YAKEEN NEET 2.0

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Units and Measurements

Physics

Assignment Solution 01

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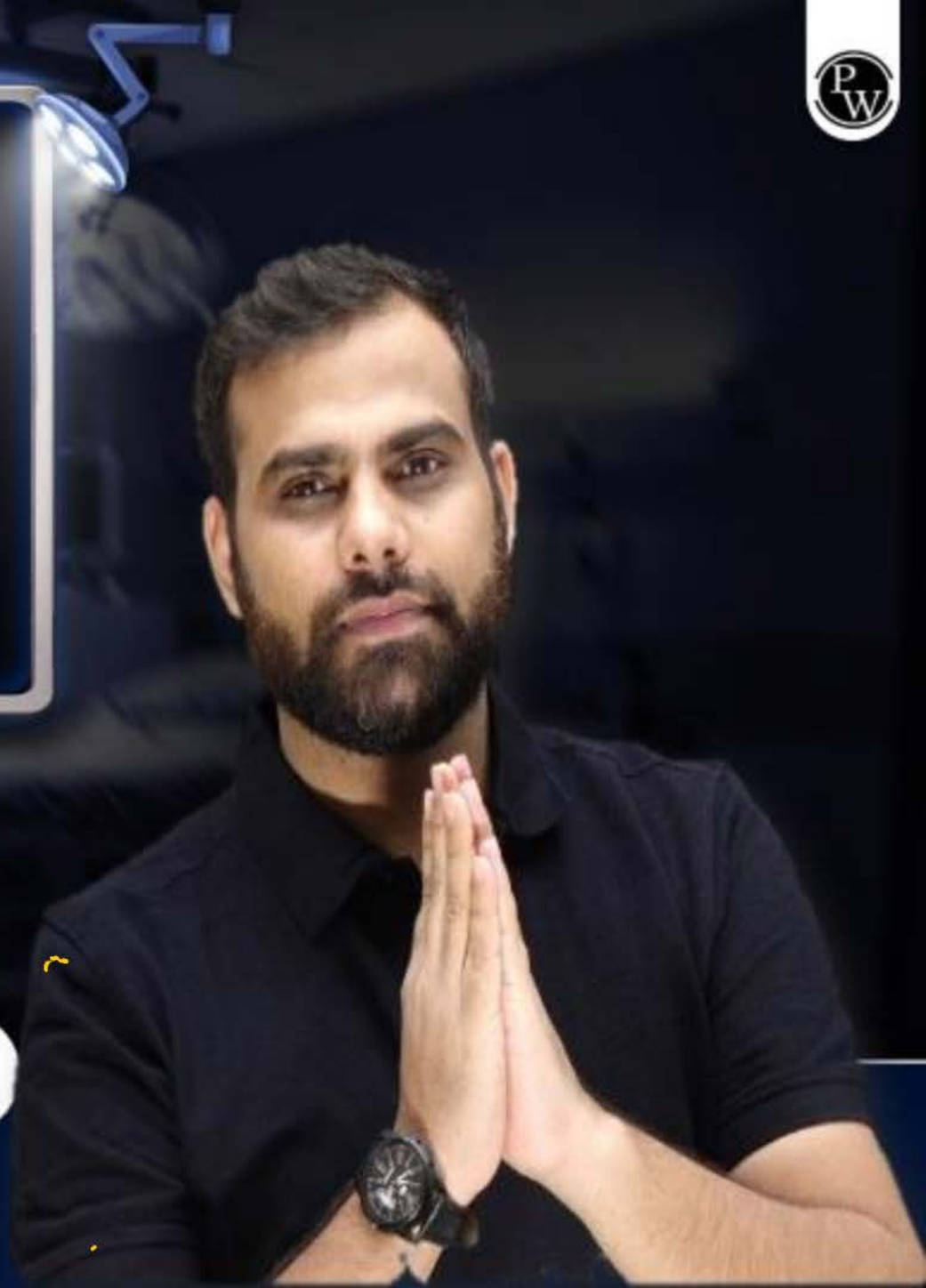

