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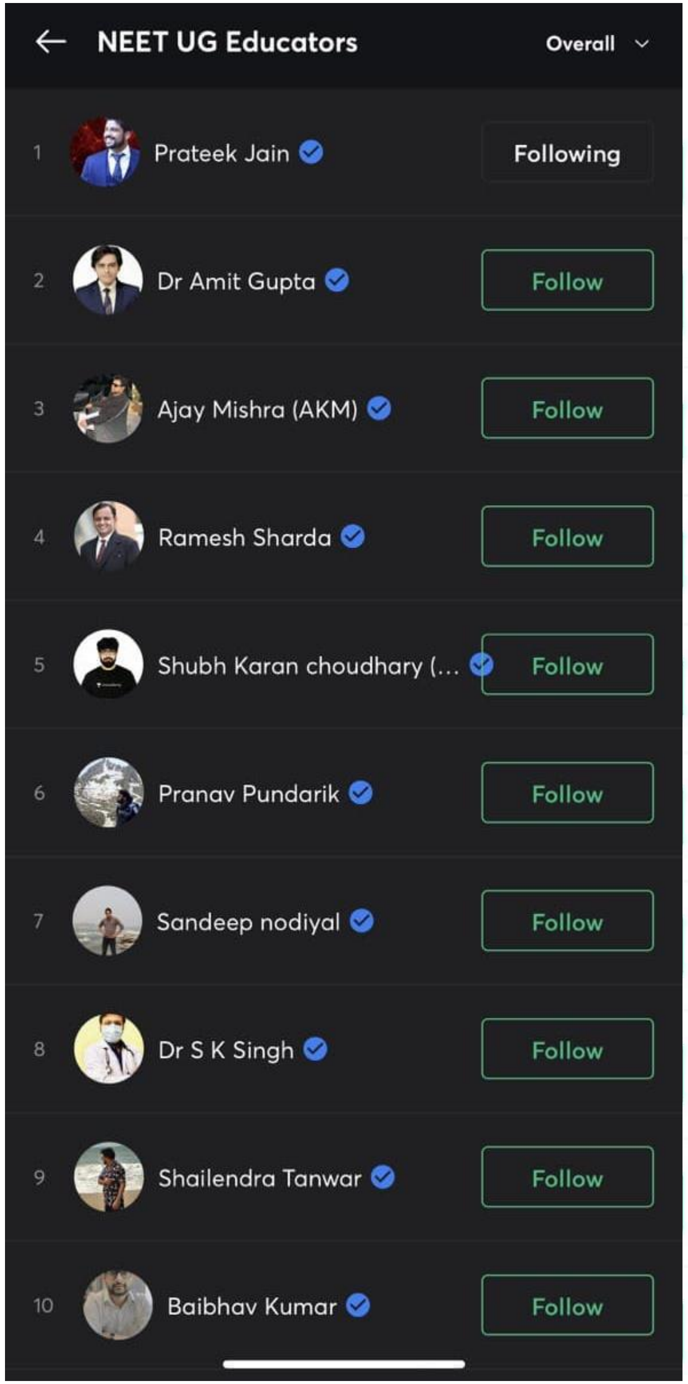


