YAKEEN NEET 2.0

2026

Units and Measurements

PHYSICS | Lecture – 07

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Todays Goal

- Conversion of Unit
- Ques Practice

*25. The Vander Waal's equation is $\left(P+\frac{a}{V^2}\right)(V-b)=RT$ Where P is pressure, V is volume, T is absolute temperature of given sample of a gas, R is called molar gas constant, a and b are Vander waal's constant.

Now answer the following

(i) The dimensional formula for b is same as for

(a) V (b) PV^2 (c) RT (d) P

(ii) The dimensional formula for a is same as for

(a) V^2 (b) P (c) PV^2 (d) RT

(iii) The dimensional formula of $\frac{ab}{RT}$ is

(a) $[ML^5T^{-2}]$ (b) $[M^0L^3T^0]$

(c) $[ML^{-1}T^{-2}]$ (d) $[M^0L^6T^0]$

(iv) The dimensional formula for RT is same as for

(a) Energy (b) force

(c) Latent heat (d) Specific heat

(v) The dimensional formula for RT is not same as that for

(a) $\frac{ab}{V^2}$ (b) Pb

(c) $\frac{a}{V^2}$ (d) PV

HW copy

2. In the formula; $P = \dfrac{nRT}{V-b}\, e^{-\frac{a}{RTV}}$ find the dimensions of 'b' and 'a' respectively, where P = pressure, n = no. of moles, T = temperature, V = volume and R = universal gas constant.

