YAKEEN NEET 2.0

2026

Units and Measurements

PHYSICS | Lecture - 5

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Todays Goal

- Physical Quan. in 12^{th}

Derived physical Quantities

12th की physical Quant. (Abhi Take it lightly)

$i = \frac{\Delta q}{\Delta t}, \frac{dq}{dt}$

*

(1) charge = current × time

$q \Rightarrow [AT]$

(2) $F = \frac{Kq_1q_2}{r^2}$

Find D.F. of K.

$K = \frac{Fr^2}{q_1q_2} \equiv \frac{MLT^{-2}L^2}{AT\,AT}$

$\equiv ML^3T^{-4}A^{-2}$

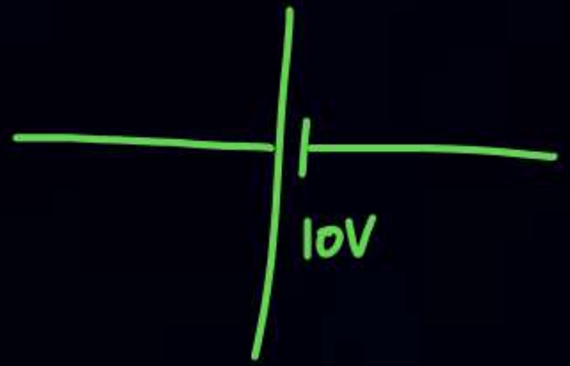
(3) $F = \frac{1}{4\pi\epsilon_0}\frac{q_1q_2}{r^2}$

$\epsilon_0 = \frac{q_1q_2}{4\pi r^2 . F} \Rightarrow \frac{A^2T^2}{L^2MLT^{-2}} = M^{-1}L^{-3}T^4A^2$

permitivity of free space

$-1, -3, 4, 2$

(4) Electric Potential $\equiv$ Pot. difference $\equiv$ E.m.f.



$$V = \frac{P.E.}{\text{charge}} \Rightarrow \frac{ML^2T^{-2}}{AT} = ML^2T^{-3}A^{-1}$$

(5) Capacitance,

$$q = CV$$

$$C = \frac{q}{V} = \frac{q.q}{U} \Rightarrow \frac{A^2T^2}{ML^2T^{-2}} = M^{-1}L^{-2}T^{4}A^{2}$$

(6) $V = iR$ → Resistance

$R = \frac{V}{i} \Rightarrow \frac{ML^2T^{-2}}{AT \cdot A} = ML^2T^{-3}A^{-2}$

(7) $R = \rho \frac{l}{A}$ → length

ρ → Resistivity

A → Area of Crosssection.

$\rho = \frac{R \cdot A}{l} = \frac{V}{i}\frac{A}{l} \Rightarrow \frac{ML^2T^{-2}}{AT \cdot A}\frac{L^2}{L}$

$\frac{1}{\rho} = \sigma$ → conductivity.

**

(8) $F = qE$

$E \Rightarrow \frac{F}{q} \Rightarrow \frac{MLT^{-2}}{AT} = MLT^{-3}A^{-1}$

(9) $\vec{J} = \sigma \vec{E}$

$\vec{J}$ → current Density

$J = \frac{i}{\text{Area}}$

$\sigma = \frac{J}{E} \Rightarrow \frac{i}{AE} \Rightarrow \frac{A \ AT}{L^2 \cdot MLT^{-2}} = $ ✓

A → Area

(10) $F = q\overset{\text{velocity}}{v}B$

$B = \frac{F}{qv} \Rightarrow \frac{MLT^{-2}}{ATLT^{-1}} = MA^{-1}T^{-2}$

(11) $\mu_0 \longrightarrow$ magnetic permeability.