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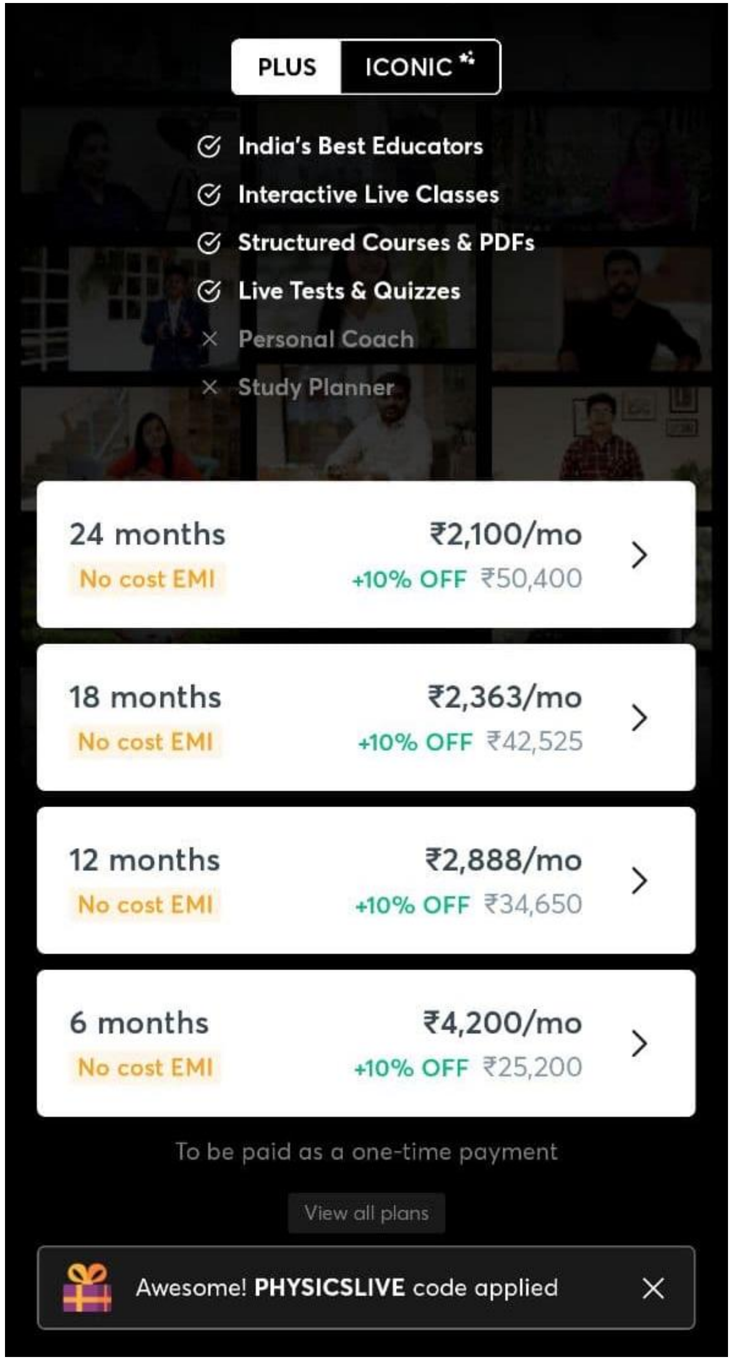

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# NEET & AIIMS PYQs Solutions

## Units & Dimensions

**By Physicsaholics Team**

The unit of permittivity of free space, $\varepsilon_0$ is

(a) coulomb/newton-metre *[CBSE AIPMT 2004]*

(b) newton-metre$^2$/coulomb$^2$

(c) coulomb$^2$/newton-metre$^2$

(d) coulomb$^2$/(newton-metre)$^2$

$$F = \frac{q_1 q_2}{4\pi\epsilon_0 r^2} \Rightarrow \epsilon_0 = \frac{q_1 q_2}{4\pi r^2 F}$$

$$\text{unit of } \epsilon_0 = \frac{\text{Coulomb}^2}{N-m^2}$$

Ans. (c)

According to Newton, the viscous force acting between liquid layers of area $A$ and velocity gradient $\frac{\Delta v}{\Delta z}$ is given by $F = -\eta A \frac{dv}{dz}$, where $\eta$ is constant called *[CBSE AIPMT 1990]*

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

$$[\eta] = \frac{[F][dz]}{[A][dv]} = \frac{MLT^{-2}L}{L^2 LT^{-1}} = ML^{-1}T^{-1}$$

Ans. (d)

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

*[CBSE AIPMT 2012]*

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

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

(c) $[LT^{-1}]$

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

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

$$\Rightarrow \left[(\mu_0\epsilon_0)^{-1/2}\right] = [c] = LT^{-1}$$

Ans. (c)

The dimensions of $\frac{1}{2}\varepsilon_0 E^2$, where $\varepsilon_0$ is permittivity of free space and $E$ is electric field, are *[CBSE AIPMT 2010]*

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

$$\left[\frac{1}{2}\varepsilon_0 E^2\right] = [\text{energy density}] = \left[\frac{\text{energy}}{\text{volume}}\right]$$

$$= \frac{ML^2T^{-2}}{L^3} = ML^{-1}T^{-2}$$

Ans. (b)

If the dimensions of a physical quantity are given by $[M^a L^b T^c]$, then the physical quantity will be *[CBSE AIPMT 2009]*

(a) pressure if $a = 1, b = -1, c = -2$
(b) velocity if $a = 1, b = 0, c = -1$
(c) acceleration if $a = 1, b = 1, c = -2$
(d) force if $a = 0, b = -1, c = -2$

$M^{+1} L^{-1} T^{-2} = [\text{Pressure}]$ $\quad$ $M L T^{-2} \neq [\text{acceleration}]$

$M^1 L^0 T^{-1} \neq [\text{Velocity}]$ $\quad$ $M^0 L^{-1} T^{-2} \neq [\text{force}]$

Ans. (a)

Which two of the following five physical parameters have the same dimensions?

