Formula Sheet

Date: ______ Day: ______

Unit no:- 2 Vectors & Equilibrium

Imp points

Resultant of 2 vectors max if direction is same. Will be mini. if direction is opposite.

Two like parallel vectors of equal magnitude are called equal vectors.

If $\vec{A}$ & $\vec{B}$ are 2 vectors then magnitude of their resultant is.

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

$\theta = 0^\circ$ $(A+B)$

$\theta = 180^\circ$ $(A-B)$

$\theta = 90^\circ$ $(\sqrt{A^2+B^2})$

Torque plays same role in angular motion as force plays in linear motion.

Used to determine angular acceleration

$\tau = I\alpha$

Complete equilibrium

A body will be in complete equilibrium if both conditions of equilibrium are satisfied (Static equilibrium).

Geometric vectors:- Without reference to coordinate axes.

Algebraic vectors:- With reference to coordinate axes.

Unit vectors:- Only used to tell direction magnitude (1).

$\hat{A} = \dfrac{\vec{A}}{|\vec{A}|}$

$\hat{i}, \hat{j}, \hat{k}$ for x, y, z

In plane (2D) only 1 angle is required to represent a vector while 3 angles are required to represent a vector in space.

Commutative law of vector addition:- $\vec{A} + \vec{B} = \vec{B} + \vec{A}$

Subtraction of vectors:- $\vec{A} - \vec{B} = \vec{A} + (-\vec{B})$

Multiplication of vector with a scalar:- (Cases)

- If $k = 0$ then $k\vec{A} = \vec{0}$ (null) vector
- If $k > 0$ then $+k.\vec{A} = k\vec{A}$ (Only Magnitude changes)
- If $k < 0$ then $-k.\vec{A} = -k\vec{A}$ (Both magnitude & direction changes)

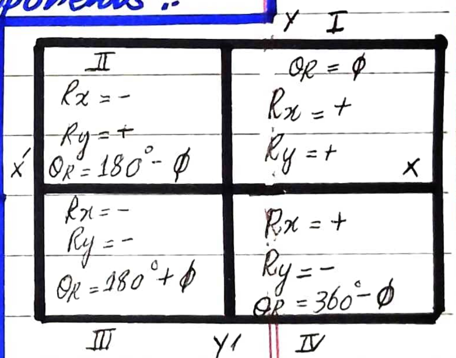
Determination of vector by rectangular components:-

$A = \sqrt{A_x^2 + A_y^2}$ (Magnitude) $\theta = \tan^{-1}(A_y/A_x)$ Direction

Vector addition by rectangular components:-

$R = \sqrt{(A_x+B_x)^2 + (A_y+B_y)^2}$ (Magnitude)

$\theta = \tan^{-1}\left(\dfrac{R_y}{R_x}\right)$ (Direction)



Torque:- Product of Force & position vector

- $\vec{\tau} = rF\sin\theta\,\hat{n}$
- SI unit Nm
- Dimension $[ML^2T^{-2}]$
- Vector quantity.

Maximum $90^\circ, 270^\circ$

Minimum $0^\circ, 180^\circ$

(Positive torque) Anti-clockwise

(Negative) Clockwise

Direction:- By Right handrule

Dependence:-
- Magnitude of force
- Magnitude of position vector.
- Angle between force vector & position vector.

Equilibrium:- If a body has no acceleration, then it is said to be in equilibrium.

1st Condition	2nd Condition
$\Sigma F = 0$	$\Sigma \tau = 0$
• Books lying on table • Paratrooper	• Seesaw • Meter rod balanced on wedge

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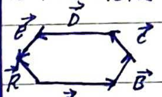
-Points-

Resolution of vector is reverse process of addition of vector.

The sum of vectors which form the sides of open polygon is not zero.



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

Null vector

Magnitude zero $\vec{0}$ (Bhoot)

Scalar product	Vector product
If $\theta = 0^\circ$ (parallel)	
Maximum AB	Minimum 0
If $\theta = 90^\circ$ (Perpendicular)	
Minimum 0	Maximum AB
If $\theta = 180^\circ$ (Antiparallel)	
-ive maximum $-AB$	minimum 0
Self Product	
Maximum A^2	Minimum 0
Other name	
Dot product	Cross product
Trigonometric ratio	
$\cos\theta$	$\sin\theta$

For direction in vector product we use the right hand rule ☺

Vector product gives area of parallelogram.