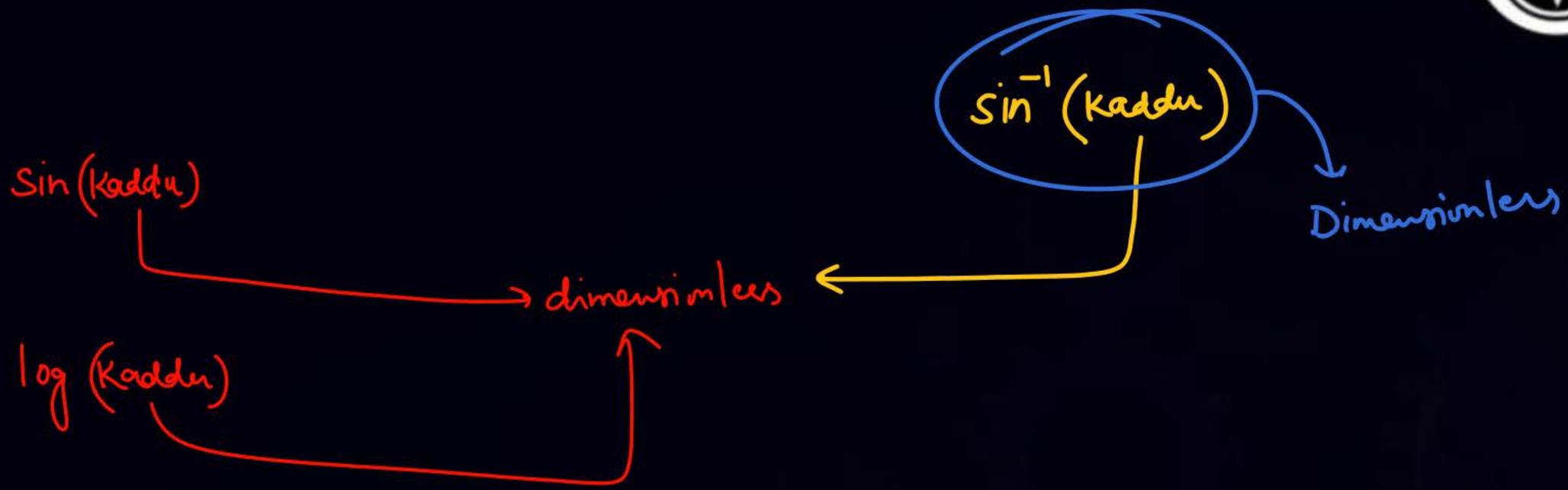
$P = \frac{nRT}{V}$ $\quad nRT = PV$

(a) $[L^3]$, $[MLT^{-2}]$ (b) $[M^2L]$, $[ML^5T^{-2}]$

(c) $[L^3]$, $[ML^5T^{-2}mol^{-1}]$ (d) $[M^2L]$, $[MLT^{-2}]$

$b \equiv L^3$ $\quad \therefore \quad \frac{a}{RTV} = 1$ $\quad a \equiv RTV \equiv \frac{PV}{n}V \equiv \frac{PV^2}{n}$

$\frac{mLT^{-2}}{L^2} \times \frac{L^6}{mol}$


$\sin^{-1}$ (kaddu)
Dimensionless
Sin (kaddu)
dimensionless
log (kaddu)

* $y = \sin^{-1}(x)$ → Dimensionless SKC

* $\int x^2\,dx \equiv x^2\,dx$

$L^2 \times L \equiv L^3$

* $dx \equiv \Delta x$

if $x \longrightarrow$ length

$dx \longrightarrow$ length

* $dt \longrightarrow$ time

* $\int, \Sigma$ Bhool jao ..... $dx \equiv \Delta x \equiv x$

copy

1. $\int \frac{xdx}{\sqrt{2ax-x^2}} = a^n \sin^{-1}\left[\frac{x}{a}-1\right]$. The value of n is

$(x \rightarrow \text{length})$

$\frac{x}{a} \longrightarrow$ Dimensionless

$x \equiv a \equiv L$

LHS $\equiv \frac{x\,dx}{\sqrt{2ax-x^2}} \equiv \frac{L \cdot L}{\sqrt{L^2}} \equiv \frac{L^2}{L} \equiv L$

RHS $\equiv L^n \times 1$

LHS $\equiv$ RHS.

$L \equiv L^n$

$n = 1$

HCV

19. Let x and a stand for distance. Is $\int \frac{dx}{\sqrt{a^2 - x^2}}$

$= \frac{1}{a} \sin^{-1} \frac{a}{x}$ dimensionally correct ?

Dimensionless

$\frac{1}{L} \equiv L^{-1}$

$\frac{L}{\sqrt{L^2}} \equiv \frac{L}{L} = 1$

LHS $\neq$ RHS

Incorrect

$F \equiv MLT^{-2}$

Unit conversion

① Convert 1N into CGS system

$$1N = 1\ \frac{Kg\ m}{Sec^2} \xrightarrow{\text{Convert in CGS}} \frac{1000\ gm\ (100\ cm)}{Sec^2}$$

$$= 10^5\ \frac{gm\ cm}{Sec^2} = 10^5\ \text{dyne}$$

② Convert 1 Joule in CGS system (erg)

$$1\ \text{Joule} = 1\ \frac{Kg\ m^2}{Sec^2} \longrightarrow \frac{1 \times 1000 gm \times (100 cm)^2}{Sec^2}$$

$$= 10^7\ \frac{gm\ cm^2}{Sec^2} \equiv 10^7\ \text{erg}$$

Alien system/hypothetical.

Q In a alien system/hypotetical system

(SKC methode)

1 unit of mass = 10kg
1 unit of length = 20m
1 unit of time = 5 sec.

① Find value of 1 unit of force in this system $= \frac{10kg \times 20m}{(5\,sec)^2} = \frac{200}{25}\ \frac{Kg\,m}{sec^2}$

$1\,N' = 8\,N$

② Find value of 1 unit of Energy in this system $= \frac{10kg \times (20m)^2}{(5\,sec)^2} = 160\ kgm^2/sec^2$

$= 160\,J$

$\boxed{1\,J' = 160\,J}$

© Find value of 1 unit of power in this system ML^2T^{-3}

$= \frac{10kg \times (20m)^2}{(5\,sec)^3} = 32\ kg\,m^2/sec^3$

$= 32$ Watt.