*[CBSE AIPMT 2008]*

(i) Energy density

(ii) Refractive index

(iii) Dielectric constant

(iv) Young's modulus

(v) Magnetic field

(a) (ii) and (iv)
(b) (iii) and (v)
(c) (i) and (iv)
(d) (i) and (v)

$$[\text{energy density}] = \frac{[\text{energy}]}{[\text{Volume}]} = \frac{ML^2T^{-2}}{L^3} = ML^{-1}T^{-2}$$

$$[\text{young Modulus}] = \left[\frac{F/A}{\Delta l/l}\right] = \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$$

Ans. (c)

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 [CBSE AIPMT 2007]

(a) $[ML^2T^{-3}I^{-1}]$
(b) $[ML^2T^{-2}]$
(c) $[ML^2T^{-1}I^{-1}]$
(d) $[ML^2T^{-3}I^{-2}]$

$P = I^2 R \Rightarrow [R] = \frac{[P]}{[I^2]} = \frac{ML^2T^{-3}}{I^2} = ML^2T^{-3}I^{-2}$

Ans. (d)

The ratio of the dimensions of Planck's constant and that of the moment of inertia is the dimension of *[CBSE AIPMT 2005]*

(a) frequency (b) velocity

(c) angular momentum (d) time

$$\frac{[h]}{[I]} = \frac{[PS]}{[I]} = \frac{MLT^{-1}L}{ML^2} = M^0L^0T^{-1}$$

$$[\text{frequency}] = \frac{1}{[T]} = T^{-1}$$

Ans. (a)

The dimensions of universal gravitational constant are *[CBSE AIPMT 2004, 1992]*

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

$F = G\frac{m_1 m_2}{r^2} \Rightarrow [G] = \frac{[F][r^2]}{[m_1][m_2]}$

$= \frac{MLT^{-2}L^2}{MM}$

$= M^{-1}L^3T^{-2}$

Ans. (a)

Planck's constant has the dimensions of

(a) linear momentum

(b) angular momentum

(c) energy

(d) power

[CBSE AIPMT 2001]

$[h] = [p\lambda] = [p\,r]$

$= [\text{Angular momentum}]$

Ans. (b)

A pair of physical quantities having same dimensional formula is *[CBSE AIPMT 2000]*

(a) force and torque

(b) work and energy

(c) force and impulse

(d) linear momentum and angular momentum



$W = \Delta K \Rightarrow [W] = [\text{energy}]$

Ans. (b)

The dimensional formula for magnetic flux is *[CBSE AIPMT 1999]*

(a) $[ML^2T^{-2}A^{-1}]$ (b) $[ML^3T^{-2}A^{-2}]$

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

$\varepsilon = -\frac{\Delta\phi}{\Delta t} \Rightarrow [\phi] = [\varepsilon][t] = \left[\frac{W}{q}\right][t]$

$= \frac{ML^2T^{-2}}{AT} T$

$= ML^2T^{-2}A^{-1}$

Ans. (a)

. Which of the following will have the dimensions of time ? *[CBSE AIPMT 1996]*

(a) $LC$ (b) $\frac{R}{L}$ (c) $\frac{L}{R}$ (d) $\frac{C}{L}$

Time Constant $\tau = \frac{L}{R}$

$\Rightarrow \left[\frac{L}{R}\right] = [t]$

Ans. (c)

Which of the following is a dimensional constant ? [CBSE AIPMT 1995]

(a) Refractive index
(b) Poisson's ratio
(c) Relative density
(d) Gravitational constant



$[\text{Refractive index}] = \frac{[c]}{[v]} = M^0L^0T^0$

$[\text{Poisson's ratio}] = \frac{[\text{transverse strain}]}{[\text{longitudinal strain}]} = M^0L^0T^0$

$[\text{relative density}] = \frac{[\rho]}{[\rho_\omega]} = M^0L^0T^0$

$[G] \neq M^0L^0T^0$

Ans. (d)

The dimensional formula for permeability of free space, $\mu_0$ is *[CBSE AIPMT 1991]*

(a) $[MLT^{-2}A^{-2}]$

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

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

(d) $[MLT^{-2}A^{-1}]$

$$\frac{F}{l} = \frac{\mu_0 i_1 i_2}{2\pi d} \Rightarrow [\mu_0] = \frac{[F d]}{[i_1 i_2 l]} = \frac{MLT^{-2}}{A^2}$$

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

Ans. (a)

The dimensional formula of pressure is

*[CBSE AIPMT 1990]*

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

$$[P] = \frac{[F]}{[A]} = \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$$

Ans. (c)

The dimensional formula of torque is

*[CBSE AIPMT 1989]*

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

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

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

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

$[\tau] = [r][F]$

$= L\ MLT^{-2}$

$= ML^2T^{-2}$

Ans. (a)

Dimensional formula of self-inductance is

*[CBSE AIPMT 1989]*

(a) $[MLT^{-2}A^{-2}]$

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

(c) $[ML^2T^{-2}A^{-2}]$

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

$U = \frac{1}{2}Li^2 \Rightarrow [L] = \frac{[U]}{[i^2]} = \frac{ML^2T^{-2}}{A^2}$

