YAKEEN NEET 2.0

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KPP (Discussion)

UNIT AND DIMENSIONS

PHYSICS Lecture - 12

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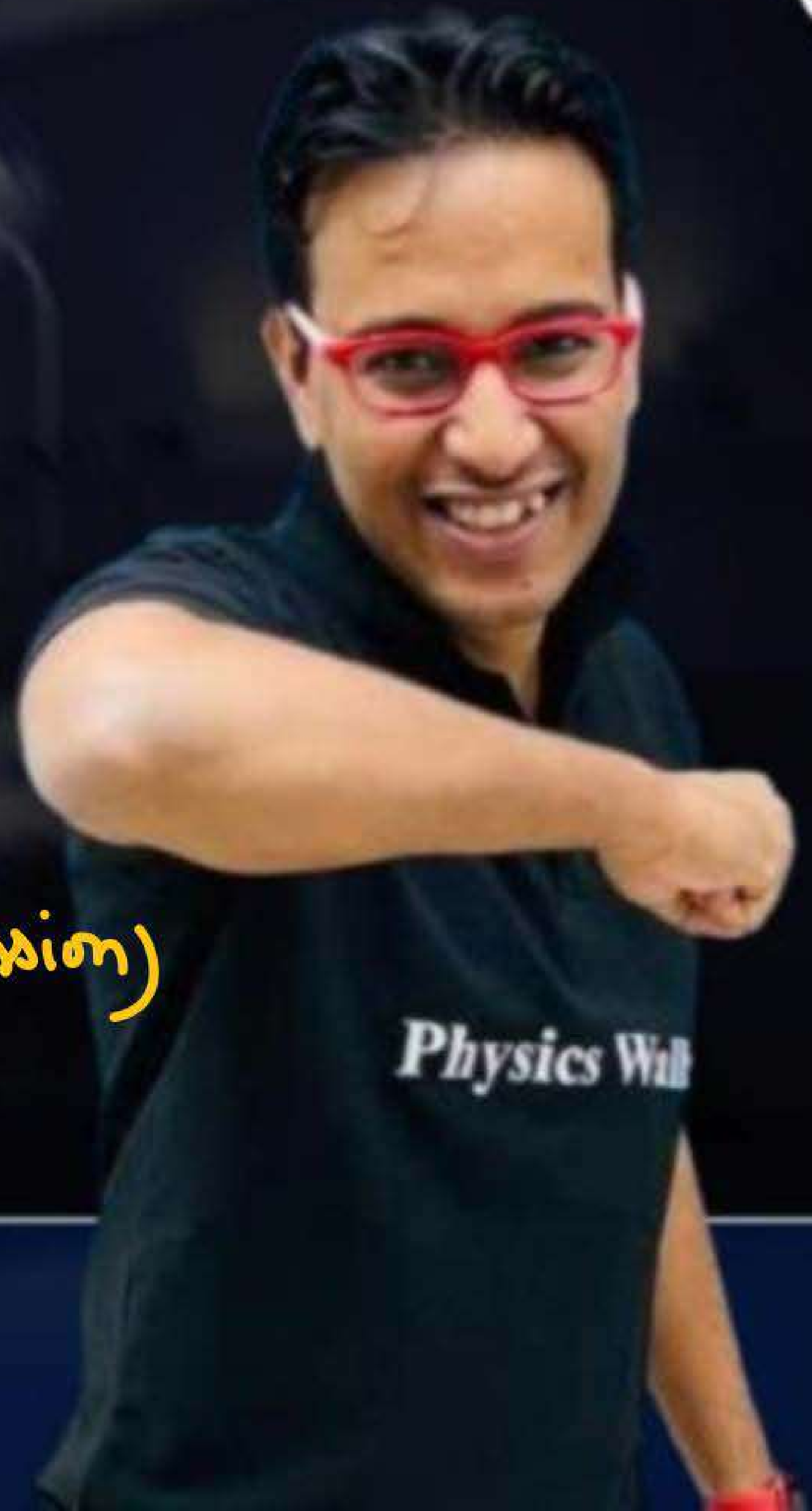