Question

Amount of solar energy received on the earth's surface per unit area per unit time is defined a solar constant. Dimension of solar constant is [JEE Main 2020]

1. $ML^2 T^{-2}$
2. MLT^{-2}
3. $M^2L^0T^{-1}$
4. ML^0T^{-3} ✓

$$S = \frac{E}{At} = \frac{mL^2T^{-2}}{L^2 T^1} = mT^{-3}$$

Question

Dimensional formula for thermal conductivity is (here K denotes the temperature)

[JEE Main 2020]

1. #
   $MLT^{-2}K^{-2}$
2. (2) $MLT^{-3}K^{-1}$
   (3) $MLT^{-3}K$
   (4) $MLT^{-2}K$
3.
4.

$$\frac{H}{t} = \frac{K A \Delta\theta}{L}$$

$$K = \frac{H}{t \times L\theta} = \frac{ML^2T^{-2} \times L}{T \times L \times \theta}$$

$$= MLT^{-3}\theta^{-1}$$

Question

A quantity x is given by (IFv^2/WL^4) in terms of moment of inertia I, force F, velocity v, work W and length L. The dimensional formula for x is same as that of

[JEE Main 2020]

1. Coefficient of viscosity
2. Force constant
3. Energy density = $\frac{\text{energy}}{\text{Volume}}$
4. Planck's constant

$$X = \frac{IFV^2}{WL^4}$$

$$= \frac{ML^2 \times MLT^{-2} \times L^2T^{-2}}{ML^2T^{-2} \times L^4L}$$

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

Question

The quantities $x = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$, $y = \frac{E}{B}$ and $z = \frac{l}{CR}$ defined where C – capacitance, R – resistance, l – length, E – electric field, B – magnetic field and ε_0, μ_0, – free space permittivity and permeability respectively. Then

[JEE Main 2020]

1. Only x and y have the same dimension
2. Only x and z have the same dimension
3. x, y and z have the same dimension
4. Only y and z have the same dimension

Question

A quantity f is given by $f = \sqrt{\frac{hc^5}{G}}$ where c is speed of light G universal gravitational constant and h is the Planck's constant. Dimension of f is that of: **[JEE Main 2020]**

1. Momentum
2. Energy
3. Force
4. Pressure

$$f = \sqrt{\frac{hc^5}{G}} = \sqrt{\frac{[ML^2T^{-2}][L^5T^{-5}]}{T^{-2} \times [M^{-1}L^3T^{-2}]}}$$

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

Question

The work done by a gas molecule in an isolated system is given by, $W = \alpha^2\beta e^{\frac{-\beta x^2}{kT}}$, where x is the displacement, k is the Boltzmann constant and T is the temperature, α and β are constants. Then the dimensions of ~~β~~ α will be: **[JEE Main 2021]**

1. $[M^0LT^0]$
2. $[M^2LT^2]$
3. $[MLT^{-2}]$
4. $[ML^2T^{-2}]$

$W = \alpha^2\beta\, e^{-\frac{\beta x^2}{KT}}$

$\frac{\beta x^2}{KT} = 1$

$W = \alpha^2\beta$

$\alpha^2 = \frac{W}{\beta} = \frac{W}{KT}x^2$

$\alpha^2 = x^2$

$\alpha = x\,(L)$

Question

Match List-I with List-II:

Choose the correct answer from the options given below: [JEE Main 2021]

	List-I		List-II
(A)	h (Planck's constant)	I	[M L T^{-1}]
(B)	E (Kinetic energy)	II	[M L^2 T^{-1}]
(C)	V (electric potential)	III	[M L^2 T^{-2}]
(D)	P (linear momentum)	IV	[$ML^2I^{-1}T^{-1}$]