$B = \frac{\mu_0 i}{2R}$ → Radius

$\mu_0 = \frac{B2R}{i} = \frac{MA^{-1}T^{-2} \times L}{A}$

$= MLT^{-2}A^{-2}$

** (12) $c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$ → speed of light

$\mu_0\epsilon_0 \Longrightarrow ?$ $c^2 = \frac{1}{\mu_0\epsilon_0}$

$\mu_0\epsilon_0 = \frac{1}{c^2} \Rightarrow L^{-2}T^{2}$

*** (13) $E = BC$

E → Electric field

B → magnetic field

C → speed of light

(14) Electric flux ϕ = Electric field × Area

$\longrightarrow \frac{MLT^{-2}}{AT} \cdot L^2 =$ ✓

**(15) Energy Density = $\frac{\text{Energy}}{\text{Vol}^n} \Rightarrow \frac{ML^2T^{-2}}{L^3} \Rightarrow ML^{-1}T^{-2}$

$\longrightarrow \frac{1}{2}\epsilon_0 E^2, \quad \frac{1}{2}\frac{B^2}{\mu_0}$

(16) $\phi = Li$ ← magnetic flux

$\phi = mi$

$m = \frac{\phi}{i}$

magnetic flux = B(Area)

$$BA = \frac{F}{qv} \cdot A = \frac{MLT^{-2}}{AT\,LT^{-1}} L^2$$

$$L = \frac{\phi}{i} = \frac{\checkmark}{A} = \checkmark$$

Self Inductuch

(17) Electric dipole moment $\equiv q \times l \Rightarrow ATL$

Home Work

q

ϵ_0

E

V (potential)

R

ρ

σ

B

Self inductance $\phi = Li$

mutual Induct. $\phi = Mi$

* $C = \dfrac{1}{\sqrt{\mu_0 \epsilon_0}}$ Verify

* dipole moment
* magnetic dipole moment $= i \times \text{Area}$
* magnetic flux
* Electric flux
* emf / motional emf / Rot. emf / कद्दू emf

Potential

$K.E. = \frac{1}{2}mv^2$

LHS $\longrightarrow$ ML^2T^{-2}

RHS $\longrightarrow$ $M(LT^{-1})^2 = ML^2T^{-2}$

D.F. of L.H.S. = D.F of R.H.S.

* $KE = \frac{1}{2}mv^2$ is Dimensionally correct & numerically correct.

$KE = \frac{1}{3}mv^2$

LHS $\longrightarrow$ ML^2T^{-2}

RHS $\longrightarrow$ $M(LT^{-1})^2 = ML^2T^{-2}$

D.F. of L.H.S. = D.F of R.H.S.

$KE = \frac{1}{3}mv^2$ $\longrightarrow$ Dimensionally correct

$\longrightarrow$ But numerically Incorrect

Overall incorrect

To a formula/Relation/eq^n to be correct, it must be dimensionally as well as numerically correct

But in this chapter Unit & Dim. we can check only dimensionally.

We can derive the formula by using dimension Analysis.

(Kuch-2)

Q Time period (T) of a simple pendulum depends on mass of block (m), length of string (l), acc due to gravity (g). Derive the relation b/w them.

Kahani par focus X

Sol^n

$$T \propto m^x l^y g^z$$

$$T = K m^x l^y g^z$$

K → Dimensionless

$$M^0L^0T^1 = M^x L^y (LT^{-2})^z$$

$$M^0L^0T^1 = M^x L^{y+z} T^{-2z}$$

$x = 0$

$y + z = 0$

$-2z = 1$

$\boxed{z = -\frac{1}{2}}$

$\boxed{y = \frac{1}{2}}$

$$T = K m^0 l^{\frac{1}{2}} g^{-\frac{1}{2}}$$

$$T = K\sqrt{\frac{l}{g}}$$

$$\boxed{T = 2\pi\sqrt{\frac{l}{g}}}$$

Q Time period of a spring block system depends on m mass of block acc to gravity (g) & spring const 'k' $\left(k = \frac{Force}{length}\right)$

Derive the relation

$$k = \frac{MLT^{-2}}{L} = MT^{-2}$$

Sol^n

$$T \propto m^x g^y k^z$$

$$T = k' m^x g^y k^z$$

$$T = M^x (LT^{-2})^y (MT^{-2})^z$$

$$M^0 L^0 T^1 = M^{x+z} L^y T^{-2y-2z}$$

$$x + z = 0$$

$$y = 0$$

$$-2y - 2z = 1$$

$$y = 0$$

$$z = -\frac{1}{2}$$

$$x = \frac{1}{2}$$

$$T = k' m^{\frac{1}{2}} \cdot g^0 \, k^{-\frac{1}{2}}$$

$$\boxed{T = k'\sqrt{\frac{m}{k}}}$$

$$\boxed{T = 2\pi\sqrt{\frac{m}{k}}}$$

Q Suppose it has observed that velocity of the ripple wave on water depends on wavelength λ, density of water ρ and surface tension 'T'. Derive the relation