UNIT AND DIMENSIONS (KPP-12)

Q In a hypothetical system (SKC method) MLT^{-2}

1 unit of mass = 10 kg

" Length = 5 m

" " time = 2 sec

SKC,m

① Find 1 unit of force in this hypo. system $= \frac{10\,kg\ 5m}{(2\,sec)^2} = \frac{25}{2}\,N$

$n_1 u_1 = n_2 u_2$ = ② Find value of 50 N in this system

$$n_1 u_1 = n_2 u_2$$

MLT^{-2}

$$50\,\frac{kg\,m}{sec^2} = n_2\,\frac{10\,kg \times 5\,m}{(2\,sec)^2}$$

$$50 = n_2 \times \frac{25}{2}$$

$$\boxed{n_2 = 4}$$

QUESTION - 01

MLT^{-2}

In a given system of units, 1 unit of mass = 2 kg, 1 unit of length = 5 m and 1 unit of time = 5 sec. Then in this system, 1 N represents:

$$n_1 u_1 = n_2 u_2$$

(1) 5/2 units of force

(2) 2/5 units of force

(3) 2 units of force

(4) 1/2 units of force

$$1 \frac{kg\,m}{s^2} = n_2 \frac{2\,kg \times 5\,m}{(5\,sec)^2}$$

$$1 = n_2 \left(\frac{10}{25}\right)$$

$$n_2 = \frac{25}{10} = \frac{5}{2}$$

Ans : (1)

QUESTION - 02

ML^2T^{-2}

Imagine a system of units in which the unit of mass is 10 kg, length is 1 km and time is 1 minute. Then 1 J in this system is equal to _______ units of work:

(1) 360

(2) 3.6

(3) 3.6×10^5

(4) 36×10^{-5}

$n_1 u_1 = n_2 u_2$

$1 \frac{kg\,m^2}{sec^2} = n_2 \times \frac{10kg \times (1000m)^2}{(60sec)^2}$

$n_2 = \frac{60 \times 60}{10^7}$

Ans : (4)

QUESTION - 03

In a new unit system, 1 unit of time is equal to 10 second, 1 unit of mass is 5 kg and 1 unit of length is 20 m. In the new system of units, 1 unit of energy is equal to:

(1) 20 Joule
(2) $\frac{1}{20}$ Joule
(3) 4 Joule
(4) 16 Joule

ML^2T^{-2}

$\frac{5\,kg \times (20\,m)^2}{(10\,sec)^2} = \frac{5 \times 400}{100}$ $\frac{kg\,m^2}{s^2}$

$= 20\,J$

Ans : (1)

QUESTION - 04

In a particular system of unit, if the unit of mass becomes twice and that of time becomes half, then 8 joules will be written as _____ units of work.

(1) 16
(2) 1
(3) 4
(4) 64

ML^2T^{-2}

In new system

1 unit of mass $\equiv$ 2 kg

" " time = $\frac{1}{2}$ sec

$n_1 u_1 = n_2 u_2$

$$8 \frac{kg\,m}{sec^2} = n_2 \frac{2\,kg \times (1\,m)^2}{\left(\frac{1}{2}\,sec\right)^2}$$

$8 = n_2 \times 2 \times 4$

$n_2 = 1$

Ans : (2)

QUESTION - 05

ML^2T^{-2}

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.

$$1\,\text{cal} = 4.2\,J = 4.2\,\frac{\text{Kg}\,m^2}{\sec^2}$$

$$n_1 u_1 = n_2 u_2$$

$$4.2\,\frac{\text{Kg}\,m^2}{\sec^2} = n_2\,\frac{\alpha\,\text{Kg}\,(\beta m)^2}{(\gamma \sec)^2}$$

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

Ans : 4.2 $\alpha^{-1}\beta^{-2}\gamma^2$

QUESTION - 06

The pressure of 10^6 dyne/cm^2 is equivalent to

(1) 10^5 N/m^2 (2) 10^6 N/m^2

(3) 10^7 N/m^2 (4) 10^8 N/m^2

$1 N = 10^5$ dyne

1 dyne $= 10^{-5}$ N

$$10^6 \times \frac{10^{-5} N}{\left(\frac{1}{100} m\right)^2} = 10^{6-5+4} N/m^2$$

Ans : (1)

QUESTION - 07

ML^2T^{-2}

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.

