→ what is Physics ?

Ans Physics is the study of rules of nature and nature is what we are seeing around us like temp, motion, electricity. Any physical phenomena.

→ we observe nature. And solve basic universe formulas.

→ Ex Let us assume "~~choose~~" ~~free~~ gravitation.

→ Before making a law the pattern should be measure ~~watche~~

So, measurement is the 1st imp thing of physics.

→ measurement includes units & ~~five~~ types of measurement is the dimension.

→ Physical quantity :-

→ Any thing / property which can be observed, measured i.e. Physically exist.

Ex → ① Temp → degree of hotness
② speed → speedometer.
③ intensity of light.
④ Electric current.

→ Intellectual of persons can't be measured, it can be compared.

→ Emotion can't measured.

Unit :-

→ It is the standard reference to measure a physical quantity.

Eg Length of a pen →

Eg Double of my finger but it is not standard.

In Britain length → foot,
France " → cm
USA " → m

Unit system – ① Foot pound sec (FPS) (British system ...)
② cm gram sec (CGS) (European system)
③ m K sec (MKS) (USA system)
④ SI (system international)

→ **SI system** – (7 fundamental quantities).
By using these 7 we can observe all the physical property.

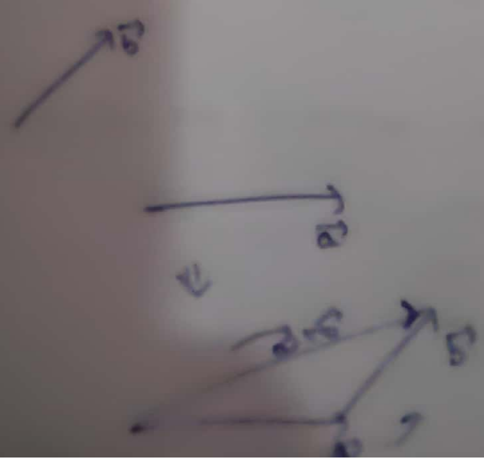
→ mass → kg.
→ Length → meter
→ Time → sec.
→ Temp(K) → Kelvin
→ (A) Amp → current
→ (N) mol → Avagadro no. 6.022×10^{23}
→ Candela → Lightening. (Luminous)

→ mechanics → (M L T)
→ Thermodynamics → The Temp.
→ Electrostatic, Electrical Ams.
→ chemistry → mol.
→ optics

① **Fundamental quantity** –.
→ Those are chosen physical quantity which are defined by SI system.
→ There are 7 fundamental quantities.
② derived quantity

Vector Algebra –.

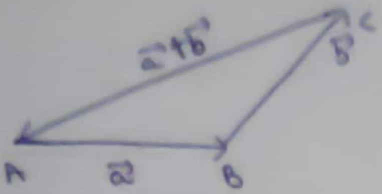
→ **Addition of vector** –.
Triangle law of vector addition –.
→ Let us consider two vectors, $\vec{a}$, $\vec{b}$ and we need to add ...



we shift $\vec{b}$ like

→ If two vectors are represented by two adjacent side of a triangle taken in a order than the resultant of two vectors is represented by 3rd side of triangle taken in reverse order

→



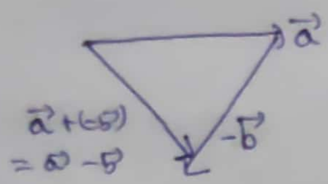
$\vec{AB} + \vec{BC} + \vec{CA}$

$\Rightarrow \vec{AC} + \vec{CA}$

$= 0$ → according to triangle law

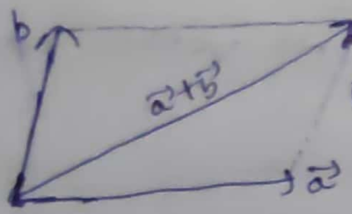
Difference of vector →

→ Difference is nothing but addition of a vector with (-ve) of another vector.



Parallelogram law of vector addition →

→



If two vectors are represented by adjacent side of parallelogram then sum of those vectors is represented by diagonal of the parallelogram which is passing through the common point of $\vec{a}$ & $\vec{b}$.

→ It is also the triangle law of vector addition.