Solⁿ

$$v \propto \lambda^x \rho^y T^z$$

$$LT^{-1} = L^x (ML^{-3})^y (MT^{-2})^z$$

$$M^0 L^1 T^{-1} = M^{y+z} L^{x-3y} T^{-2z}$$

$$y+z=0$$

$$x-3y=1$$

$$z=\frac{1}{2}$$

Surface tension $= \frac{\text{Force}}{\text{length}} = \frac{MLT^{-2}}{L}$

Solve & get

$$z=\frac{1}{2}, \; y=-\frac{1}{2}, \; x=-\frac{1}{2}$$

$$v = K \lambda^{-\frac{1}{2}} \rho^{-\frac{1}{2}} T^{\frac{1}{2}}$$

$$v = K\sqrt{\frac{T}{\lambda\rho}}$$

QUESTION - 02

The damping force on an oscillator is directly proportional to the velocity. The units of the constant of proportionality are:

[2012]

(1) $kg\,m\,s^{-1}$ (2) $kg\,m\,s^{-2}$

(3) $kg\,s^{-1}$ (4) $kg\,s$

$F \propto v$

$F = kv$

$M\cancel{L}T^{-2} = k\cancel{L}T^{-1}$

$k = MT^{-1}$

Ans : (3)

QUESTION - 34

$aT = LT^{-1}$

The velocity v of a particle at time t is given by $v = at + \frac{b}{t+c}$, where a, b and c are constants. The dimensions of a, b and c are:

$t = c$

$a = LT^{-2}$ [2006]

(1) [L], [LT] and $[LT^{-2}]$

(2) $[LT^{-2}]$, [L] and [T]

(3) $[L^2]$, [T] and $[LT^{-2}]$

(4) $[LT^{-2}]$, [LT] and [L]

Ans : (2)

QUESTION - 30

Kal KPP

Planck's constant (h), speed of light in vacuum (c) and Newton's gravitational constant (G) are three fundamental constants. Which of the following combinations of these has the dimension of length?

[NEET-II 2016]

(1) $\frac{\sqrt{hG}}{c^{3/2}}$ (2) $\sqrt{\frac{hG}{c^{5/2}}}$

(3) $\sqrt{\frac{hc}{G}}$ (4) $\sqrt{\frac{Gc}{h^{3/2}}}$

Ans : (1)

QUESTION - 28

If force [F], acceleration [A] and time [T] are chosen as the fundamental physical quantities. Find the dimensions of energy.

[2021]

(1) $[F][A^{-1}][T]$ (2) $[F][A][T]$

(3) $[F][A][T^2]$ (4) $[F][A][T^{-1}]$

Ans : (3)

QUESTION - 27

A force defined by $F = \alpha t^2 + \beta t$ acts on a particle at a given time t. The factor which is dimensionless, if α and β are constants, is:

[2024]

(1) $\frac{\beta t}{\alpha}$

(2) $\frac{\alpha t}{\beta}$

(3) $\alpha\beta t$

(4) $\frac{\alpha\beta}{t}$

$$F = \alpha t^2 + \beta t$$

$$\alpha = \frac{MLT^{-2}}{T^2} \equiv MLT^{-4}$$

Ans : (2)

QUESTION - 26

Which pair do not have equal dimensions?

[2000]

(1) Energy and torque
(2) Force and impulse
(3) Angular momentum and Planck's constant
(4) Elastic modulus and pressure

Ans : (2)

QUESTION - 25

The dimensions of Planck's constant equals to that of

[2001]

$E = h\hat{\nu}$

$h = ET^{-1}$

(1) energy ✗

(2) momentum ✗

(3) angular momentum ✓ → mvr

(4) ✗ power

Ans : (3)

QUESTION - 24

The dimensions of universal gravitational constant are:

[2004, 1992]

(1) $[M^{-1}L^{3}T^{-2}]$ (2) $[ML^{2}T^{-1}]$

(3) $[M^{-2}L^{3}T^{-2}]$ (4) $[M^{-2}L^{2}T^{-1}]$

Ans : (1)