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

(3) $100\,\alpha\beta^{-2}\gamma$ (4) $1000\,\alpha^{-2}\beta^{2}\gamma^{-1}$

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

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

Ans : (1)

QUESTION - 08

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

$\rightarrow 10^{-6}\,m$

$10^{-6}\,sec$

(1) 100 m/s
(2) 10 m/s
(3) 10^{-6} m/s
(4) 1 m/s

$LT^{-1} \doteq \frac{L}{T}$

$$\frac{10^{-6}\,m}{10^{-6}\,sec} \equiv m/sec.$$

Ans : (4)

QUESTION - 09

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:

ML^2T^{-3}

(1) 16 watts (2) 1/16 watts

(3) 25 watts (4) None of these

$$\frac{20\,kg \times (10\,m)^2}{(5\,sec)^3} = \frac{20 \times 100}{125}\ \frac{kg\,m^2}{sec^3}$$

$$= 16 \text{ watt}$$

Ans : (1)

QUESTION - 10

If the units of force and that of length are doubled, the unit of energy will become

(1) 1/4 times (2) 1/2 times

(3) 2 times (4) 4 times

Energy = $F \times L$

Ans : (4)

QUESTION - 11

If the units of mass and length are doubled then the unit of kinetic energy will become

(1) 2 times (2) 4 times

(3) 8 times (4) 16 times

$\frac{1}{2} m v^2$

Ans : (3)

QUESTION - 12

Ⓓ $n_1 u_1 = n_2 u_2$

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

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.

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

ML^2T^{-3}

(1) A-(q); B-(p); C-(r); D-(s)
(2) A-(p); B-(q); C-(r); D-(s)
(3) A-(q); B-(p); C-(s); D-(r)
(4) A-(p); B-(r); C-(q); D-(s)

Ⓐ $n_1 u_1 = n_2 u_2$

$1 \frac{kg\, m}{sec^2} = \frac{n_2\, \alpha\, kg\, \beta m}{(\gamma\, sec)^2}$

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

SKC

Ⓑ $\alpha^{-1}\beta^{-2}\gamma^2$

Ⓒ Pressure $\equiv ML^{-1}T^{-2}$

$1 \frac{kg}{m\, sec^2} = n_2 \frac{\alpha\, kg}{\beta m (\gamma\, sec)^2}$

$1 = n_2 \frac{\alpha}{\beta\gamma^2}$

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

Ⓓ 1 unit of power in new system $= \frac{\alpha\, kg (\beta m)^2}{(\gamma\, sec)^3}$

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

α shakti $= \frac{\alpha^2 \beta^2}{\gamma^3}$ (watt)

Ans : (1)

QUESTION - 13

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:

[10 Jan, 2019 (Shift-I)]

(1) 40 (2) 16

(3) 640 (4) 410

$$\frac{m}{L^3}$$

$$n_1 u_1 = n_2 u_2$$

$$128 \times \frac{kg}{m^3} = n_2 \frac{(50 \times 10^{-3} kg)}{(.25 m)^3}$$

Ans : (1)

QUESTION - 14

$\frac{a}{V^2} \longrightarrow$ Pressure

What is the dimensional formula of ab^{-1} in the equation $\underbrace{\left(P+\frac{a}{V^2}\right)}\underbrace{(V-b)}=RT$, where letters have their usual meaning. $PV = RT$

[05 April, 2024 (Shift-II)]

(1) $\left[M^0L^3T^{-2}\right]$

(2) $\left[ML^2T^{-2}\right]$

(3) $\left[M^{-1}L^5T^3\right]$

(4) $\left[M^6L^7T^4\right]$

$\frac{a}{b} \Rightarrow \frac{PV^2}{V} = PV \equiv RT$

$\frac{MLT^{-2}}{L^2} \cdot L^3$

Ans : (2)

QUESTION - 15

The moment of inertia of a body rotating about a given axis is 12.0 kg m^2 in the SI system. What is the value of the moment of inertia in a system of units in which the unit of length is 5 cm and the unit of mass is 10 g?

