{a}| = a = OA$

$\angle COA = \phi$? $\angle\theta_1 = 0^\circ$

$|\vec{b}| = b = OB$

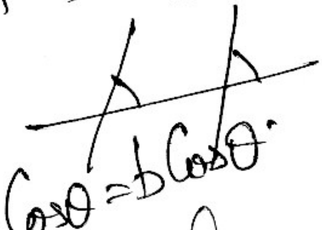
$\angle\theta_2 = \theta$



$\angle CAD = \angle BOA = \theta$

$AC = OB = b$

$\vec{R} = \vec{a} + \vec{b}$ $|\vec{R}| = ?$



In $\triangle ACD$

$\cos\theta = \frac{AD}{AC}$

$AD = AC\cos\theta = b\cos\theta$

$\sin\theta = \frac{CD}{AC}$

$CD = AC\sin\theta$
$= b\sin\theta$

In $\triangle OCD$

$OC^2 = OD^2 + CD^2$

$= (OA + AD)^2 + CD^2$

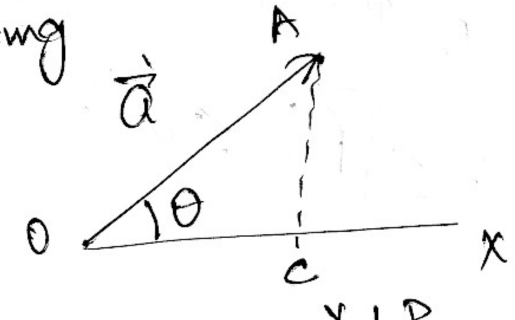
$R^2 = (a + b\cos\theta)^2 + (b\sin\theta)^2$

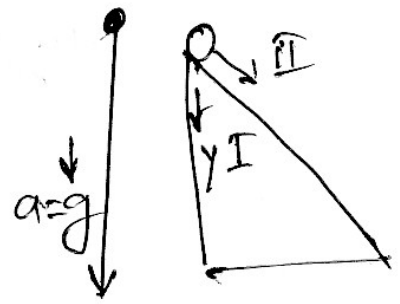
$= a^2 + b^2 + 2ab\cos\theta$

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

$\tan\phi = \frac{CD}{OD} = \frac{CD}{OA + AD} = \frac{b\sin\theta}{a + b\cos\theta}$

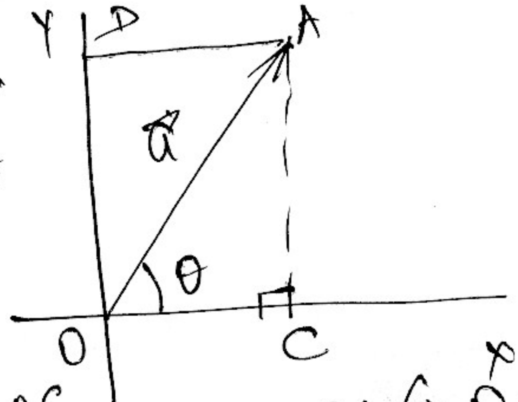
Resolution of Vectors:





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

$\angle AOC = \theta$



X - Component :

$OC = a_x$. $OA = a$ $\Big\}$ $\cos\theta = \frac{OC}{OA}$, $OC = OA\cos\theta$.

$$\boxed{a_x = a\cos\theta}$$

y - Component

$\sin\theta = \frac{AC}{OA} = \frac{OD}{OA}$.

$OD = OA\sin\theta$

$$\boxed{a_y = a\sin\theta}$$

$\triangle OAC$

$\tan\theta = \frac{AC}{OC} = \frac{OD}{OC}$

$= \frac{a_y}{a_x}$.