QUESTION - 19

Energy Den $\equiv \frac{mL^2T^{-2}}{L^3} \equiv \underline{mL^{-1}T^{-2}}$

The dimension of $\frac{1}{2}\varepsilon_0 E^2$, where ε_0 is permittivity of free space and E is electric field, is:

[2010]

(1) ML^2T^{-2} (2) $ML^{-1}T^{-2}$

(3) ML^2T^{-1} (4) MLT^{-1}

Ans : (2)

QUESTION - 22

$\rightarrow R = \checkmark$

Dimensions of resistance in an electrical circuit, in terms of dimension of mass M, of length L, of time T and of current I, would be:

[2007]

(1) $[ML^2T^{-2}]$ (2) $[ML^2T^{-1}I^{-1}]$

(3) $[ML^2T^{-3}I^{-2}]$ (4) $[ML^2T^{-3}I^{-1}]$

Ans : (3)

QUESTION - 23

The ratio of the dimensions of Planck's constant and that of moment of inertia is the dimensions of:

[2005]

(1) time

(2) frequency

(3) angular momentum

(4) velocity

$E = h\nu$

$\frac{h}{mR^2}$

$\frac{ET}{mR^2} = \frac{\cancel{M}\cancel{L^2}T^{-2} \cdot T}{\cancel{M}\cancel{L^2}} = T^{-1}$

Ans : (2)

QUESTION - 20

If the dimensions of a physical quantity are given by $M^a L^b T^c$, then the physical quantity will be:

[2009]

(1) velocity if $a = 1, b = 0, c = -1$

(2) acceleration if $a = 1, b = 1, c = -2$

(3) force if $a = 0, b = -1, c = -2$

(4) pressure if $a = 1, b = -1, c = -2$

$M^a L^b T^c$ $\quad$ $M^1 L^1 T^{-2}$

$M^0 L T^{-1}$

Ans : (4)

QUESTION - 18

The dimensions of $(\mu_0 \varepsilon_0)^{-1/2}$ are

[Mains 2012, 2011]

(1) $[L^{1/2}T^{-1/2}]$ (2) $[L^{-1}T]$

(3) $[LT^{-1}]$ (4) $[L^{1/2}T^{1/2}]$

$$c = \frac{1}{\sqrt{\mu_0 \epsilon_0}} = (\mu_0 \epsilon_0)^{-\frac{1}{2}}$$

Ans : (3)

QUESTION - 17

The pair of quantities having same dimensions is:

[Karnataka NEET 2013]

(1) Impulse and Surface Tension
(2) Angular momentum and Work
(3) Work and Torque
(4) Young's modulus and Energy

Ans : (3)

QUESTION - 16

$\frac{F}{A} = \frac{MLT^{-2}}{L^2} =$

Dimensions of stress are:

[2020]

(1) $[MLT^{-2}]$ (b) $[ML^2T^{-2}]$

(3) $[ML^0T^{-2}]$ (4) $[ML^{-1}T^{-2}]$

Ans : (4)

QUESTION - 15

If E and G respectively denote energy and gravitational constant, then E/G has the dimensions of:

[2021]

(1) $[M^2][L^{-2}][T^{-1}]$ (2) $[M^2][L^{-1}][T^0]$

(3) $[M][L^{-1}][T^{-1}]$ (4) $[M][L^0][T^0]$

$\frac{E}{G} =$

Ans : (2)

QUESTION - 03

The unit of permittivity of free space, ε_0, is: [2004]

(1) coulomb/newton-metre
(2) newton-metre^2/coulomb^2
(3) coulomb^2/newton-metre^2
(4) coulomb^2/(newton-metre)^2

$$\varepsilon_0 = \frac{q_1 q_2}{r^2 F} \rightarrow \frac{Cb^2}{m^2 N}$$

Ans : (3)

QUESTION - 13

The dimension $[MLT^{-2}A^{-2}]$ belong to the:

[2022]

(1) magnetic flux
(2) self inductance
(3) magnetic permeability
(4) electric permittivity

Ans : (3)

QUESTION - 14

Plane angle and solid angle have:

[2022]

(1) Units but no dimensions
(2) Dimensions but no units
(3) No units and no dimensions
(4) Both units and dimension

Ans : (1)

QUESTION - 01

The unit of thermal conductivity is:

[2019]

(1) $W\,m^{-1}\,K^{-1}$ (2) $J\,m\,K^{-1}$

(3) $J\,m^{-1}\,K^{-1}$ (4) $W\,m\,K^{-1}$

Ans : (1)

8. A physical quantity $\vec{S}$ is defined as $\vec{S} = \frac{(\vec{E} \times \vec{B})}{\mu_0}$, where $\vec{E}$ is electric field, $\vec{B}$ is magnetic field and μ_0 is the permeability of free space. The dimensions of $\vec{S}$ are the same as the dimensions of which of the following quantity (ies) ?

