General physics I
PHY 101

26/11/2025

1) Space Measurement
2) physical and Derived measurements
3) Dimension

Space Measurement:

A space is a distance between two things and it can be measured.

* Fundamental Quantities: Are quantities that are Independent of other quantities and cannot be expressed in terms of them.

Fundamental Qtys	Unit	Instrument
1. Length	m	M_2 (1mm or $\frac{1}{cm}$)
2. Mass	kg	
3. Time	S	
4. Thermodynamics		Thermometer
5 Luminous Intensity	cd	Optical
6. Electric current	A	Ampere
7. Amount of substance	Mol	Mass Spectrometer

Note: Linometer (Q)
Is defined as the force of the distance

* Derived Quantity: Are quantities that can be derived by the combination of fundamental Unit or measurement.

Or Derived quantities are those quantities that are from the Mathematical or algebraic combination of 2 or more Fundamental quantities.

eg Area $\Rightarrow$ Lcm x wl (m) $= m^2$

Volume $\Rightarrow$ Lcm x wl (m) x Lcm $= m^3$

Speed $\Rightarrow$ $\frac{\text{Distance (m)}}{\text{Time (s)}} = m/s$ or ms^{-1}

Velocity $\Rightarrow$ $\frac{\text{Displacement (m)}}{\text{Time (s)}} = m/s$ or ms^{-1}

- Velocity (vector)
- Distance (scalar)

Acceleration $\Rightarrow$ $\frac{\text{Velocity } (ms^{-1})}{\text{Time (s)}} = ms^{-2}$

Force $\Rightarrow$ Mass (kg) x acceleration $(ms^{-2}) = Kgms^{-2}$

$1Kgm^{-2} = 1N$

Pressure $\Rightarrow \frac{\text{Force}}{\text{Area}}$ $\frac{(kgms^{-2})}{m^2} = \frac{kgs^{1}}{m}$

Induced $g' = \frac{1}{g}$

$= \frac{1}{m} \times kgs^2$

$m^{-1} \times kgs^{-2}$

$= kgm^{-1}s^{-2} \Rightarrow Nm^{-2}$

Question 1: Find out the unit of B in the equation below?

$$P = \frac{A - x^2}{Bt}$$

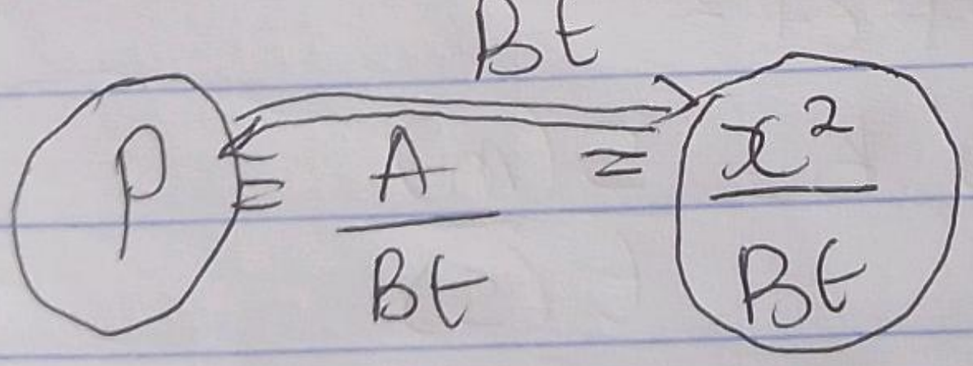
Where P = Pressure

x = Distance

t = Time

Solution

$$P = \frac{A - x^2}{Bt}$$



$$P = \frac{x^2}{Bt}$$

~~But~~ $B = \frac{x^2}{Bt}$

Where $x^2 = m^2$

$P = Kgm^{-1}s^{-2}$

$t = s$

$B = \frac{m^2}{Kgm^{-1}s^{-1} \times s1}$

$= \frac{m^2}{Kgm^{-1}s^{-1}}$

$= \frac{m^3}{Kgs^{-1}}$

$= \frac{1}{Kg} \times \frac{m^3 \times 1}{s-1}$

$B = Kg^{-1}m^3s^{-1}$

Question 2; The displacement of a particle is given as

$S = A + Bt + Ct^2$

Find the Unit of B

Solution

$S = A + Bt + Ct^2$

$S = Bt = B = S(m)$

$t \quad t \quad t(s)$

$= ms^1$

For Ct^2;

$$\frac{S}{t^2} = \frac{Ct^2}{t^2} = C = \frac{S(m)}{t^2(s)}$$

$$\therefore C = ms^{-2}$$

Dimension:

Dimension is the ability to mathematically represent derived physical quantities with four Fundamental quantit Such as length (L), Mass (M), Time (T), and Electric curr (I).