(1) 2.4×10^3
(2) 6.0×10^3
(3) 5.4×10^5
(4) 4.8×10^5

ML^2

$$12\ kg\,m^2 = n_2 (10 \times 10^{-3}\ kg)\left(\frac{5}{100} m\right)^2$$

$$12 = n_2 \times \frac{1}{100} \times \frac{25}{10^4}$$

$$n_2 = \frac{10^6 \times 12}{25} =$$

Ans : (4)

QUESTION - 16

The density of a material in CGS system of units is 4 g/cc. In a system of units in which unit of length is 2 cm and unit of mass is 16 g, find the numerical value of density of material.

$\frac{m}{L^3} \equiv mL^{-3}$

$n_1 u_1 = n_2 u_2$

$4 \frac{gm}{(cm)^3} = n_2 \times \frac{16\, gm}{(2\,cm)^3}$

$4 = n_2 \times \frac{16}{8}$

$n_2 = 2$

Ans : (2)

QUESTION - 17

ML^2T^{-2}

In a new system of units, the unit of mass is 100 g, unit of length is 4 m and unit of time is 2 s. Find the numerical value of 10 J in this system.

$$10\,\frac{kg\,m^2}{s^2} = n_2 \times \frac{.1\,kg \times (4m)^2}{(2\,sec)^2}$$

Ans : (25)

Hamain

QUESTION - 18

$KE = \frac{1}{2}mv^2 = \frac{1}{2}\,10kg\,400\frac{m^2}{s^2}$

$= 2000\,kg\,m^2/s^2 = 2000\,J$

Hmana Syst.

A block of mass 10kg is moving with acc. 10 m/s^2. Let at a given instant its speed is 20 m/s. Now in a hypothetical system at the given instant value of net force on particle is 100 unit of force and its kinetic energy is 20 unit of energy.
If a liquid has surface tension of 10. SI units find its surface tension in new system. Surface tension $= MT^{-2}$ [SSSQ]

$v = 20\,m/s$ $\quad a = 10\,m/s^2$

10kg

In new hypo. syst.

1 unit of mass $= \alpha$ kg

" " length $= \beta$ m

" " time $= \gamma$ sec

Ans

$F_{net} = ma = 10kg\,10m(sec)^{-2}$

$\boxed{F = 100\,N}$ $\quad MLT^{-2}$

$n_1 u_1 = n_2 u_2$

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

$\boxed{\frac{\alpha\beta}{\gamma^2} = 1}$ — (1)

$n_1 u_1 = n_2 u_2$ $\quad ML^2T^{-2}$

$2000\,\frac{kg\,m^2}{sec^2} = 20\,\frac{(\alpha kg)(\beta m)^2}{(\gamma sec)^2}$

$\boxed{100 = \frac{\alpha\beta^2}{\gamma^2}}$ — (2)

Ans : (1000)

$n_1 v_1 = n_2 v_2$

$10 \times \frac{Kg}{(sec)^2} = n_2 \frac{\alpha Kg}{(\gamma sec)^2}$

$\boxed{10 = n_2 \cdot \frac{\alpha}{\gamma^2}}$

$10 = n_2 \alpha \frac{1}{100}$

$n_2 = 1000$

Surface tension $= \frac{m}{T^2}$

put $\frac{\alpha\beta}{\gamma^2} = 1$

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

Ratio $\frac{1}{\beta} = \frac{1}{100}$

$\beta = 100$

$\frac{\alpha \times 100}{\gamma^2} = 1$

$\frac{\alpha}{\gamma^2} = \frac{1}{100}$

$\frac{F}{L} \equiv \frac{m \cancel{L} T^{-2}}{\cancel{L}}$

$= \frac{m}{T^2}$

surface tension $= \frac{F}{l} = \frac{M\cancel{L}T^{-2}}{\cancel{L}} = MT^{-2}$

THANK
YOU