Your Choice
Alien system/hypothetical.

Q In a alien system/hypotetical system

(SKC methode)

1 unit of mass = 5kg
1 unit of length = 10m
1 unit of time = 2 sec

① Find value of 1 unit of force in this system = $\frac{5\text{kg} \times 10\text{m}}{(2\text{sec})^2} = 12.5\ \text{N}$

② Find value of 1 unit of Energy in this system = $\frac{5\text{kg} \times (10\text{m})^2}{(2\text{sec})^2} = 125\ \text{J}$

© Find value of 1 unit of power in this system

ML^2T^{-3}

$\frac{5\text{kg} \times (10\text{m})^2}{(2\text{sec})^3} = 62.5\ \text{W}$

Your Choice
Alien system/hypothetical.

Q In a alien system/hypotetical system

1 unit of mass = 10kg
1 unit of length = $\frac{1}{5}$m
1 unit of time = $\frac{1}{2}$ sec

(SKC methode)

① Find value of 1 unit of force in this system = $\frac{10kg \times \left(\frac{1}{5}m\right)}{\left(\frac{1}{2}sec\right)^2} = 8\,N$

② Find value of 1 unit of Energy in this system = $\frac{10kg \times \left(\frac{1}{5}m\right)^2}{\left(\frac{1}{2}sec\right)^2} = \frac{8}{5}J$

$= 1.6\,J$

© Find value of 1 unit of power in this system

ML^2T^{-3}

$\frac{10kg \times \left(\frac{1}{5}m\right)^2}{\left(\frac{1}{2}sec\right)^3} = 3.2\,W$

Alien system/hypothetical.

Q In a alien system/hypotetical system

(SKC methode)

1 unit of mass = 10kg
1 unit of length = 20m
1 unit of time = 5 sec.

① Find value of 1 unit of force in this system $= \frac{10kg \times 20m}{(5sec)^2} = 8N$

$1N' = 8N$

Alien system/hypothetical.

Q In a alien system/hypotetical system

1 unit of mass = 10kg
1 unit of length = 20m
1 unit of time = 5 sec.

(SKC methode)

① Find value of 1 unit of force in this system $= \frac{10kg \times 20m}{(5sec)^2} = 8N$

$1N' = 8N$

② Find numerical value of 1Newton (1N) in this system $= \frac{1}{8} N'$

(Good methode) X

$1N' = 8N$

$8N = 1N'$

$1N = \frac{1}{8} N'$

Not good

© Find numerical value of 80 Newton in this system

$1N \longrightarrow \frac{1}{8} N'$

$80N \longrightarrow \frac{1}{8} \times 80\, N' = 10\, N'$

Alien system/hypothetical.

$n_1 u_1 = n_2 u_2$

1m = 100 cm → CGS

Q In a alien system/hypotetical system

1 unit of mass = 10kg

1 unit of length = 20m

1 unit of time = 5 sec.

Find numerical value of 80 Newton in this system

Sol^n

$$n_1 u_1 = n_2 u_2$$

$$80 \frac{kg\,m}{sec^2} = n_2 \frac{(10kg)(20m)}{(5sec)^2}$$

$$80 = n_2 \times \frac{200}{25}$$

$$n_2 = 10$$

Alien system/hypothetical.

$n_1u_1 = n_2u_2$

1m = 100 cm → CGS

Q In a alien system/hypotetical system

1 unit of mass = 20kg
1 unit of length = 10m
1 unit of time = 2sec

Find numerical value of 50 Newton in this system

MLT^{-2}

Sol^n

$$n_1u_1 = n_2u_2$$

$$50\ \frac{kgm}{sec^2} = n_2 \times \frac{20kg \times 10m}{(2sec)^2}$$

$$50 = n_2 \times \frac{200}{4}$$

$$n_2 = 1$$

Alien system/hypothetical.