$S = \frac{EB}{\mu_0} = \frac{E}{\cancel{\mu_0}}\left(\frac{\cancel{\mu_0} i}{2R}\right)$

(1) $\frac{\text{Energy}}{\text{charge} \times \text{current}}$

$\frac{MLT^{-2}}{LT} = MT^{-3}$

(2) $\frac{\text{Force}}{\text{Length} \times \text{Time}}$

$S = \frac{MLT^{-2}}{AT} \cdot \frac{A}{L} = MT^{-3}$

(3) $\frac{\text{Energy}}{\text{Volume}}$

(4) $\frac{\text{Power}}{\text{Area}}$

$\frac{ML^2T^{-3}}{L^2}$

Ans (2, 4)

(JEE Advanced 2021)

7. The relation between $[\in_0]$ and $[\mu_0]$ is :- [JEE Advanced-2018]

$[\in_0]$ और $[\mu_0]$ के बीच में संबंध है

(A) $[\mu_0] = [\in_0][L]^2[T]^{-2}$

(B) $[\mu_0] = [\in_0][L]^{-2}[T]^2$

(C) $[\mu_0] = [\in_0]^{-1}[L]^2[T]^{-2}$

(D) $[\mu_0] = [\in_0]^{-1}[L]^{-2}[T]^2$

Ans. (D)

$$c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$$

$$L^2T^{-2} = \frac{1}{\mu_0 \epsilon_0}$$

$$\mu_0 \epsilon_0 = L^{-2}T^2$$

6. The relation between [E] and [B] is :- [JEE Advanced-2018]

[E] और [B] के बीच में संबंध है :-

(A) $[E] = [B][L][T]$ (B) $[E] = [B][L]^{-1}[T]$ (C) $[E] = [B][L][T]^{-1}$ (D) $[E] = [B][L]^{-1}[T]^{-1}$

E = BC

Ans. (C)

3. In terms of potential difference V, electric current I, permittivity ε_0, permeability μ_0 and speed of light c, the dimensionally correct equation(s) is(are)

विभवान्तर V, विद्युत धारा I, परावैद्युतांक ε_0, पारगम्यता μ_0 तथा प्रकाश की चाल c के पदों में विमीय रूप से सही विकल्प है (हैं)।

[JEE Advanced-2015]

(A) $\mu_0 I^2 = \varepsilon_0 V^2$ (B) $\varepsilon_0 I = \mu_0 V$ (C) $I = \varepsilon_0 c V$ (D) $\mu_0 c I = \varepsilon_0 V$

Ans. (A,C)

Homework

μ_0

ε_0

i

V

Question [redacted]

In terms of potential difference V, electric current I, permittivity ε_0, permeability μ_0 and speed of light c the dimensionally correct equations is/are: [JEE Adv. 2015]

Potential Diff = $\dfrac{\text{Energy}}{\text{Charge}} = \dfrac{ML^2T^{-2}}{AT} = ML^2T^{-3}A^{-1}$

(1) $\mu_0 I^2 = E_0 V^2$

(2) $\varepsilon_0 I = \mu_d V$

(3) $I = E_0 c V$

(4) $\mu_0 c I = \varepsilon_0 V$

$\epsilon_0 = M^{-1}L^{-3}T^{4}A^{2}$

$\mu_0 = MLT^{-2}A^{-2}$

$C = LT^{-1}$

$C = \dfrac{1}{\sqrt{\mu_0 \epsilon_0}}$

Sol^n next page

option

$V = \frac{\text{Energy}}{\text{Charge}}$

(1) $\mu_0 I^2 = \epsilon_0 V^2$

LHS $\mu_0 I^2 \longrightarrow MLT^{-2}I^{-2}.I^2 = MLT^{-2}$

RHS $\rightarrow$ $\epsilon_0 V^2 \longrightarrow M^{-1}L^{-3}T^4A^2 . \left(\frac{ML^2T^{-2}}{AT}\right)^2$