1. (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
2. (A)-(I), (B)-(II), (C)-(IV), (D)-(III)
3. (A)-(III), (B)-(II), (C)-(IV), (D)-(I)
4. (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

Question

If e is the electronic charged, c is the speed of light in free space and h is Planck's constant, the quantity $\frac{1}{4\pi\varepsilon_0}\frac{|e|^2}{hc}$ has dimensions of: **[JEE Main 2021]**

1. $[LC^{-1}]$
2. $[M^0L^0T^0]$
3. $[MLT^0]$
4. $[MLT^{-1}]$

$\frac{e^2}{4\pi\varepsilon_0 hc} = ??$

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

$\frac{F\gamma^2}{hc} = \frac{F\gamma^2}{E\lambda} = \frac{F\gamma^2}{F\times\gamma\times\lambda}$

$E = \frac{hc}{\lambda}$

Question

If a typical combustion engine the work done by a gas molecule is given by $W = \alpha^2\beta e^{\frac{-Bx^2}{kT}}$, where x is the displacement, k is the Boltzmann constant and T is the temperature. If α and β are constants, dimensions of α will be: **[JEE Main 2021]**

1. $[M^0 LT^0]$
2. $[M^2 LT^{-2}]$
3. $[MLT^{-2}]$
4. $[MLT^{-1}]$

$W = \alpha^2 \beta e^{-\beta x^2/kT}$

Question

The dimension of mutual inductance is: [JEE Main 2022]

$E = \frac{1}{2} L I^2$

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

1. $[ML^2 T^{-2} A^{-1}]$
2. $[ML^2 T^{-3} A^{-1}]$
3. $[ML^2 T^{-2} A^{-2}]$ ✓
4. $[ML^2 T^{-3} A^{-2}]$

Question

The SI unit of a physical quantity is pascal-second. The dimensional formula of this quantity will be

[JEE Main 2022]

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

$\frac{F}{A}$ time

$\frac{ML T^{-2}}{L^2} \times T^{+2}$

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

Question

If L, C and R are the self inductance, capacitance and resistance respectively, which of the following does not have the dimension of time? **[JEE Main 2022]**

1. RC ✓
2. $\frac{L}{R}$ ✓
3. $\sqrt{LC}$ ✓
4. $\frac{L}{C}$ ✗

$R = \omega L = \frac{1}{\omega C}$

$\boxed{R = \frac{L}{T} = \frac{T}{C}}$

$T = \frac{L}{R}$

$RC = T$

$T^2 = LC$

$T = \sqrt{LC}$

Question

In Vander Waals equation $\left[P+\frac{a}{V^2}\right][V-b]=RT$; P is pressure, V is volume, R is universal gas constant and T is temperature. The ratio of constants $\frac{a}{b}$ is dimensionally equal to:

[JEE Main 2022]

$P=\frac{a}{V^2}$ $\quad V=b$

$a=PV^2$

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

1. $\frac{P}{V}$
2. $\frac{V}{P}$
3. PV ✓
4. PV^3

Question

Dimension of $\frac{1}{\mu_0 \varepsilon_0}$ should be equal to

[JEE Main 2023]

$v = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

1. $L\,T^{-1}$
2. $T^2\,L^{-2}$
3. $L^2\,T^{-2}$ ✓
4. $T\,L^{-1}$

Question

Match List I with List II

Choose the correct answer from the options given below: [JEE Main 2023]

	List-I		List-II
(A)	Torque	I	$M L^{-2} T^{-2}$
(B)	Stress	II	$M L^{2} T^{-2}$
(C)	Pressure gradient	III	$M L^{-1} T^{-1}$
(D)	Coefficient of viscosity	IV	$M L^{-1} T^{-2}$

1. A-I, B-III, C-II, D-IV
2. A-IV, B-I, C-III, D-II
3. A-II, B-I, C-IV, D-III
4. A-II, B-IV, C-I, D-III

(II) (IV) (I) (III)