Eg Area $\Rightarrow L \times L = L^2$

Volume $\Rightarrow L \times L \times L = L^3$

Speed $\Rightarrow \frac{L}{T} = LT^{-1}$

Acceleration $\Rightarrow \frac{LT^{-1}}{T} = LT^2$

Force $\Rightarrow M \times LT^{-2} = MLT^{-2}$

Quantities	Unit	Dimension
Area	m^2	L^2
Volume	m^3	L^3
Time	s	T

Mass	Kg	m
Current	~~ms^{-1}~~ A	I
Speed	~~ms^{-1}~~ ms^{-1}	LT^{-1}
Velocity	~~ms^{-2}~~ ms^{-1}	LT^{-1}
Acceleration	ms^{-2}	LT^{-2}
Force	Kgm^{-2}	MLT^{-2}
Pressure	$Kgm^{-1}s^{-2}$	$ML^{-1}T^{-2}$

Phy 101

- Measurement
- Scalers & Vectors
- Kinematics
- Dynamics

} Study the Following Topics

PHY 201 12/12/2025

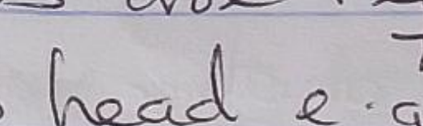
Topics

Vectors and Scalers

Vectors are quantities that has both magnitude and direction
eg of vector quantities Includes: Velocity, displacement, Momentum, Force e.t.c.

Scalar quantities has magnitude or value but no direction
eg of Scalars: Speed, density, energy mass, Volume, temperature e.t.c.

Vector Representation

Vectors are represented by line Segments with an arrow head e.g 

; the direction another way to represent a vector is to use a letter and an arrow above it ($\vec{A}$), small letters can also be used ($\vec{a}$). Any other letter can be used except letter O because it looks like Zero.

N:B If the letter is written or typed in a dark print, darker than the rest of the other letters, it can be used to represent vector quantities but does not need an arrow head above it.

While

Scalers are represented by letters only e.g F, d, B e.t.c. No arrow head above them and they are not written in dark prints.

Vector Algebra

* Two vectors $\vec{A}$ and $\vec{B}$ are equal only if they have the same value and direction. If they have the same magnitude but different direction, they are not equal.

* A vector having a direction opposite another vector but has equal magnitude is denoted by $-\vec{F}$ For instance. Eg $\vec{A} = 2i + 2j - 3k$ } two opposite
$-\vec{A} = -2i - 2j + 3k$ } vectors.

* The sum or resultant of vectors $\vec{A}$ and $\vec{B}$ is another vector $\vec{C}$. Eg $\vec{A} + \vec{B} = \vec{C}$.

* The difference of two vectors is another vector ie $\vec{A} - \vec{B} = \vec{C}$.

* If a vector $\vec{A}$ is multiplied by a scalar m or n, then another vector $m\vec{A}$ or $n\vec{A}$ is obtained.

Eg If $\vec{A} = 2i - j + 3k$

Solution

$\vec{A} = 2i - j + 3k$

Then $3A = 3(2i - j) + 3k$

$A = 6i - 3j + 9k$

Laws of Vector Algebra

1) $\vec{A} + \vec{B} = \vec{B} + \vec{A}$ [Cumtative Law]

2) $\vec{A} + (\vec{B} + \vec{C}) = (\vec{A} + \vec{B}) + \vec{C}$ [Associative Law]

3) $m(n\vec{A}) = (mn)\vec{A} = (mn\vec{A})$ [Associative Law]

4) $(m+n)\vec{A} = m\vec{A} + n\vec{A}$ [Associative Law]

5) $m(\vec{A} + \vec{B}) = m\vec{A} + m\vec{B}$ [Distributive Law]

Exercises:

Example 1: If $\vec{A} = 4i - j + 2k$, $\vec{B} = 3i - 3j + k$ and $\vec{C} = 2i - 3j + k$

