JEE-Main (Previous Year Questions)

1. Let $[\in_0]$ denote the dimensional formula of the permittivity of vacuum. If M = mass, L = length, T = time and A = electric current, then: **[JEE(Main)-2013]**

(1) $[\in_0] = [M^{-1} L^{-3} T^2 A]$ (2) $[\in_0] = [M^{-1} L^{-3} T^4 A^2]$

(3) $[\in_0] = [M^{-1} L^2 T^{-1} A^{-2}]$ (4) $[\in_0] = [M^{-1} L^2 T^{-1} A]$

2. An ideal gas enclosed in a vertical cylindrical container supports a freely moving piston of mass M. The piston and the cylinder have equal cross-sectional area A. When the piston is in equilibrium, the volume of the gas is V_0 and its pressure is P_0. The piston is slightly displaced from the equilibrium position and released. Assuming that the system is completely isolated from its surrounding, the piston executes a simple harmonic motion with frequency. **[JEE(Main)-2013]**

(1) $\frac{1}{2\pi}\frac{A\gamma P_0}{V_0 M}$ (2) $\frac{1}{2\pi}\frac{V_0 M P_0}{A^2\gamma}$

(3) $\frac{1}{2\pi}\sqrt{\frac{A^2\gamma P_0}{MV_0}}$ (4) $\frac{1}{2\pi}\sqrt{\frac{MV_0}{A\gamma P_0}}$

3. A man grows into a giant such that his linear dimensions increase by a factor of 9. Assuming that his density remains same, the stress in the leg will change by factor of : **[JEE(Main)-2017]**

(1) $\frac{1}{81}$ (2*) 9 (3) $\frac{1}{9}$ (4) 81

4. Expression for time in terms of G (universal gravitational constant), h (Planck constant) and c (speed of light) is proportional to: **[JEE(Main)-2019]**

(1) $\sqrt{\frac{Gh}{c^3}}$ (2) $\sqrt{\frac{Gh}{c^5}}$ (3) $\sqrt{\frac{hc^5}{G}}$ (4) $\sqrt{\frac{c^5}{Gh}}$

5. The density of a material in SI units is128 kg m^{-3}. In certain units in which the unit of length is 25 cm and the unit of mass is 50g, the numerical value of density of the material is: **[JEE(Main)-2019]**

(1) 640 (2) 16

(3) 410 (4) 40

6. The force of interaction between two atoms is given by $F = \alpha\beta \exp\left(-\frac{x^2}{\alpha kt}\right)$; where x is the distance, k is the Boltzmann constant and T is temperature and α and β are two constants. The dimension of $\beta$is: **[JEE(Main)-2019]**

(1) $M^2L^2T^{-2}$ (2) $M^0L^2T^{-4}$

(3) MLT^{-2} (4) M^2LT^{-4}

7. If speed (V), acceleration (A) and force (F) are considered as fundamental units, the dimension of Young's modulus will be: **[JEE(Main)-2019]**

(1) $V^{-2}A^2F^{-2}$ (2) $V^{-4}A^{-2}F$

(3) $V^{-2}\ A^2F^2$ (4) $V^{-4}A^2F$

8. Let ℓ, r, c and v represent inductance, resistance, capacitance and voltage, respectively. The dimension of $\frac{\ell}{rcv}$ in SI units will be: **[JEE(Main)-2019]**

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

(3) $[LA^{-2}]$ (4) $[LT^2]$

9. In SI units, the dimensions of $\sqrt{\frac{\epsilon_0}{\mu_0}}$ is: **[JEE(Main)-2019]**

(1) $AT^2M^{-1}L^{-1}$ (2) $A^{-1}TML^3$

(3) $AT^{-3}ML^{3/2}$ (4) $A^2T^3M^{-1}L^{-2}$

10. If Surface tension (S), Moment of Inertia (I) and Planck's constant (h), are to be taken as the fundamental units, the dimensional formula for linear momentum would be: **[JEE(Main)-2019]**

(1) $S^{3/2}I^{1/2}h^0$ (2) $S^{1/2}I^{3/2}h^{-1}$

(3) $S^{1/2}I^{1/2}h^0$ (4) $S^{1/2}I^{1/2}h^{-1}$

11. 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) Area (3) Energy (4) Volume

12. If speed V, area A and force F are chosen as fundamental units, then the dimension of Young's modulus will be: **[JEE(Main)-2020]**

(1) $FA^{-1}V^0$ (2) FA^2V^{-1} (3) FA^2V^{-3} (4) FA^2V^{-2}

13. If momentum (P), area (A) and time (T) are taken to be the fundamental quantities then the dimensional formula for energy is: **[JEE(Main)-2020]**