$= ML^2T^{-2}A^{-2}$

Ans. (c)

Of the following quantities, which one has dimensions different from the remaining three? *[CBSE AIPMT 1989]*

(a) Energy per unit volume
(b) Force per unit area
(c) Product of voltage and charge per unit volume
(d) Angular momentum



[force per unit area] = [P] = [Pressure energy per unit volume]

$$\left[\frac{qV}{\text{Volume}}\right] = \left[\frac{\text{work by electric field}}{\text{Volume}}\right] = \left[\frac{\text{energy}}{\text{Volume}}\right]$$

Ans. (d)

The dimensional formula for angular momentum is *[CBSE AIPMT 1988]*

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

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

(c) $[MLT^{-1}]$

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

$[L] = [r][P]$

$= L\ MLT^{-1}$

$= ML^2T^{-1}$

Ans. (b)

If $C$ and $R$ denote capacitance and resistance respectively, then the dimensional formula of $CR$ is [CBSE AIPMT 1988]

(a) $[M^0L^0T]$

(b) $[M^0L^0T^0]$

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

(d) Not expressible in terms of [MLT]

Time Constant $\tau = RC$

$[\tau] = [RC] = T$

Ans. (a)

The unit of thermal conductivity is :

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

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

**NEET 2019**

$$\frac{\Delta Q}{\Delta t} = \frac{K A \Delta T}{l} \Rightarrow K = \frac{\Delta Q\, l}{A\, \Delta t\, \Delta T}$$

$$\text{unit of } K = \frac{J\ m}{m^2\ sec\ K}$$

$$= watt\ m^{-1}\ K^{-1}$$

Ans. (c)

Q) Dimensions of stress are :

**NEET 2020**

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

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

(3) $[MLT^{-2}]$

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

$[\text{stress}] = \frac{[F]}{[A]} = \frac{MLT^{-2}}{L^2}$

$= ML^{-1}T^{-2}$

Ans. 2

The only mechanical quantity which has negative dimension of mass is

(a) angular momentum

(b) torque

(c) coefficient of thermal conductivity

(d) gravitational constant

AIIMS 2019

$G = \frac{Fr^2}{m^2} = \frac{MLT^{-2}L^2}{M^2} = M^{-1}L^3T^{-2}$

Ans. (d)

What is the dimension of luminous flux?

(a) $[LT^{-1}]$ (b) $[ML^2T^{-3}]$

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

**AIIMS 2019**

Luminous flux = visible power emitted by a body

[L. flux] = [Power]

$= ML^2T^{-3}$

Ans. (b)

The dimensions of Planck's constant are ***[1997]***

AIIMS

(a) $[ML^{-3}T^{-1}]$ (b) $[ML^{-2}T^{-1}]$

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

$[h] = [p][\lambda]$ as $p = h/\lambda$

$= MLT^{-1}L$

$= ML^2T^{-1}$

Ans. (d)

The dimensional formula of magnetic flux is

AIIMS *[1998]*

(a) $[ML^0T^{-2}A^{-1}]$ (b) $[ML^2T^{-2}A^{-1}]$

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

$\varepsilon = -\frac{\Delta\phi}{\Delta t} \Rightarrow [\phi] = [\varepsilon][\Delta t] = \frac{[W][\Delta t]}{[q]}$

$= \frac{ML^2T^{-2}T}{AT} = ML^2T^{-2}A^{-1}$

Ans. (b)

What is the dimensional formula of gravitational constant? AIIMS *[2000]*

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

(c) $[M^{-1}L^3T^{-2}]$ (d) none of these

$F = \frac{Gm_1m_2}{r^2} \Rightarrow [G] = \frac{[F][r^2]}{[m_1][m_2]} = \frac{MLT^{-2}L^2}{M^2}$

$= M^{-1}L^3T^{-2}$

Ans. (c)

Which of the following pairs does not have similar dimensions? AIIMS *[2001]*

(a) tension and surface tension
(b) stress and pressure
(c) Planck's constant and angular momentum
(d) angle and strain



$[\text{tension}] = [\text{force}]$

$[\text{surface tension}] = \dfrac{[\text{force}]}{[\text{length}]} \neq [\text{tension}]$

Ans. (a)

The dimensions of energy are AIIMS *[2002]*

(a) $[ML^3T^{-3}]$ (b) $[ML^{-1}T^{-1}]$

(c) $[ML^2T^{-2}]$ (d) $[MT^{-2}]$

$[\text{energy}] = \left[\frac{1}{2}mv^2\right]$

$= [m][v]^2$

$= ML^2T^{-2}$

Ans. (c)