Find: i) $\vec{A} + \vec{B}$

ii) $\vec{A} + (\vec{B} + \vec{C})$

iii) $3(2\vec{B})$

iv) $(2+4)(\vec{A})$

Solution

i) $\vec{A} + \vec{B}$

Example 2: If $\vec{a} = 4i + 5j - 3k$ and $\vec{B} = 3i - 2j + k$. Find the magnitude of $\bar{A}$, $\bar{B}$ and $\bar{A} - \bar{B}$

Solution

Magnitude $|\bar{A}| = \sqrt{x^2 + y^2 + z^2}$ where x, y, z are magnitudes of i, J and k respectively.

For $|\bar{A}| = \sqrt{4^2 + 5^2 + (-3)^2}$

$= \sqrt{16 + 25 + 9}$

$= \sqrt{50}$

Ans

For $|\bar{B}| = \sqrt{3^2 + (-2)^2 + 12}$

$= \sqrt{9 + 4 + 1}$

$= \sqrt{14}$

Ans

For $|A - B|$:

$A - B = (4i + 5j - 3k) - (3i - 2j + k)$

$= 4i + 5j - 3k - 3i + 2j - k$

CLT

$= 4i - 3i + 5j + 2j - 3k - k$

$A - B = i + 7j - 4k$

$|A - B| = \sqrt{12 + 7^2 + (-4)^2}$

$= \sqrt{1 + 49 + 16}$

$= \sqrt{66}$ Ans

Unit Vector

A Unit vector is a vector that has a unit length. Consider a vector $\vec{A}$ having a length $\bar{A} > 0$, then that vector $\frac{\vec{A}}{A}$ is a unit vector.

Normally $\vec{A}$ by $\bar{a}$, where $\bar{a}$ is the unit vector of $\bar{A}$

i.e $\bar{a} = \frac{\bar{A}}{|\bar{A}|}$, It can also be written as $|\bar{A}| = A$

$\therefore \frac{\vec{A}}{|\bar{A}|} = \frac{\vec{A}}{A}$

Eg If $\vec{A} = 3i + 2j + k$

Solution

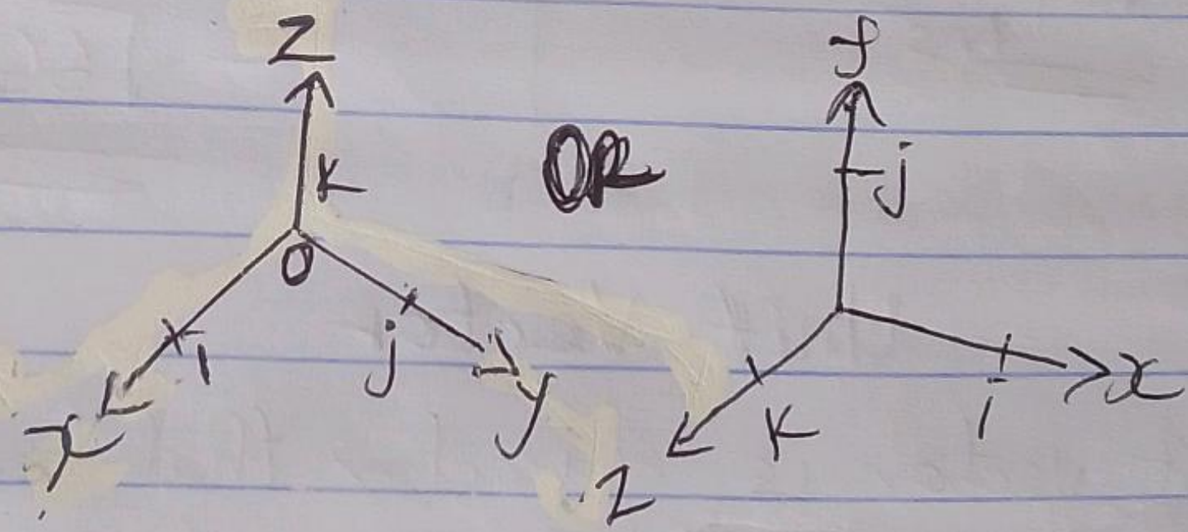
$\bar{a} = \frac{\bar{A}}{A}$

$= \frac{3i + 2j + k}{\sqrt{3^2 + 2^2 + 1^2}}$

$= \frac{3i + 2j + k}{\sqrt{14}}$

Rectangular Unit Vectors

In the rectangular Co-ordinate System, the unit vectors i, j and k are the unit vectors specifying x, y and z direct axis or directions.