Stress $= F/A = ML^{-1}T^{-2}$

$\frac{P}{\rho} = \frac{ML^{-1}T^{-2}}{\rho} = ML^{2}T^{-2}$

$\eta = \frac{F}{\delta v} = \frac{MLT^{-2}}{L(LT^{-1})}$

Question

Match List I with List II

Choose the correct answer from the options given below: [JEE Main 2023]

List-I		List-II	
(A)	Spring constant	I	$[T^{-1}]$
(B)	Angular speed	II	$[MT^{-2}]$
(C)	Angular momentum	III	$[ML^2]$
(D)	Moment of inertia	IV	$[ML^2T^{-1}]$

1. A-I, B-III, C-II, D-IV
2. A-IV, B-I, C-III, D-II
3. A-II, B-I, C-IV, D-III
4. A-II, B-III, C-I, D-IV

Question

In the equation $\left[X + \frac{a}{Y^2}\right][Y - b] = RT$, X is pressure, Y is volume, R is universal gas constant and T is temperature. The physical quantity equivalent to the ratio $\frac{a}{b}$ is:

[JEE Main 2023]

1. Pressure gradient
2. Energy
3. Impulse
4. Coefficient of viscosity

$\frac{a}{b} - \frac{x}{y^2}\,y = PV$

Question

Match List I with List II

Choose the correct answer from the options given below: [JEE Main 2023]

1. A-II, B-III, C-V, D-I
2. A-III, B-I, C-II, D-IV
3. A-I, B-III, C-IV, D-II
4. A-I, B-II, C-III, D-IV

	List-I		List-II
(A)	Young's Modulus (Y)	I	$[M L^{-1} T^{-1}]$
(B)	Co-efficient of Viscosity (η)	II	$[M L^{2} T^{-1}]$
(C)	Planck's constant (h)	III	$[M L^{-1} T^{-2}]$
(D)	Work function (ϕ)	IV	$[M L^{2} T^{-2}]$

$\eta = \frac{F}{\delta V} = ML^{-1}T^{-1}$

Question

The equation of stationary wave is:

$$y = 2a \sin\left(\frac{nt}{\lambda}\right) \cos\left(\frac{x}{\lambda}\right)$$

Which of the following is not correct:

[JEE Main 2024]

1. The dimensions of n/λ is [T]
2. The dimensions of n is $[LT^{-1}]$
3. The dimensions of x is [L]
4. The dimensions of nt is [L]

Question

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

[JEE Main 2024]

1. $[M^{-1} L^5 T^3]$
2. $[M^6 L^7 T^4]$
3. $[ML^2 T^{-2}]$
4. $[M^0 L^3 T^{-2}]$

Question

If ε_0 is the permittivity of free space and E is the electric field, then $\varepsilon_0 E^2$ has the dimensions:

[JEE Main 2024]

1. $[M^{-1} L^{-3} T^4 A^2]$
2. $[ML^2 T^{-2}]$
3. $[M^0 L^{-2} TA]$
4. $[ML^{-1} T^{-2}]$

Question

The dimensional formula of latent heat is: [JEE Main 2024]

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

$Q = mL$

$L = \frac{Q}{m} = \frac{ML^2T^{-2}}{M}$

Question

The equation of state of a real gas is given by $\left(P+\frac{a}{V^2}\right)(V-b)=RT$, where P, V and T are pressure. Volume and temperature respectively and R is the universal gas constant. The dimensions of $\frac{a}{b^2}$ is similar to that of: [JEE Main 2024]

1. PV
2. P
3. RT
4. R

Question

A force is represented by $F = ax^2 + bt^{1/2}$. Where x = distance and t = time. The dimensions of b^2/a are:

[JEE Main 2020]