Using mass (M), length (L), time (T) and current (A) as fundamental quantities, the dimensions of permeability are : AIMS *[2003]*

(a) $[M^{-1}LT^{-2}A]$ (b) $[ML^{-2}T^{-2}A^{-1}]$

(c) $[MLT^{-2}A^{-2}]$ (d) $[MLT^{-1}A^{-1}]$

$$\frac{F}{l} = \frac{\mu_0 i_1 i_2}{2\pi d} \Rightarrow [\mu_0] = \frac{[F][d]}{[i_1][i_2][l]} = \frac{MLT^{-2}L}{A^2 L}$$

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

Ans. (c)

Using mass (M), length (L), time (T) and current (A) as fundamental quantities, the dimensional formula of permittivity is : AIIMS *[2004]*

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

(c) $[MLT^{-2}A]$ (d) $[ML^{2}T^{-1}A^{2}]$



$$F = \frac{q_1 q_2}{4\pi\epsilon_0 r^2} \Rightarrow [\epsilon_0] = \frac{[q_1 q_2]}{[F][r^2]} = \frac{A^2T^2}{MLT^{-2}L^2}$$

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

Ans. (b)

Dimensions of electrical resistance are : *[2005]*

AIIMS

(a) $[ML^2T^{-3}A^{-1}]$

(b) $[ML^2T^{-3}A^{-2}]$

(c) $[ML^3T^{-3}A^{-2}]$

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

$P = i^2 R \Rightarrow [R] = \frac{[P]}{[i^2]}$

$= \frac{ML^2T^{-3}}{A^2}$

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

Ans. (b)

The magnetic moment has dimensions of: ***[2006]***

AIIMS

(a) [LA] (b) $[L^2A]$

(c) $[LT^{-1}A]$ (d) $[L^2T^{-1}A]$

$[\text{magnetic moment}] = [i][A]$

$= L^2 A$

Ans. (b)

Which of the following physical quantities do not have same dimensions? *[2007]*

AIIMS

(a) pressure and stress

(b) tension and surface tension

(c) strain and angle

(d) energy and work.

$[\text{Tension}] = [\text{force}] = MLT^{-2}$

$[\text{Surface tension}] = \left[\frac{F}{l}\right] = \frac{MLT^{-2}}{L} = MT^{-2}$

Ans. (b)

What is the dimensions of impedance? *[2007]* AIIMS

(a) $ML^2T^{-3}I^{-2}$ (b) $M^{-1}L^{-2}T^3I^2$

(c) $ML^3T^{-3}I^{-2}$ (d) $M^{-1}L^{-3}T^3I^2$

$Z^2 = R^2 + (X_C - X_L)^2 \Rightarrow [Z] = [R]$

$\Rightarrow [Z] = \left[\frac{P}{i^2}\right] = \frac{ML^2T^{-3}}{I^2} = ML^2T^{-3}I^{-2}$

Ans. (a)

Dimensions of coefficient of viscosity is

AIIMS *[2010]*

(a) $[MT^2]$ (b) $[ML^{-3}T^{-4}]$

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

$F = 6\pi \eta r v \Rightarrow [\eta] = \left[\frac{F}{rv}\right] = \frac{MLT^{-2}}{LLT^{-1}}$

$= ML^{-1}T^{-1}$

Ans. (d)

Which of the following pair of quantities do not have the same dimensions : AIIMS *[2011]*

(a) Potential gradient, electric field

(b) Torque, kinetic energy

(c) Light year, time period

(d) Impedance, reactance



[Light year] = L

[time period] = T

Ans. (c)

The dimensional formula for torque is : *[2011]* AIIMS

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

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

(c) $L^2T^{-1}$

(d) $M^2T^{-2}K^{-1}$

$\tau = rF\sin\theta$

$[\tau] = [r][F][\sin\theta]$

$= L\, MLT^{-2}$

$= ML^2T^{-2}$

Ans. (a)

The dimensional formula of farad is *[2012]*

AIIMS

(a) $[M^{-1}L^{-2}TQ]$ (b) $[M^{-1}L^{-2}T^{2}Q^{2}]$

(c) $[M^{-1}L^{-2}TQ^{2}]$ (d) $[M^{-1}L^{-2}T^{2}Q]$

$[\text{farad}] = [\text{Capacitance}] = \left[\frac{q^2}{2U}\right] = \frac{Q^2}{ML^2T^{-2}}$

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

Ans. (b)

The dimensions of $\left(\frac{1}{2}\right)\varepsilon_0 E^2$ ( $\varepsilon_0$ : permittivity of free space, E electric field) are AIIMS *[2014]*

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

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

$\left[\frac{1}{2}\varepsilon_0 E^2\right] = [\text{energy density}] = [\text{Pressure}]$