$= MLT^{-2}$

LHS = RHS

(3) $I = \epsilon_0 CV$

RHS $M^{-1}L^{-3}T^4A^2 . LT^{-1} . \left(\frac{ML^2T^{-2}}{AT}\right) = A$

LHS $I \equiv A$

Very easy

1. Match List I with List II and select the correct answer using the codes given below the lists :

[JEE Advanced-2013]

	List I		List II
P.	Boltzmann constant	1.	$[ML^2T^{-1}]$
Q.	Coefficient of viscosity	2.	$[ML^{-1}T^{-1}]$
R.	Planck constant	3.	$[MLT^{-3}K^{-1}]$
S.	Thermal conductivity	4.	$[ML^2T^{-2}K^{-1}]$

Not Adv. level ques

Ans. C

[redacted]

2. To find the distance d over which a signal can be seen clearly in foggy conditions, a railways engineer uses dimensional analysis and assumes that the distance depends on the mass density ρ of the fog, intensity (power/area) S of the light from the signal and its frequency f. The engineer finds that d is proportional to $S^{1/n}$. The value of n is.

कोहरे की स्थिति में वह दूरी d, जहाँ से सिग्नल स्पष्ट रूप से दिखाई दे, जानने के लिए एक रेलवे इंजीनियर विमीय विश्लेषण का प्रयोग करता है। उसके अनुसार यह दूरी d कोहरे के द्रव्यमान घनत्व ρ, सिग्नल के प्रकाश की तीव्रता S (शक्ति/क्षेत्रफल) तथा उसकी आवृत्ति f पर निर्भर है। यदि इंजीनियर d को $S^{1/n}$ के समानुपाती पाता है, तब n का मान है :

[JEE Advanced-2014]

Ans. 3

Homework

$d \propto \rho^x S^y f^z$

Question - [redacted]

Solution $S = \text{Intensity} = \frac{\text{Power}}{\text{Area}} \equiv MT^{-3}$

To find the distance d over which a signal can be seen clearly in foggy conditions, a railway engineer uses dimensional analysis and assumes that the distance depends on the mass density p of the fog, intensity (power/area) S of the light from the signal and its frequency f. The engineer finds that d is proportional to $S^{1/n}$. The value of n is: [JEE Adv. 2014]

$$\text{Distance} \propto (\text{density})^x (\text{Intensity})^y (\text{freq.})^z$$

$$L = (ML^{-3})^x \cdot (MT^{-3})^y (T^{-1})^z$$

$$M^0 L^1 T^0 = M^{x+y} \cdot L^{-3x} \cdot T^{-3y-z}$$

solve & get

$$x = -\frac{1}{3}, \quad y = \frac{1}{3}, \quad z = -1$$

Ans $\frac{1}{y} = 3$

Ans: (3)

we already solved

1. In the relation, $p=\frac{\alpha}{\beta}e^{-\left(\frac{\alpha z}{k\theta}\right)}$ is pressure, z is distance, k is Boltzmann's constant and θ is the temperature. The dimensional formula of β will be: **[IIT-JEE 2004]**

(1) $[M^0L^2T^0]$ (2) $[ML^2T]$

(3) $[ML^0T^{-1}]$ (4) $[M^0L^2T^{-1}]$

3. Match the physical quantities given in Column-I with dimensions expressed in terms of mass (M), length (L), time (T) and charge (Q) given in Column-II and write the correct answer against the matched quantity in a tabular form in your answer book. [IIT-JEE]

Homework

Ans
A → r
B → u
C → p
D → t
E → q
F → s

Column-I		Column-II	
A.	Angular momentum	p.	$[ML^2T^{-2}]$
B.	Latent heat	q.	$[ML^2Q^{-2}]$
C.	Torque	r.	$[ML^2T^{-1}]$
D.	Capacitance	s.	$[ML^3T^{-1}Q^{-2}]$
E.	Inductance	t.	$[M^{-1}L^{-2}T^2Q^2]$
F.	Resistivity	u.	$[L^2T^{-2}]$

H/W
Sol^n
& hint
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9. Let us consider a system of units in which mass and angular momentum are dimensionless. If length has dimension of L, which of the following statement(s) is/are correct? **[JEE Adv, 2019]**

(1) The dimension of force is L^{-3}.