Q In a alien system/hypotetical system

1 unit of mass = 5Kg
1 Unit of length = 2m
1 Unit of time = 5 sec

(a) Find numerical value of 50 Newton in this system

Soln (b) Find numerical value of 100 joule in this system

MLT^{-2}

(a) $n_1u_1 = n_2u_2$

$$50\ \frac{Kg\,m}{Sec^2} = n_2\ \frac{5Kg\ 2m}{(5\,sec)^2}$$

$$50 = \frac{2}{5}n_2 \qquad \boxed{n_2 = 125}$$

(b) $n_1u_1 = n_2u_2$

n_1u_1 → Hmara, n_2u_2 → Unka

$$100\ \frac{Kg\,m^2}{Sec^2} = n_2 \times \frac{5Kg \times (2m)^2}{(5\,sec)^2}$$

$$100 = n_2\left(\frac{5\times 4}{5\times 5}\right)$$

$$\boxed{n_2 = 125}$$

∴

* Agar 1 Unit of force Pooche ⟶ SKC Lagao ($M L T^{-2}$) put

* Agar Value of 50N pooche to $n_1 u_1 = n_2 u_2$ Lagao.

Example 14: A calorie is a unit of heat or energy and it equals about 4.2 J, where 1 J = 1 kg m^2/s^2. Suppose we employ a system of units in which the unit of mass equals α kg, the unit of length equals β metre, the unit of time is γ second. Show that a calorie has a magnitude $4.2\ \alpha^{-1}\beta^{-2}\gamma^2$ in terms of the new units.

Every book

$M^1 L^2 T^{-2}$

$1\,Cal = 4.2\,J$

Value of 4.2 J. in new system

$n_1 u_1 = n_2 u_2$

$4.2\ \frac{kg\,m^2}{Sec^2} = n_2\ \frac{\alpha\,kg\,(\beta m)^2}{(\gamma\,Sec)^2}$

$n_2 = 4.2\,\alpha^{-1}\beta^{-2}\gamma^2$

29. Suppose two students are trying to make a new measurement system so that they can use it like a code measurement system and others do not understand it. Instead of taking 1 kg, 1 m and 1 s. as basic unit they took unit of mass as α kg, the unit of length as β m and unit of time as γ second. They called power in new system as SHAKTI, then match the two columns.

H/W

1 P'

Column-I		Column-II	
A.	1N in new system	p.	$\alpha^{-1}\beta^{-2}\gamma^{2}$
B.	1J in new system	q.	$\alpha^{-1}\beta^{-1}\gamma^{2}$
C.	1 Pascal (SI unit of pressure) in new system	r.	$\alpha^{-1}\beta\gamma^{2}$
D.	α SHAKTI in watt	s.	$\alpha^{2}\beta^{2}\gamma^{-3}$

(a) A-(q); B-(p); C-(r); D-(s)

(b) A-(p); B-(q); C-(r); D-(s)

(c) A-(q); B-(p); C-(s); D-(r)

(d) A-(p); B-(r); C-(q); D-(s)

Soln next page

① 1 N in new system means value of 1 N Poocha hai (methode 2 $n_1u_1 = n_2u_2$)

$$n_1u_1 = n_2u_2$$

$$1\ \text{Kg}\frac{\text{m}}{\text{sec}^2} = n_2\ \frac{\alpha\text{Kg}\,\beta\text{m}}{(\gamma\,\text{sec})^2} \Rightarrow \quad n_2 = \alpha^{-1}\beta^{-1}\gamma^2$$

② Similarly

$$n_1u_1 = n_2u_2$$

$$1\ \text{Kg}\frac{\text{m}^2}{\text{sec}^2} = n_2\ \frac{\alpha\text{Kg}(\beta\text{m})^2}{(\gamma\,\text{sec})^2} \Rightarrow \quad n_2 = \alpha^{-1}\beta^{-2}\gamma^2$$