$= [F/A] = \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$

Ans. (c)

If e is the charge, V the potential difference, T the temperature, then the units of $\frac{eV}{T}$ are the same as that of AIMS *[2016]*

(a) Planck's constant

(b) Stefan's constant

(c) Boltzmann constant

(d) Gravitational constant

$\left[\frac{eV}{T}\right] = \left[\frac{W}{T}\right]$

$= \left[\frac{K.E.}{T}\right]$

$= \left[\frac{\frac{3}{2}KT}{T}\right] = [K]$

Ans. (c)

**Assertion :** The dimensional formula for relative velocity is same as that of the change in velocity.

**Reason :** Relative velocity of P w.r.t. Q is the ratio of velocity of P and that of Q. ***[2002]***

AIIMS

$\vec{V}_{A,B} = \vec{V}_A - \vec{V}_B$

$\Rightarrow$ Assertion is correct reason is wrong

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

Ans. (c)

**Assertion :** Specific gravity of a fluid is a dimensionless quantity.

**Reason :** It is the ratio of density of fluid to the density of water. AIIMS ***[2005]***

$$[\text{specific gravity}] = \frac{[\text{density of fluid}]}{[\text{density of water}]} = M^0 L^0 T^0$$

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

Ans. (a)

Suppose a quantity $y$ can be dimensionally represented in terms of M, L and T, that is $[y] = [M^a \; L^b \; T^c]$ then M

(a) may be represented in terms of L, T and $y$ if $a = 0$

if $a=0 \Rightarrow [y] = L^b T^c \Rightarrow$ M is not in equation.

(b) may be represented in terms of L, T and $y$ if $a \neq 0$

(c) can always be dimensionally represented in terms of L, T and $y$

(d) can never be dimensionally represented in terms of L, T and $y$. *(2018)*

AIIMS

Ans. (b)

# PYQs on Following Subtopic:

Principle of homogeneity

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 respectively *[CBSE AIPMT 2006]*

(a) $[LT^{-2}]$, $[L]$ and $[T]$
(b) $[L^2]$, $[T]$ and $[LT^2]$
(c) $[LT^2]$, $[LT]$ and $[L]$
(d) $[L]$, $[LT]$ and $[T^2]$

$[c] = [t] = T$

$[v] = [a][t] \Rightarrow [a] = \frac{LT^{-1}}{T} = LT^{-2}$

$\frac{[b]}{[t+c]} = [v] \Rightarrow [b] = LT^{-1}T = L$

Ans. (a)

The force $F$ on a sphere of radius $r$ moving in a medium with velocity $v$ is given by $F = 6\pi\,\eta r v$. The dimensions of $\eta$ are

*[CBSE AIPMT 1997]*

(a) $[ML^{-3}]$ (b) $[MLT^{-2}]$ (c) $[MT^{-1}]$ (d) $[ML^{-1}T^{-1}]$



$$[\eta] = \frac{[F]}{[r][v]} = \frac{MLT^{-2}}{L\,LT^{-1}} = ML^{-1}T^{-1}$$

Ans. (d)

An equation is given as $\left(p + \frac{a}{V^2}\right) = b\,\frac{\theta}{V}$,

where $p$ = pressure, $V$ = volume and $\theta$ = absolute temperature. If $a$ and $b$ are constants, then dimensions of $a$ will be

*[CBSE AIPMT 1996]*

$= [P] \Rightarrow [a] = ML^{-1}T^{-2}L^{6} = ML^{5}T^{-2}$

(a) $[ML^5T^{-2}]$ (b) $[M^{-1}L^5T^2]$

(c) $[ML^{-5}T^{-1}]$ (d) $[ML^5T]$

Ans. (a)

Turpentine oil is flowing through a tube of length $l$ and radius $r$. The pressure difference between the two ends of the tube is $p$. The viscosity of oil is given by

$$\eta = \frac{p(r^2 - x^2)}{4vl}$$

$$[\eta] = \frac{[p][r^2]}{[v][l]} = \frac{ML^{-1}T^{-2}L^2}{LT^{-1}L} = ML^{-1}T^{-1}$$

where, $v$ is the velocity of oil at distance $x$ from the axis of the tube. The dimensions of $\eta$ are *[CBSE AIPMT 1993]*

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

Ans. (d)

If $x = at + bt^2$, where x is the distance travelled by the body in kilometer while $t$ is the time in second, then the unit of $b$ is

*[CBSE AIPMT 1989]*

(a) km/s (b) km-s (c) km/s$^2$ (d) km-s$^2$



$[b][t^2] = [x]$

$[b] = \frac{L}{T^2} \Rightarrow$ Km/Sec$^2$

Ans. (c)

The dimensional formula of the constant a in Vander Waal's gas equation

$$\left(P+\frac{a}{V^2}\right)(V-b)=RT \text{ is:}$$

AIIMS **[1999]**

(a) $[ML^4T^{-1}]$ (b) $[ML^2T^{-2}]$

$[P] = [a]/[V^2] \Rightarrow [a] = [P][V^2] = ML^{-1}T^{-2}L^6 = ML^5T^{-2}$

(c) $[ML^5T^{-3}]$ (d) $[ML^5T^{-2}]$

Ans. (d)

What are the dimensions of $\frac{A}{B}$ in the relation $F = A\sqrt{x} + Bt^2$, where $F$ is the force, $x$ is distance and $t$ is time ?