1. $[ML^3T^{-3}]$
2. $[MLT^{-2}]$
3. $[ML^{-1}T^{-1}]$
4. $[ML^2T^{-3}]$

$F = ax^2 = bt^{1/2}$

$\frac{b^2}{a} = \frac{F^2}{T} \times \frac{x^2}{F}$

$= \frac{F x^3}{T}$

$= \frac{m L^3 T^{-3}}{}$

Question

The position of a particle moving on x-axis is given by $x(t) = A \sin t + B \cos^2 t + Ct^2 + D$, where t is time. The dimension of $\frac{ABC}{D}$ is:

[JEE Main 2025]

1. $L^2 T^{-2}$
2. L^2
3. L
4. $L^3 T^{-2}$

$X = A \sin(t) + B \cos^2 t + Ct^2 + D$

$X = A = B = Ct^2 = D$

$\frac{x^2 \times x}{t^2 \times}$

$\frac{x^2}{t^2}$

Question

The electric flux is $\phi = \alpha\sigma + \beta\lambda$ where λ and σ are linear and surface charge density, respectively. $\frac{\alpha}{\beta}$ represents

[JEE Main 2025]

1. electric field
2. area
3. charge
4. displacement

$$\phi = \alpha\sigma = \beta\lambda$$

$$\frac{\alpha}{\beta} = \frac{\lambda}{\sigma} = \frac{\lambda}{\frac{q}{A}} = \frac{\lambda A}{q} = \rho$$

Question

The expression given below shows the variation of velocity (v) with time (t), $v = At^2 + \frac{Bt}{C+t}$. The dimension of ABC is: **[JEE Main 2025]**

1. $[M^0 L^2 T^{-2}]$
2. $[M^0 L^1 T^{-3}]$
3. $[M^0 L^1 T^{-2}]$
4. $[M^0 L^2 T^{-3}]$ ✓

$V = At^2 = \frac{Bt}{t}$

$A = \frac{V}{t^2}$

$\frac{V}{t^2} \times t$

$= \frac{V^2}{t} = \frac{L^2T^{-2}}{T} = L^2T^{-3}$

$C = t$

$B = V$

Question

Match List I with List II

Choose the correct answer from the options given below: [JEE Main 2025]

	List-I		List-II
(A)	Boltzmann constant	I	ML^2T^{-1}
(B)	Coefficient of viscosity	II	$MLT^{-3}K^{-1}$
(C)	Planck's constant	III	$ML^2T^{-2}K^{-1}$
(D)	Thermal conductivity	IV	$ML^{-1}T^{-1}$

1. A-III, B-IV, C-I, D-II
2. A-II, B-III, C-IV, D-I
3. A-III, B-II, C-I, D-IV
4. A-III, B-IV, C-II, D-I

Question

The dimension of $\sqrt{\frac{\mu_0}{\epsilon_0}}$ is equal to that of:

(μ_0 = Vacuum permeability and ϵ_0 = Vacuum permittivity)

[JEE Main 2025]

1. Voltage
2. Capacitance
3. Inductance
4. ✓ Resistance

$$\sqrt{\frac{\mu_0}{\epsilon_0}} = \sqrt{\frac{F \times F\gamma^2}{I^2 \quad q^2}}$$

$$= \frac{F\gamma}{I \times 2} = \frac{E}{I^2 t}$$

$E = I^2 R t$

$$F = \frac{\mu_0 I^2 \ell}{4\pi \gamma}$$

$$\mu_0 = \frac{F}{I^2}$$

$$F = \frac{q^2}{4\pi\epsilon_0 r^2}$$

Question

Match List I with List II

Choose the correct answer from the options given below: **[JEE Main 2025]**

	List-I		List-II
(A)	Mass density	I	$[ML^2 T^{-3}]$
(B)	Impulse	II	$[MLT^{-1}]$
(C)	Power	III	$[ML^2T^0]$
(D)	Moment of inertia	IV	$[ML^{-3}T^0]$

1. A-IV, B-II, C-III, D-I
2. A-I, B-III, C-IV, D-II
3. A-IV, B-II, C-I, D-III
4. A-II, B-III, C-IV, D-I

THANK YOU