③ Similarly

$$n_1u_1 = n_2u_2$$

$$1\ \text{Kg}\frac{\text{m}^2}{\text{sec}^3} = n_2\ \frac{\alpha\text{Kg}(\beta\text{m})^2}{(\gamma\,\text{sec})^3} \Rightarrow \quad n_2 = \alpha^{-1}\beta^{-2}\gamma^3$$

④ α Shakti in watt $\equiv$ $n_1u_1 = n_2u_2$

same type

(4) "α" shakti in watt $\Rightarrow$ $n_1 v_1 = n_2 v_2$ → mL^2T^{-3}

$$n_1 \frac{kg\,m^2}{sec^2} = \alpha \frac{(\alpha kg)(\beta m)^2}{(\gamma sec)^3}$$

$$n_1 = \frac{\alpha \cdot \alpha \beta^2}{\gamma^3} = \alpha^2 \beta^2 \gamma^{-3}$$

If you toy from SKC methode

$$1\,w' = \frac{\alpha kg(\beta m)^2}{(\gamma sec)^3} = \frac{\alpha \beta^2}{\gamma^3}\left(\frac{kg\,m^2}{sec^3}\right)$$

$$1\,w' = \frac{\alpha\beta^2}{\gamma^3} w$$

$\Rightarrow$ (ise shakti Bol Raha hai)

$$\alpha w' = \alpha \cdot \frac{\alpha\beta^2}{\gamma^3} w = \alpha^2\beta^2\gamma^{-3}\,(watt)$$

Limitation of Dim. Analysis

① Formula derive - - $T \propto m^x \ell^y g^z$

$T = (K) m^x \ell^y g^z$

→ No. information, if Dimensionless then only

② Dependency.

$\boxed{S = ut + \frac{1}{2}at^2}$ ≡ Cannot be derived.