(2) The dimension of energy of L^{-2}.

(3) The dimension of power is L^{-5}.

(4) The dimension of linear momentum is L^{-1}.

Question [redacted]

Let us consider a system of units in which mass and angular momentum are dimensionless. If length has dimension of L, which of the following statement(s) is/are correct?

[JEE Adv. 2019]

Angular momentum = mvr

$= 1 \times LT^{-1} \cdot L = L^2T^{-1}$

mass → Dimensionless

$M = 1, \quad L^2T^{-1} = 1 \Rightarrow T = L^2$

(1) The dimension of force is L^{-3}.

(2) The dimension of energy of L^{-2}.

(3) The dimension of power is L^{-5}.

(4) The dimension of linear momentum is L^{-1}.

(1) Force $= MLT^{-2} = 1 \times L \times L^{-4} = L^{-3}$

(2) Energy $= ML^2T^{-2} \Rightarrow 1 \times L^2 \times L^{-4} = L^{-2}$

(3) Power $= ML^2T^{-3} = 1 \times L^2 \times L^{-6} = L^{4}$

(4) Momentum $= MLT^{-1} = 1 \times L \times L^{-2} = L^{-1}$

Ans: (1, 2, 4)

12. A temperature difference can generate e.m.f. in some materials. Let S be the e.m.f. produced per unit temperature difference between the ends of a wire, σ the electrical conductivity and κ the thermal conductivity of the material of the wire. Taking M, L, T, I and K as dimensions of mass, length, time, current and temperature, respectively, the dimensional formula of the quantity $Z = \frac{S^2\sigma}{\kappa}$ is: **[JEE Adv. 2025]**

(1) $[M^0L^0T^0I^0K^0]$ (2) $[M^0L^0T^0I^0K^{-1}]$

(3) $[M^1L^2T^{-2}I^{-1}K^{-1}]$ (4) $[M^1L^2T^{-4}I^{-1}K^{-1}]$

Question - 12 Emf $\Rightarrow$ Potential $\Rightarrow \frac{\text{Potential Energy}}{\text{charge}} \Rightarrow \frac{ML^2T^{-2}}{AT} = ML^2T^{-3}A^{-1}$

A temperature difference can generate e.m.f. in some materials. Let S be the e.m.f. produced per unit temperature difference between the ends of a wire, σ the electrical conductivity and κ the thermal conductivity of the material of the wire. Taking M, L, T, I and K as dimensions of mass, length, time, current and temperature, respectively, the dimensional formula of the quantity $Z = \frac{S^2\sigma}{\kappa}$ is: [JEE Adv. 2025]

$S = \frac{\text{Emf}}{\Delta \text{Temp}} = \frac{ML^2T^{-3}A^{-1}}{K} = ML^2T^{-3}A^{-1}K^{-1}$

(1) $[M^0L^0T^0I^0K^0]$

(2) $[M^0L^0T^0I^0K^{-1}]$

$\sigma = \frac{J}{E} = \frac{\text{current Density}}{\text{Electric field}} = \frac{A \cdot AT}{L^2 \cdot MLT^{-2}} = M^{-1}L^{-3}T^3A^2$

(3) $[M^1L^2T^{-2}I^{-1}K^{-1}]$

thermal conductivity $= M^1L^1T^{-3}K^{-1}$

(4) $[M^1L^2T^{-4}I^{-1}K^{-1}]$

Now put value in $\frac{S^2\sigma}{\kappa} \Rightarrow$ solve & get $= K^{-1}$

Ans: (2)

7. In a particular system of units, a physical quantity can be expressed in terms of the electric charge e, electron mass m_e, Planck's constant h, and coulomb's constant $k = \dfrac{1}{4\pi\varepsilon_0}$, where ε_0 is the permittivity of vacuum. In terms of these physical constants, the dimension of the magnetic field is $[B] = [e]^{\alpha}[m_e]^{\beta}[h]^{\gamma}[k]^{\delta}$. The value of $\alpha + \beta + \gamma + \delta$ is ________. **[JEE Adv. 2022]**