Properties of vector addition →

1) Commutative → $\vec{a} + \vec{b} = \vec{b} + \vec{a}$

same magnitude & same direction.

(ii) Associative -

→ Now associate

→ $(\vec{a}+\vec{b})+\vec{c} = \vec{a}+(\vec{b}+\vec{c})$

(iii) Additive Identity - It is such an element which is added to a thing such that we get the same thing.

→ $\vec{a}+\vec{0} = \vec{a}$

$\vec{0}$ is called additive identity.

(iv) Additive inverse -. It is such an element when added to a vector such that we get 0

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

Multiplication of a vector by a scalar -.

→ $\vec{a}$ $\longrightarrow$ $\frac{1}{2}\vec{a} = \longrightarrow$ $2\vec{a} = \longrightarrow$

$-2\vec{a} = \longleftarrow$

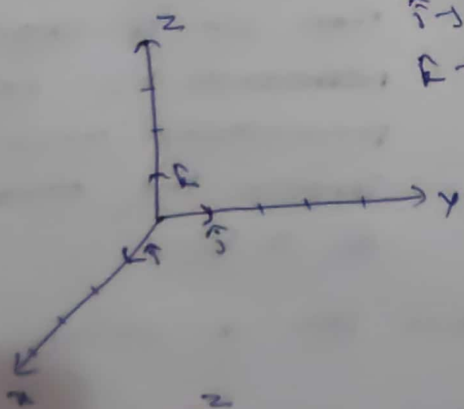
Component form of vector -.

$\hat{i}$ → unit vector along x-axis.

$\hat{j}$ → " " " y - "

$\hat{k}$ → " " " z " .

→



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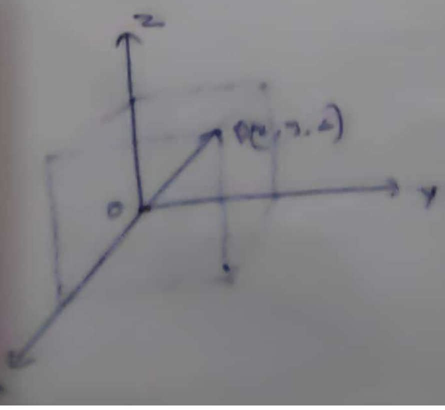


→ consider a point $P(x, y, z)$

so the position vector of P is $\vec{OP} = \vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$

$$|\vec{r}| = \sqrt{x^2 + y^2 + z^2}$$

→ Let $P(1, 2, 3)$ so, $\vec{OP} = \vec{r} = \hat{i} + 2\hat{j} + 3\hat{k}$

$$|\vec{r}| = \sqrt{1^2 + 2^2 + 3^2} = \sqrt{14}.$$

→ $\vec{OP} = x\hat{i} + y\hat{j} + z\hat{k}$ here, x, y, z are the scalar components.

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

__Unit vector →__ $(\hat{a})$

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

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

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

$\vec{a}$ will be equal to $\vec{b}$ iff $a_1 = b_1$, $a_2 = b_2$, $a_3 = b_3$

→ unit vector in direction of $\vec{a}$ (or) simply unit vector of $\vec{a}$

$\vec{a} = x\hat{i} + y\hat{j} + z\hat{k}$

$$\hat{a} = \frac{\vec{a}}{|\vec{a}|} = \frac{\vec{a}}{\sqrt{x^2+y^2+z^2}} = \frac{x\hat{i} + y\hat{j} + z\hat{k}}{\sqrt{x^2+y^2+z^2}}$$

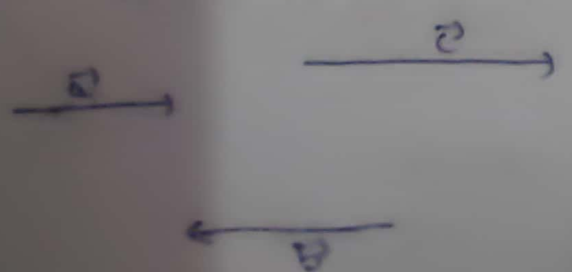
__eg__ $\vec{a} = \hat{i} + \hat{j} + 2\hat{k}$

$$\hat{a} = \frac{\vec{a}}{|\vec{a}|} = \frac{\hat{i} + \hat{j} + 2\hat{k}}{\sqrt{6}} = \frac{1}{\sqrt{6}}\hat{i} + \frac{1}{\sqrt{6}}\hat{j} + \frac{2}{\sqrt{6}}\hat{k}.$$

__Condition of collinearity →__

• Two vectors are collinear if they have the same direction (or) are parallel (or) anti parallel.