Q Disp. of a particle depends on u, t, & a find formula

$S \propto u^x t^y a^z$

1 1 1

③ dependency more than 3 phy. quantity

$$v \propto F^{x} a^{y} \eta^{z} G^{u}$$

III

we cannot solve

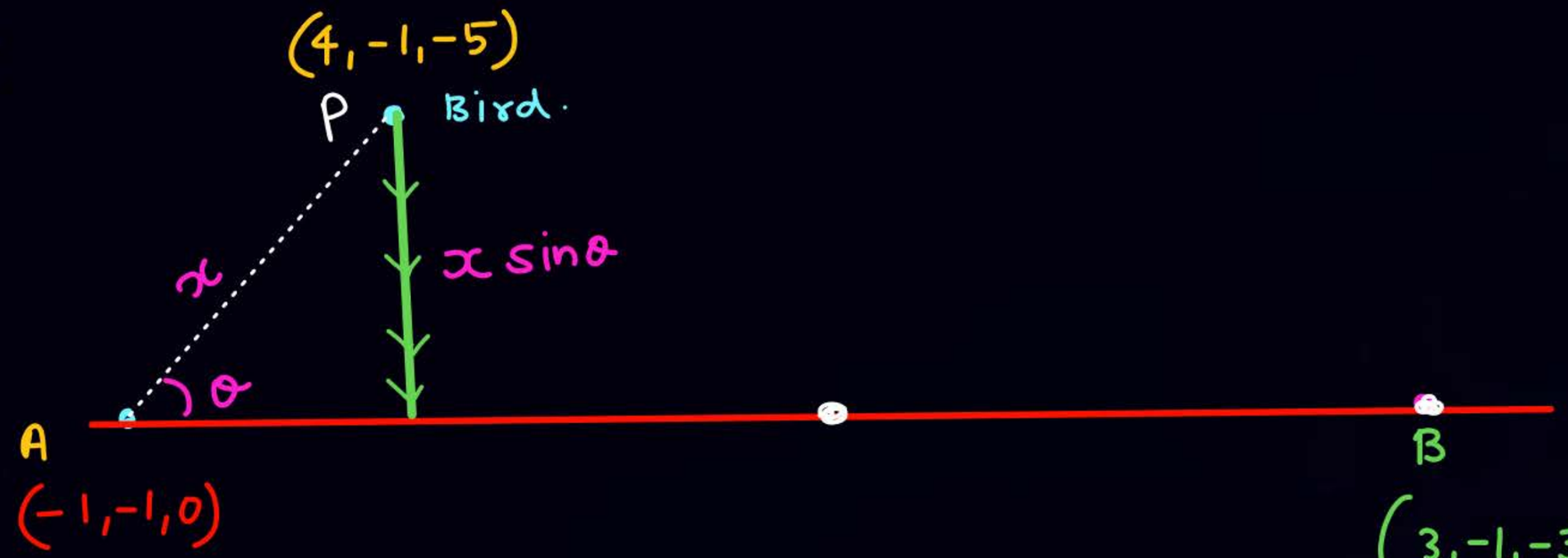
Beast mode

1 unit = 1 m

Q. A bird is at a point $(4,-1,-5)$
she see two point A$(-1,-1,0)$ and B $(3,-1,-3)$
She can fly with speed 10 m/s.
what is min time in which she can reach line joining A to B.

Soln

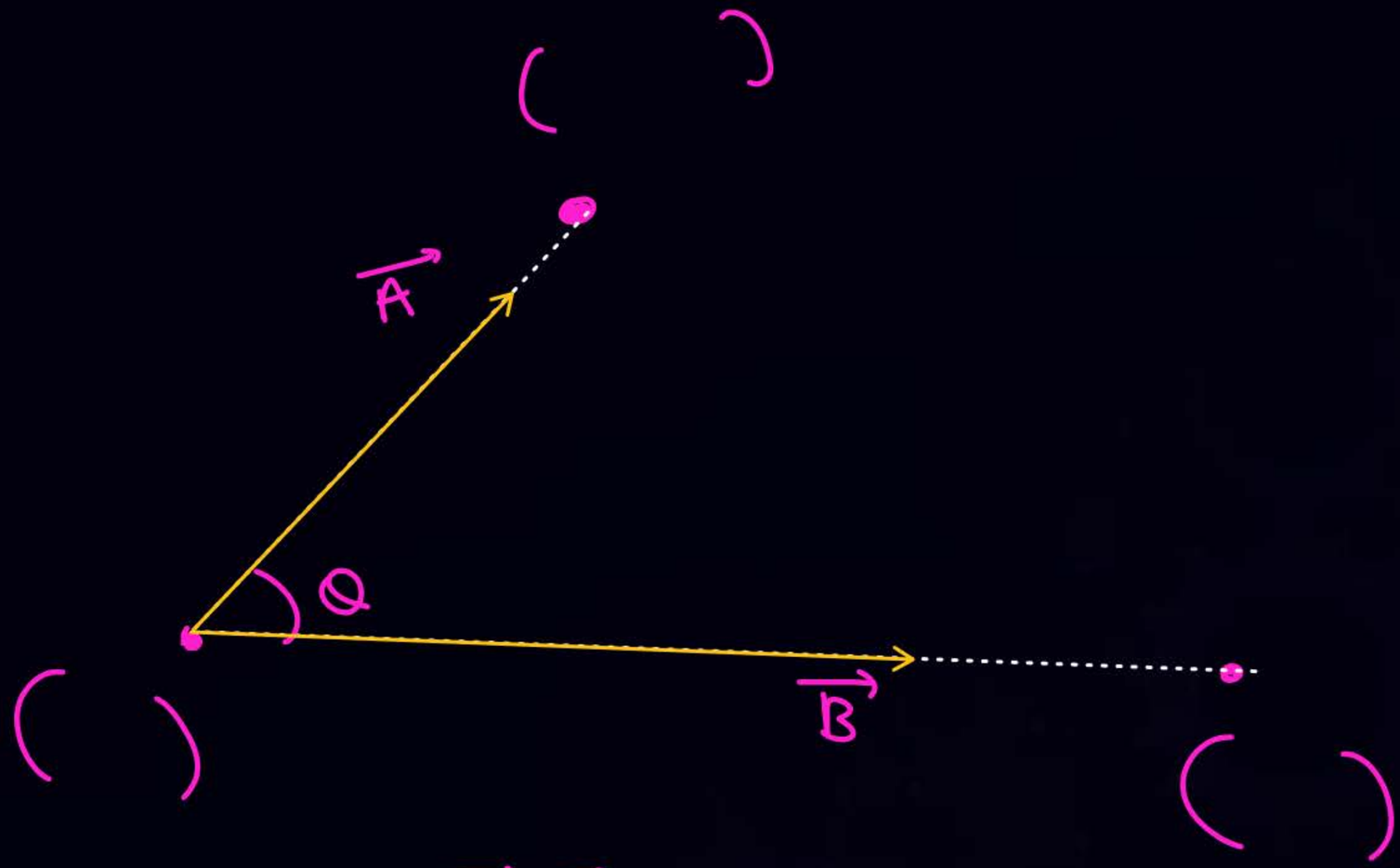
Ans .5 sec.