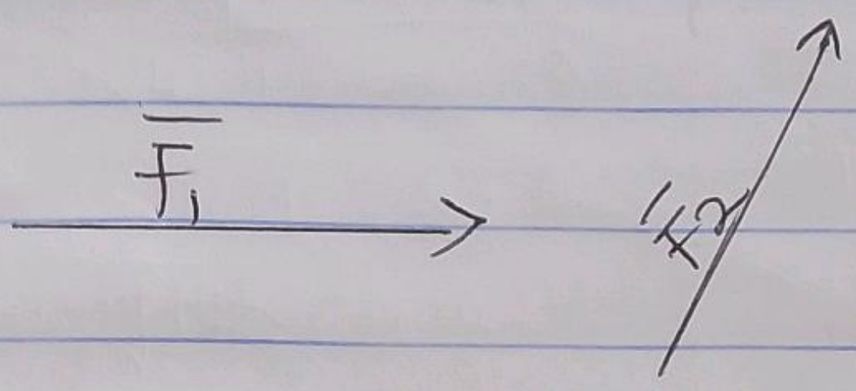
Addition of Vectors

i) Geometrical methods: Triangular, Parallelogram and polygon.
ii) Analytical methods

Geometrical methods:

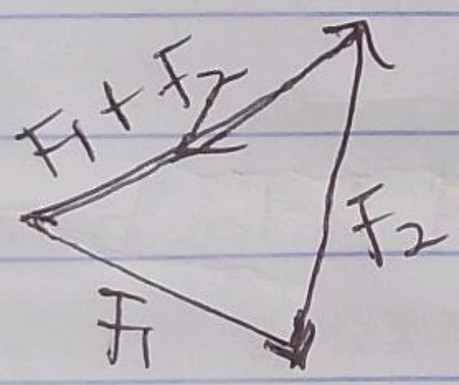
i) Triangle of ~~vectors~~: Two known vectors are drawn to represent two sides of a ~~tt~~triangle, the third side which is unknown is obtained by using a rule (metre rule) to join the two Vectors. The value of the third side is the third vector.

e.g



Steps:

1) Draw F_1 in s to length and direction
2) Draw F_2 starting from the head of F_1, maintaining its direction and length.

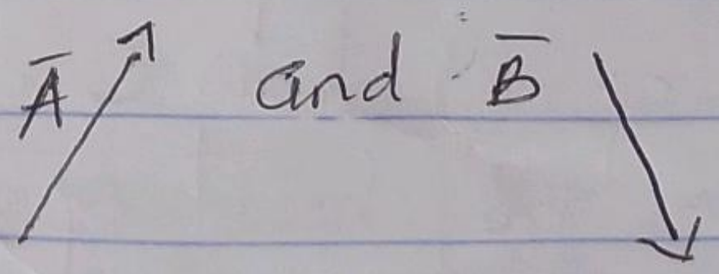


The third ~~stid~~ side is a vector, the ~~sum~~ of F_1 and F_2. It's direction must Counter the direction of F_1 & F_2

The Measurement of the length of the line of F_1 & F_2 gives the Sum.

ii) Parallelogram of Vectors:

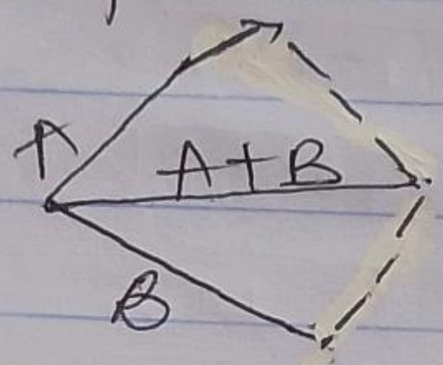
Consider two vectors $\bar{A}$ and $\bar{B}$



Steps:

1. Draw a line matching $\bar{A}$ in direction
2. From the tail of $\bar{A}$, draw $\bar{B}$ in the same direction.
3. Draw a symmetrical one from the head of $\bar{B}$ that is // to $\bar{A}$ and from the head of $\bar{A}$