Question [redacted]

$$F = \frac{k q_1 q_2}{r^2} \Rightarrow k = \frac{F r^2}{q_1 q_2} = \frac{MLT^{-2} \cdot L \cdot L}{(AT)^2} = ML^3T^{-4}A^{-2}$$

Sol^n

In a particular system of units, a physical quantity can be expressed in terms of the electric charge e, electron mass m_e, Planck's constant h, and coulomb's constant $k = \frac{1}{4\pi\varepsilon_0}$, where ε_0 is the permittivity of vacuum. In terms of these physical constants, the dimension of the magnetic field is $[B] = [e]^{\alpha}[m_e]^{\beta}[h]^{\gamma}[k]^{\delta}$. The value of $\alpha + \beta + \gamma + \delta$ is ______.

[JEE Adv. 2022]

$B \Rightarrow MT^{-2}A^{-1}$

$e \Rightarrow AT$

$h \Rightarrow ML^2T^{-1}$

$k = ML^3T^{-4}A^{-2}$

Now put the value & solve by yourself.

its maths & very calculative & get

$\alpha = 3, \beta = 2, \gamma = -3, \delta = 2$

Ans: (4)

Paragraph ([redacted]

A dense collection of equal number of electrons and positive ions is called neutral plasma. Certain solids containing fixed positive ions surrounded by free electrons can be treated as neutral plasma. Let N be the number density of free electrons, each of mass m. When the electrons are subjected to an electric field, they are displaced relatively away from the heavy positive ions. If the electric field becomes zero, the electrons begin to oscillate about the positive ions with a natural angular frequency ω_p, which is called the plasma frequency. To sustain the oscillations, a time varying electric field needs to be applied that has an angular frequency w, where a part of the energy is absorbed and a part of it is reflected. As ω approaches ω_p, all the free electrons are set to resonance together and all the energy is reflected. This is the explanation of high reflectivity of metals. **[IIT-JEE 2011]**

Question - [redacted]

Taking the electronic charge as e and the permittivity as ε_0, use dimensional analysis to determine the correct expression for ω_p.

(1) $\sqrt{\dfrac{Ne}{m\varepsilon_0}}$

(2) $\sqrt{\dfrac{m\varepsilon_0}{Ne}}$

(3) $\sqrt{\dfrac{Ne^2}{m\varepsilon_0}}$

(4) $\sqrt{\dfrac{m\varepsilon_0}{Ne^2}}$

ω_p = Angular frequence $\longrightarrow T^{-1}$

$N \rightarrow$ numer Density $= \dfrac{1}{L^3}$

$e \Rightarrow AT$

$\epsilon_0 = M^{-1}L^{-3}T^{4}A^{2}$

Check options

$$(3)\ \sqrt{\frac{Ne^2}{m\epsilon_0}} = \sqrt{\frac{1}{L^3}\cdot\frac{A^2T^2}{M.M^{-1}L^{-3}T^{4}A^{2}}} = \frac{1}{T} = T^{-1}$$

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Ans: (3)

Question [redacted]

A length-scale (l) depends on the permittivity (ε) of a dielectric material, Boltzmann's constant (k_B), the absolute temperature (T), the number per unit volume (n) of certain charged particles and the charge (q) carried by each of the particles. Which of the following expression(s) for l is (are) dimensionally correct?

$l \Rightarrow L$ $\epsilon_0 \Rightarrow M^{-1}L^{-3}T^{4}A^{2}$ $k_B = ML^{2}T^{-2}K^{-1}$ [JEE Adv. 2016]

(1) $l = \sqrt{\left(\dfrac{nq^2}{\varepsilon k_B T}\right)}$

(2) $l = \cancel{\sqrt{\left(\dfrac{\varepsilon k_B T}{nq^2}\right)}} = \sqrt{\dfrac{\epsilon_0 k_B T}{nq^2}}$

$n = \dfrac{1}{L^3} = L^{-3}$

(3) $l = \sqrt{\left(\dfrac{q^2}{\varepsilon h^{2/3} k_B T}\right)}$

(4) $l = \sqrt{\left(\dfrac{q^2}{\varepsilon n^{1/3} k_B T}\right)}$

Home work

in this ppt

- NEET PYQ are attached solved by yourself I will provide Pdf (KPP) too.
- JEE Adv. ques are attached (with hint & Sol^n too of many ques)

  ↓ Solve them by yourself Again
- DPP

Thank

You