Let



$\vec{c} = \lambda\vec{a}$

$\vec{b} = -\lambda\vec{a}$

Q) $\vec{a} = 2\hat{i} - 3\hat{j} + 4\hat{k}$

$\vec{b} = -4\hat{i} + 6\hat{j} - 8\hat{k}$

Show that these two vectors are colinear

Ans) Here we have to show one vector is equal to λ of sometimes the other vector.

$\vec{b} = -2(2\hat{i} + 3\hat{j} + 4\hat{k}) = -2\vec{a}$.

So, $\vec{a}$ & $\vec{b}$ are colinear.

Direction cosine & direction ratios →.

→ vector $\hat{i} + 2\hat{j} + 3\hat{k}$.

Direction ratios = 1, 2, 3.

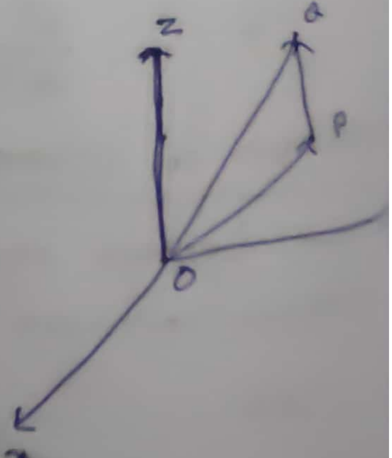
Direction cosines = $\dfrac{\hat{i} + 2\hat{j} + 3\hat{k}}{\sqrt{1^2+2^2+3^2}} = \dfrac{1}{\sqrt{14}}\hat{i} + \dfrac{2}{\sqrt{14}}\hat{j} + \dfrac{3}{\sqrt{14}}$

$$\frac{1}{\sqrt{14}}, \frac{2}{\sqrt{14}}, \frac{3}{\sqrt{14}}$$

In unit vector direction ratio = direction cosine.

Vector joining two points →.

$P(x_1, y_1, z_1)$ ——— $Q(x_2, y_2, z_2)$



$\vec{PQ} = (x_2 - x_1)\hat{i} + (y_2 - y_1)\hat{j} + (z_2 - z_1)\hat{k}$.

$|\vec{PQ}| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$

In △ OPQ, $\vec{OQ} = \vec{OP} + \vec{PQ}$

→ $\vec{PQ} = \vec{OQ} - \vec{OP}$

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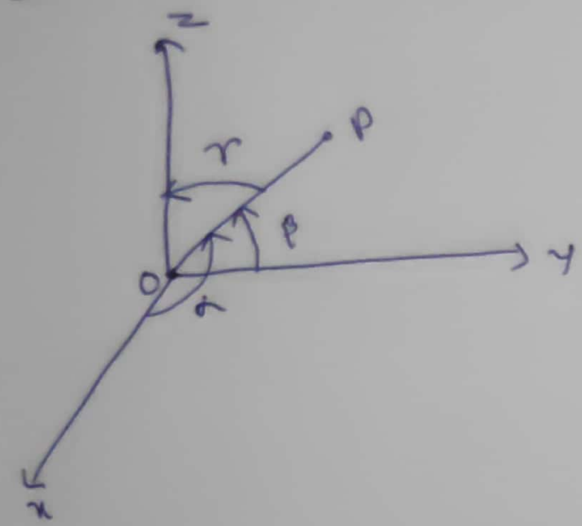
Section formula applied in vector algebra –

→ ## Direction cosine & direction of a vector →.



Let α be the angle OP makes with x-axis,
β " " y-axis
γ " " z-axis.

So, α, β, γ are known as direction angle & cosine of these gives the direction cosine of those vector.

$\cos\alpha = l$

$\cos\beta = m$

$\cos\gamma = n$

Direction ratio →.