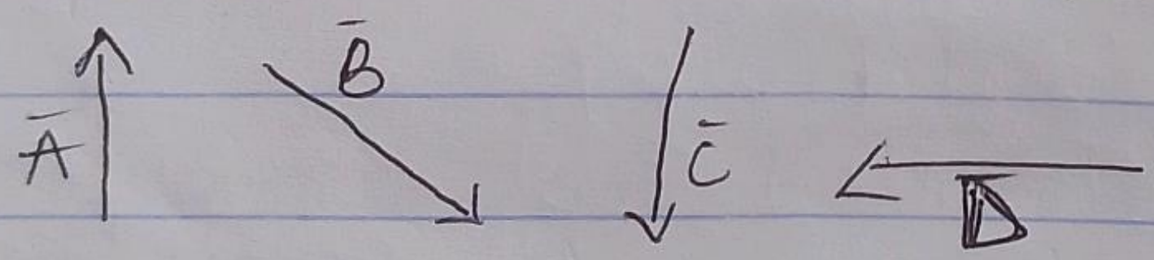
Thus:



4. Draw a diagonal as seen above to represent $\bar{A}+\bar{B}$ touching both vectors $\bar{A}$ and $\bar{B}$
5. The diagonal drawn is the sum of vectors $\bar{A}+\bar{B}$

iii) Polygon of Vectors:

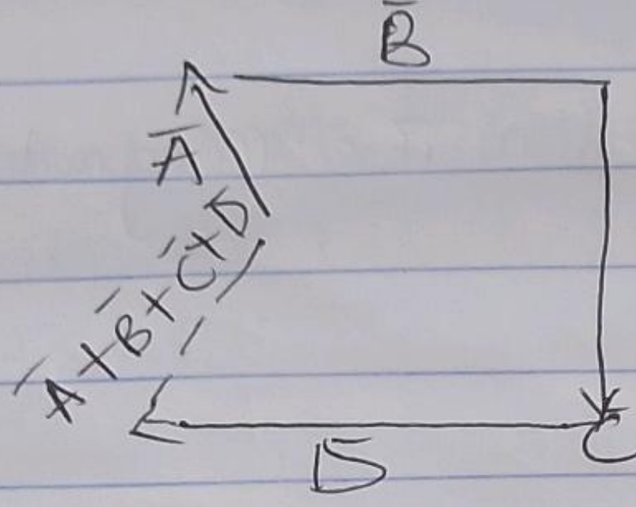
Consider two vectors $\bar{A}$, $\bar{B}$, $\bar{C}$ and $\bar{D}$ to be added.



Steps:

1. Draw to scale and direction
2. Draw B from the head of A in appropriate length and direction
3. From the head of B, draw C in direction and length.
4. Draw D from the head of C.

5. You will be left with a gap which will be closed with a line in counter direction.



NB: In analytical method, diagrams are not used.

Eg
If $\bar{P} = 7i - 3j + 2k$ and $\bar{Q} = 4i + 5j - 3k$, what is the sum of $\bar{P}$ and $\bar{Q}$ or resultant

Solution

$$P + Q = (7i - 3j + 2k) + (4i + 5j - 3k)$$
$$= 7i + 4i - 3j + 5j + 2k - 3k$$
$$\therefore \bar{P} + \bar{Q} = 11i + 2j - k \quad \text{Ans}$$

$$|\bar{P} + \bar{Q}| = \sqrt{11^2 + 2^2 + (-1)^2}$$
$$= \sqrt{121 + 4 + 1} = \sqrt{126}$$

Position Vector Or Radius Vector

The Radius vector $\bar{R}$ from origin O to the point x, y and z is always written as $\bar{R} = xi + yj + zk$

and has magnitude or value $|\bar{R}| = \sqrt{x^2+y^2+k^2}$

Example:

