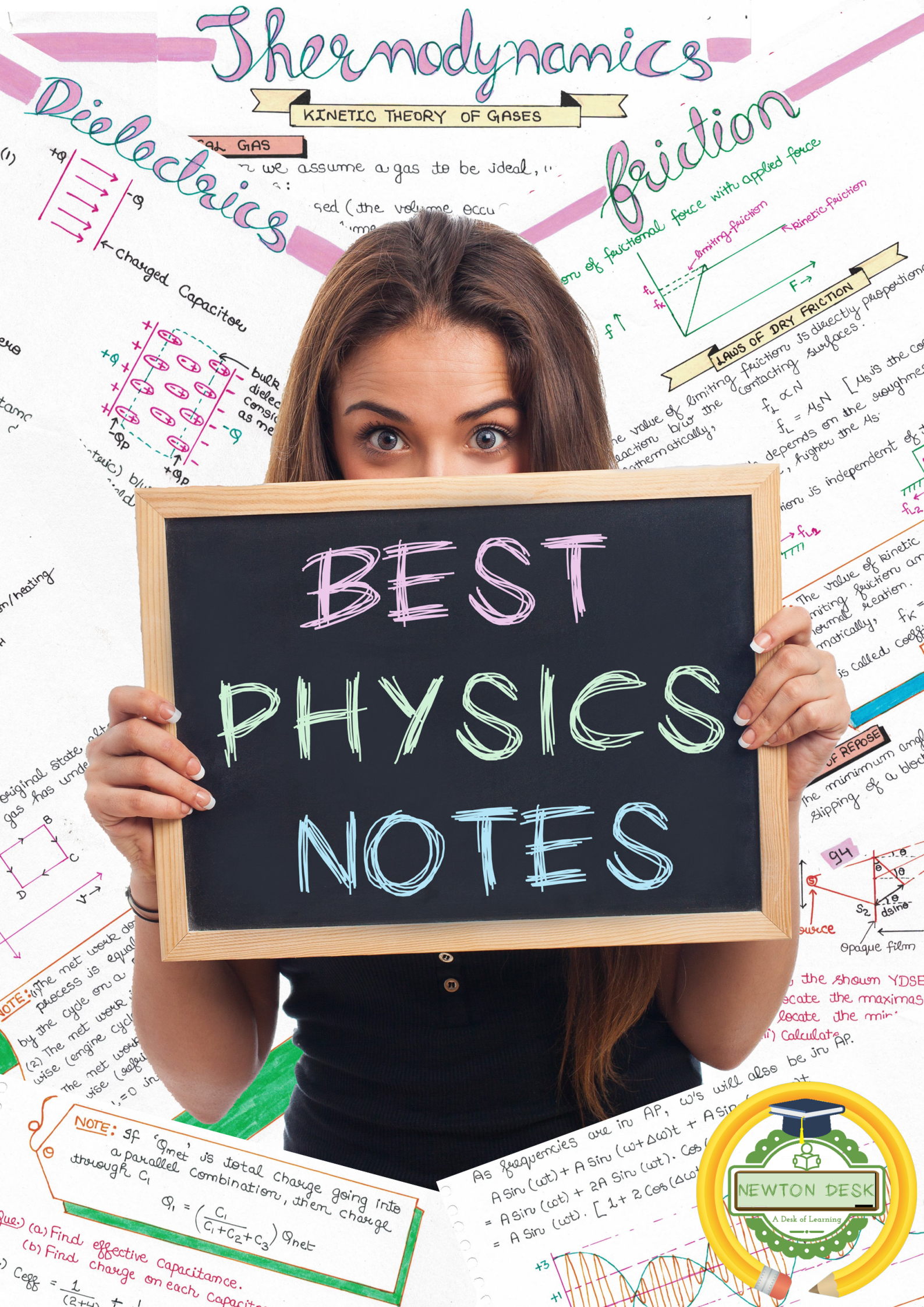
Thermodynamics
KINETIC THEORY OF GASES
Dielectrics
friction
BEST
PHYSICS
NOTES
NEWTON DESK
A Desk of Learning

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Vectors & Scalars

SCALAR

The physical quantity which has a magnitude but no specific direction. eg. - distance, mass, speed.

VECTOR

The physical quantity which has a magnitude as well as direction and follows the vector law of addition. eg.- Force, velocity, displacement, momentum.

NOTE -1 Current is not a vector quantity though it has direction and magnitude as it does not follow vector law of addition.

REPRESENTATION OF A VECTOR QUANTITY

A vector is representated by drawing an arrow proportional in length to the physical quantity being represented.

- A vector variable is represented by an arrow over english or greek alphabet.
- The same alphabet without the vector sign represents the magnitude of the vector and the same alphabet with a cap sign represents the direction of the vector.

Practice Time

(a) $\sin\left(\frac{2\pi}{3}\right) = \frac{\sqrt{3}}{2}$

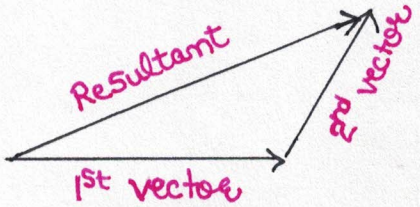
(b) $\cos\left(\frac{5\pi}{6}\right) = -\frac{\sqrt{3}}{2}$

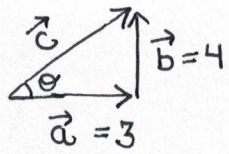
(c) $\tan\left(\frac{3\pi}{4}\right) = -1$

(d) $\tan\left(\frac{2\pi}{3}\right) = -\sqrt{3}$

TRIANGLE LAW OF ADDITION

To add two vectors, using triangle law, place the tail of the second vector on the head of the first vector. Now complete the triangle and the resultant vector is given by the arrow starting from tail of the first vector to the head of the second vector.