(a) $[ML^2T^{-2}]$
(b) $[L^{-1/2}T^2]$
(c) $[L^{-1/2}T^{-1}]$
(d) $[LT^{-2}]$

AIIMS *(2018)*

$$\frac{F}{B} = \frac{A}{B}\sqrt{x} + t^2 \Rightarrow \left[\frac{A}{B}\right] = \frac{[t^2]}{[\sqrt{x}]} = L^{-1/2}T^2$$

Ans. (b)

# PYQs on Following Subtopic:

Powers are always dimensionless.

. The time dependence of physical quantity $p$ is given by $p = p_0 \exp(-\alpha t^2)$, where $\alpha$ is a constant and $t$ is the time. The constant $\alpha$ *[CBSE AIPMT 1992]*

(a) is dimensionless (b) has dimensions $[T^{-2}]$

(c) has dimensions $[T^2]$ (d) has dimensions of $p$

$[\alpha][t^2] = M^0 L^0 T^0$

$\Rightarrow [\alpha] = M^0 L^0 T^{-2}$

Ans. (b)

# PYQs on Following Subtopic:

To check if a given relation is dimensionally correct or not.

If the capacitance of a nanocapacitor is measured in terms of a unit '$u$' made by combining the electric charge '$e$', Bohr radius '$a_0$', Planck's constant '$h$' and speed of light '$c$' then

$[\text{energy}] = \left[\frac{e^2}{2u}\right] = \left[\frac{hc}{\lambda}\right]$

AIIMS *[2016]*

$\Rightarrow \left[\frac{e^2}{u}\right] = \left[\frac{hc}{a_0}\right]$

$\Rightarrow [u] = \left[\frac{e^2 a_0}{hc}\right]$

(a) $u = \dfrac{e^2 h}{a_0}$ (b) $u = \dfrac{hc}{e^2 a_0}$

(c) $u = \dfrac{e^2 c}{h a_0}$ (d) $u = \dfrac{e^2 a_0}{hc}$

Ans. (d)

# PYQs on Following Subtopic:

To derive a physical relation if the dependencies are known.

If dimensions of critical velocity $v_c$ of a liquid flowing through a tube are expressed as $[\eta^x \rho^y r^z]$, where $\eta$, $\rho$ and $r$ are the coefficient of viscosity of liquid, density of liquid and radius of the tube respectively, then the values of x, y and z are given by

*[CBSE AIPMT 2015]*

(a) 1, – 1, – 1

(b) – 1, – 1, 1

(c) – 1, – 1, – 1

(d) 1, 1, 1

$[v_c] = \eta^x \rho^y r^z$

$\Rightarrow M^0 L T^{-1} = (ML^{-1}T^{-1})^x (ML^{-3})^y (L)^z$

$x + y = 0$ , $-x - 3y + z = 1$

$-x = -1 \Rightarrow x = 1,\ y = -1,\ z = -1$

Ans. (a)

If energy ($E$), velocity ($v$) and time ($T$) are chosen as the fundamental quantities, the dimensional formula of surface tension will be *[CBSE AIPMT 2015]*

(a) $[Ev^{-2}T^{-1}]$

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

(c) $[Ev^{-2}T^{-2}]$

(d) $[E^{-2}v^{-1}T^{-3}]$

$[S] = E^a v^b T^c$

$\Rightarrow ML^0T^{-2} = (ML^2T^{-2})^a (LT^{-1})^b T^c$

$a = 1$, $2a + b = 0$, $-2a - b + c = -2$

$b = -2$

$c = -2$

Ans. (c)

The frequency of vibration $f$ of a mass $m$ suspended from a spring of spring constant $k$ is given by a relation of the type $f = Cm^x k^y$, where $C$ is a dimensionless constant. The values of x and y are

*[CBSE AIPMT 1990]*

(a) $x = \frac{1}{2}, y = \frac{1}{2}$

(b) $x = -\frac{1}{2}, y = -\frac{1}{2}$

(c) $x = \frac{1}{2}, y = -\frac{1}{2}$

(d) $x = -\frac{1}{2}, y = \frac{1}{2}$

$T^{-1} = M^x (MT^{-2})^y$

$-2y = -1$

$y = 1/2$

$x + y = 0$

$x = -1/2$

Ans. (d)