If $\bar{R} = 3\bar{i} - \bar{j} * 2k$, what is its magnitude

Solution

$$|\bar{R}| = \sqrt{3^2+(1)^2+2^2}$$
$$= \sqrt{9+1+4}$$
$$= \sqrt{14}$$

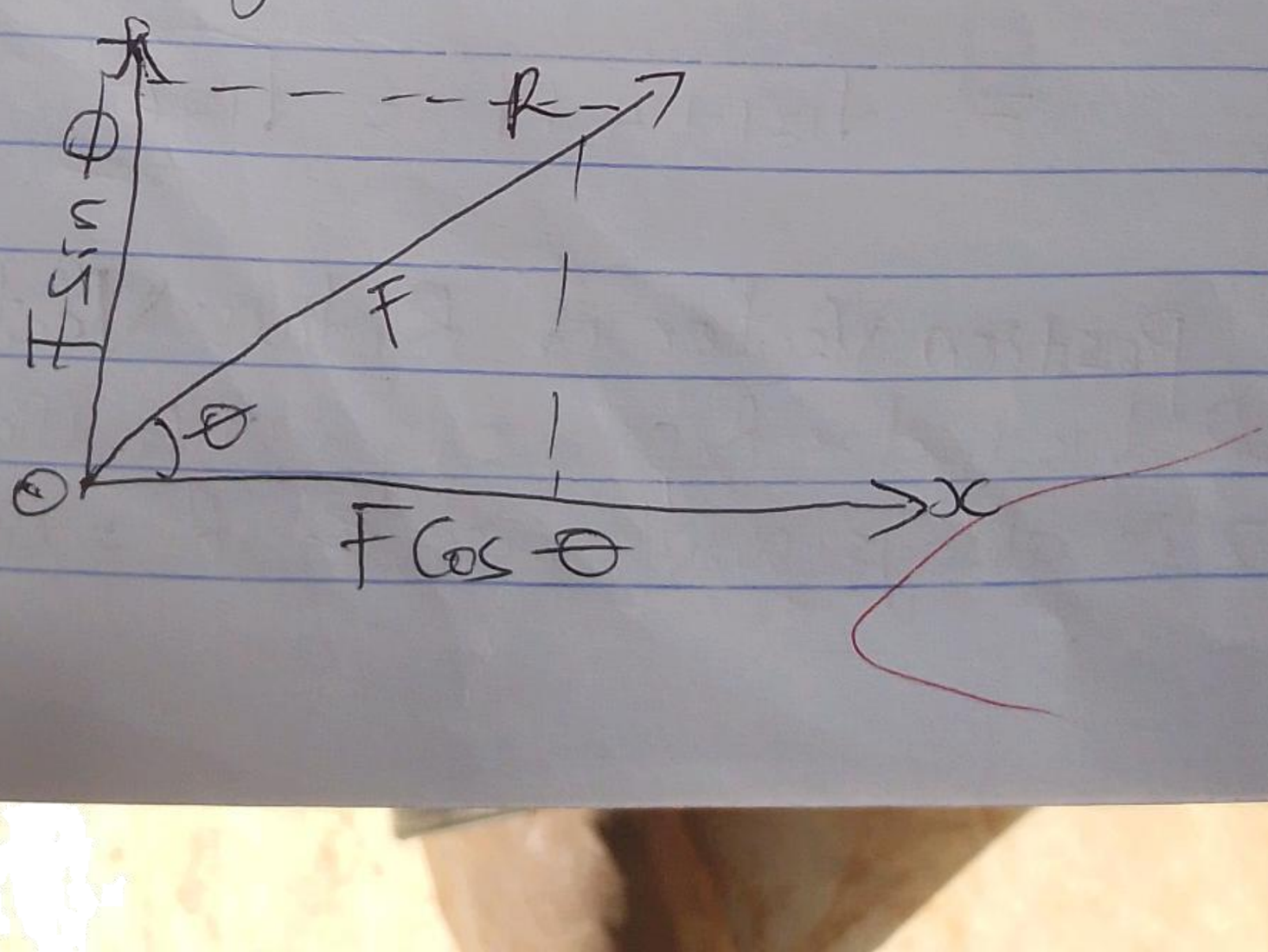
ans

Components of a Vector

The effect of a Vector around itself is its Component and when they are all added, they give the Vector itself.

The Component of a vector is the effect or path of a vector in the direction being considered.

Consider a Force $\bar{F}$ (OR) acting from the Origin O at an angle θ to the horizontal or x-axis



Component of $\bar{F}$ along x-axis is ~~$F\cos\theta$~~ $F\cos\theta$

" " " " y-axis is $F\sin\theta$

$\therefore F\cos\theta + F\sin\theta = \bar{F}$

$\bar{F}$ is the resultant or sum of its Component $F\cos\theta$ and $F\sin\theta$