Eg - 

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

$\theta = \tan^{-1}\left(\frac{4}{3}\right)$

For example -

If $\vec{a}$ = 1Km North

then, a = 1km and $\hat{a}$ = North

INVERSE TRIGONOMETRIC NOTATION FOR ANGLES

$\sin^{-1}(x)$ represents an angle whose Sin is x

Eg - $\tan^{-1}(x) = \tan^{-1}(1) = 45^\circ$

$\sin^{-1}\left(\frac{1}{2}\right) = 30^\circ$

RADIAN MEASURE OF AN ANGLE

$360^\circ = 2\pi$ radian

If the angle (θ) of an arc is expressed in radians then the arc length is simply

$$\boxed{l = r\theta}$$

Trigonometric ratios for angles $> 90^\circ$

$\sin(\pi-\theta) = \sin\theta$

$\cos(\pi-\theta) = -\cos\theta$

$\tan(\pi-\theta) = -\tan\theta$

$\sin(\pi+\theta) = -\sin\theta$

$\cos(\pi+\theta) = -\cos\theta$

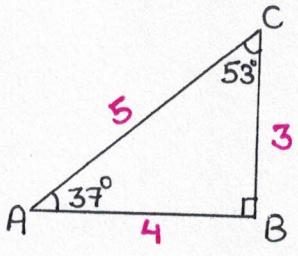
$\tan(\pi+\theta) = \tan\theta$

NOTE -2 $\sin 37^\circ = \frac{3}{5}$

$\cos 37^\circ = \frac{4}{5}$

$\sin 53^\circ = \frac{4}{5}$

$\cos 53^\circ = \frac{3}{5}$



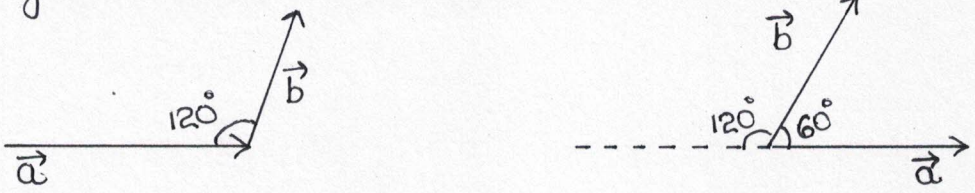
NOTE -3 Vector Sum is commutative i.e.

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

ANGLE BETWEEN TWO VECTORS

The angle between two vectors is defined as the non-reflex angle, between the vectors when they are joined tail to tail.

Eg - The angle between the vectors is 60°.



ANALYTICAL ADDITION OF VECTORS

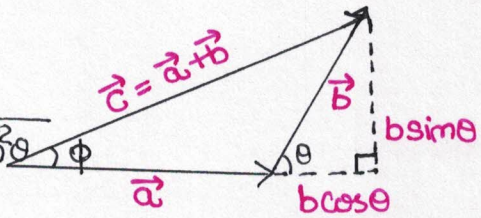
When we consider two vectors $\vec{a}$ and $\vec{b}$ represented for finding the resultant $(\vec{a}+\vec{b})$ using the triangle law as shown in fig.

Using pythagoras theorem

$$|\vec{c}| = \sqrt{(a+b\cos\theta)^2 + (b\sin\theta)^2}$$

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

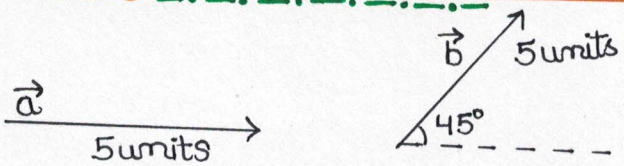
$$|\vec{c}| = \sqrt{a^2+b^2+2ab\cos\theta}$$



and direction is given by

$$\phi = \tan^{-1}\left(\frac{b\sin\theta}{a+b\cos\theta}\right)$$

Practice Time

■ 

$$\text{resultant} = \sqrt{25+25+50\times\frac{1}{\sqrt{2}}}$$

$$= \sqrt{50+\frac{50}{\sqrt{2}}}$$

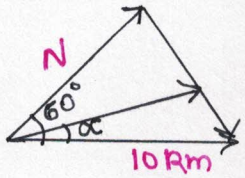
$$= \sqrt{\frac{50\sqrt{2}+50}{\sqrt{2}}}$$

$$\phi = \tan^{-1}\left(\frac{5/\sqrt{2}}{5+5/\sqrt{2}}\right) = \tan^{-1}\left(\frac{5}{5\sqrt{2}+5}\right)$$

$$\phi = \tan^{-1}\left(\frac{1}{\sqrt{2}+1}\right)$$

■ A man walks 10 Km towards east & then another 10 km towards 60° North east. Find its resultant & direction.

$$\vec{c} = \sqrt{200+200\times\frac{1}{2}}$$

$$= \sqrt{300}$$

$$= 10\sqrt{3}$$