1unit = 1m

$$\text{time} = \frac{x \sin\theta}{v}$$

2



$$\vec{A}.\vec{B} = AB\cos\theta$$

5. The density of a material in SI units is $128\ kg\ m^{-3}$. In certain units in which the unit of length is 25 cm and the unit of mass 50 g, the numerical value of density of the material is

$\frac{m}{L^3}$ **[10 Jan, 2019 (Shift-I)]**

(a) 40 (b) 16 (c) 640 (d) 410

$n_1 u_1 = n_2 u_2$

$128\ \frac{kg}{m^3} = n_2 \times \frac{50\ gm}{(25\ cm)^3}$

$\frac{128 \times 1000\ gm}{(100\ cm)^3} = \frac{n_2 \times 50\ gm}{(25\ cm)^3}$

$\frac{128 \times 1000}{10^6} = \frac{n_2 \times 50}{25 \times 25 \times 25}$ 2

$\frac{25 \times 25 \times 128}{2000} = n_2 = 40$

40. If in a system of measurements unit of mass is α kg, unit of length is β m and that of time is γ sec. Find the value of 100 joule in this system.

ML^2T^{-2}

(a) $100\ \alpha^{-1}\beta^{-2}\gamma^2$

(b) $100\ \alpha^{-2}\beta^{-1}\gamma^{-2}$

(c) $100\ \alpha\beta^{-2}\gamma$

(d) $1000\ \alpha^{-2}\beta^{2}\gamma^{-1}$

$$100\ \frac{kg\ m^2}{sec^2} = n_2 \times \frac{(\alpha kg)(\beta m)^2}{(\gamma sec)^2}$$

$$100 = n_2 \cdot \frac{\alpha\beta^2}{\gamma^2}$$

$$n_2 = 100\,\alpha^{-1}\beta^{-2}\gamma^2$$

15. If the unit of length is micrometer and the unit of time is microsecond, the unit of velocity will be

(a) 100 m/s
(b) 10 m/s
(c) 10^{-6} m/s
(d) 1 m/s

16. In a certain system of units, unit of time is 5 s, unit of mass is 20 kg and unit of length is 10m. In this system, one unit of power will be equal to

(a) 16 watts
(b) 1/16 watts
(c) 25 watts
(d) None of these

17. If the unit of force is 1 kN, the unit of length is 1 km and the unit of time is 100 s, what will be the unit of mass?

(a) 1000 kg
(b) 10 kg
(c) 10000 kg
(d) 100 kg

Todays Goal

- Small KPP for today class based ques.
- PYQ (Unit & Dim.)
- module (Now can completely solve for unit & dimension)
- DPP 4, DPP,5

THANK YOU