. The speed of light (c), gravitational constant (G) and planck's constant (h) are taken as fundamental units in a system. The dimensions of time in this new system should be *[2008]*

AIIMS

(a) $G^{1/2} h^{1/2} c^{-5/2}$ (b) $G^{-1/2} h^{1/2} c^{1/2}$

(c) $G^{1/2} h^{1/2} c^{-3/2}$ (d) $G^{1/2} h^{1/2} c^{1/2}$



$[T] = [G]^x [h]^y [c]^z \Rightarrow T = (M^{-1}L^3T^{-2})^x (ML^2T^{-1})^y (LT^{-1})^z$

$\Rightarrow -x+y=0,\ 3x+2y+z=0,\ -2x-y-z=1 \Rightarrow x=\frac{1}{2},\ y=\frac{1}{2},\ z=-\frac{5}{2}$

Ans. (a)

If $p$ represents radiation pressure, $c$ represents speed of light and $S$ represents radiation energy striking unit area per sec. The non-zero integers $x$, $y$, $z$ such that $p^x S^y c^z$ is dimensionless are

$[S] = \frac{[U]}{[A][t]} = \frac{ML^2T^{-2}}{L^2 T}$

$(ML^{-1}T^{-2})^x (MT^{-3})^y (LT^{-1})^z = M^0L^0T^0$

**[CBSE AIPMT 1992]**

(a) $x = 1, y = 1, z = 1$ (b) $x = -1, y = 1, z = 1$
(c) $x = 1, y = -1, z = 1$ (d) $x = 1, y = 1, z = -1$

$x + y = 0$
$-x - z = 0$
Only (c) option is satisfying these equations.

Ans. (c)

A physical quantity of the dimensions of length that can be formed out of $c$, $G$ and $\frac{e^2}{4\pi\varepsilon_0}$ is [$c$ is velocity of light, $G$ is universal constant of gravitation and $e$ is charge]

*[NEET 2017]*

(a) $\frac{1}{c^2}\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2}$ (b) $c^2\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2}$

(c) $\frac{1}{c^2}\left[\frac{e^2}{G\,4\pi\varepsilon_0}\right]^{1/2}$ (d) $\frac{1}{c}G\frac{e^2}{4\pi\varepsilon_0}$

$F = \frac{q^2}{4\pi\varepsilon_0 r^2}$

$F = \frac{Gm_1m_2}{r^2}$

$\left[\frac{Ge^2}{4\pi\varepsilon_0}\right]^{1/2} = \left[GFr^2\right]^{1/2}$

$= \left[\frac{F^2r^4}{m_1m_2}\right]^{1/2} = L^3T^{-2}$

$\left[\frac{1}{c^2}\left(\frac{Ge^2}{4\pi\varepsilon_0}\right)\right] = \frac{L^3T^{-2}}{L^2T^{-2}} = L$

Ans. (a)

If force ($F$), velocity ($v$) and time ($T$) are taken as fundamental units, then the dimensions of mass are *[CBSE AIPMT 2014]*

(a) $[FvT^{-1}]$ (b) $[FvT^{-2}]$ (c) $[Fv^{-1}T^{-1}]$ (d) $[Fv^{-1}T]$

$$[\text{mass}] = \left[\frac{F}{a}\right] = \left[\frac{F}{v/T}\right] = \left[\frac{FT}{v}\right]$$

$$= F\,v^{-1}\,T$$

Ans. (d)

# PYQs on Following Subtopic:

## Conversion of units from one system to another

In a particular system, the unit of length, mass and time are chosen to be 10 cm, 10 g and 0.1 s respectively. The unit of force in this system will be equivalent to

*[CBSE AIPMT 1994]*

(a) 0.1 N (b) 1 N (c) 10 N (d) 100 N

1 unit of force = n newton $\Rightarrow 1\, M_1 L_1 T_1^{-2} = n\, M_2 L_2 T_2^{-2}$

$\Rightarrow n = \left(\frac{M_1}{M_2}\right)\left(\frac{L_1}{L_2}\right)\left(\frac{T_1}{T_2}\right)^{-2} = \left(\frac{10g}{1000g}\right)\left(\frac{10cm}{100cm}\right)\left(\frac{.1 Sec}{1 Sec}\right)^{-2}$

$= .1$

Ans. (a)

"Parsec" is the unit of : *[2005]* AIIMS

(a) time

(b) distance

(c) frequency

(d) angular acceleration



Parsec is unit of distance

1 Parsec $= 3.08 \times 10^{16}$ m

Ans. (b)

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