(1) $[PA^{-1}\ T^{-2}]$ (2) $[PA^{1/2}T^{-1}]$ (3) $[P2AT^{-2}]$ (4) $[P^{1/2}AT^{-1}]$

14. 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^2T^{-2} (2) MLT^{-2} (3) $M^2L^0T^{-1}$ (4) ML^0T^{-3}

15. 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) Planck's constant (2) Force constant

(3) Energy density (4) Coefficient of viscosity

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

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

17. Match List-I with List-II : **[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)$[M\ L^2\ I^{-1}T^{-3}]$

Choose the correct answer from the options given below:

(1) (a)→(iii), (b)→(iv), (c)→(ii), (d)→(i) (2) (a)→(ii), (b)→(iii), (c)→(iv), (d)→(i)

(3) (a)→(i), (b)→(ii), (c)→(iv), (d)→(iii) (4) (a)→(iii), (b)→(ii), (c)→(iv), (d)→(i)

18. If e is the electronic charge, 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) $[M^0\ L^0\ T^0]$ (2) $[L\ C^{-1}]$ (3) $[M\ L\ T^{-1}]$ (4) $[M\ L\ T^0]$

19. The force is given in terms of time t and displacement x by the equation F = A cos Bx + C sin Dt. The dimensional formula of $\frac{AD}{B}$ is: **[JEE(Main)-2021]**

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

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

20. If E, L, M and G denote the quantities as energy, angular momentum, mass and constant of gravitation respectively, then the dimensions of P in the formula $P = EL^2M^{-5}G^{-2}$ are :- **[JEE(Main)-2021]**

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

21. Match **List-I** with **List-II.** **[JEE(Main)-2021]**

List-I	**List-II**
(a) Torque	(i) MLT^{-1}
(b) Impulse	(ii) MT^{-2}
(c) Tension	(iii) ML^2T^{-2}
(d) Surface Tension	(iv) MLT^{-2}

Choose the **most appropriate** answer from the option given below :

(1) (a)–(iii), (b)–(i), (c)–(iv), (d)–(ii) (2) (a)–(ii), (b)–(i), (c)–(iv), (d)–(iii)

(3) (a)–(i), (b)–(iii), (c)–(iv), (d)–(ii) (4) (a)–(iii), (b)–(iv), (c)–(i), (d)–(ii)

22. Which of the following equations is dimensionally incorrect?

Where t = time, h = height, s = surface tension, θ = angle, ρ = density, a, r = radius, g = acceleration due to gravity, v = volume, p = pressure, W = work done, Γ = torque, $\in$ = permittivity, E = electric field, J = current density, L = length. **[JEE(Main)-2021]**

(1) $v = \frac{\pi pa^4}{8\eta L}$ (2) $h = \frac{2s\cos\theta}{\rho rg}$ (3) $J = \in \frac{\partial E}{\partial t}$ (4) $W = \Gamma\theta$

23. An expression of energy density is given by $u = \frac{\alpha}{\beta}\sin\left(\frac{\alpha x}{kt}\right)$, where α, β are constants, x is displacement, k is Boltzmann constant and t is the temperature. The dimensions of β will be: **[JEE(Main)-2022]**

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

24. the dimensions of $\left(\frac{B^2}{\mu_0}\right)$ will be

(if μ_0 : permeability of free space and B : magnetic field) **[JEE(Main)-2022]**

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

25. Consider the efficiency of Carnot's engine is given by $\eta = \frac{\alpha\beta}{\sin\theta}\log_e\frac{\beta x}{kT}$, where α and β are constants. If T is temperature, k is Boltzman constant, θ is angular displacement and x has the dimensions of length. Then, choose the **incorrect** option. **[JEE(Main)-2022]**

(1) Dimensions of β is same as that of force.

(2) Dimensions of $\alpha^{-1}x$ is same as that of energy.

(3) Dimensions of $\eta^{-1}\sin\theta$ is same as that of $\alpha\beta$

(4) Dimensions of α is same as that of β

26. Match the list-I with List -II.

List I		List II	
A.	Torque	I.	Nms^{-1}
B.	Stress	II.	$J\,kg^{-1}$
C.	Latent Heat	III.	Nm
D.	Power	IV.	Nm^{-2}

Choose the correct answer from the options given below: **[JEE(Main)-2022]**

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

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

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

28. 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]

(1) $\frac{P}{V}$ (2) $\frac{V}{P}$ (3) PV (4) PV^3

ANSWER KEY

1.	(2)	**2.**	(3)	**3.**	(2)	**4.**	(2)	**5.**	(4)	**6.**	(4)	**7.**	(4)
8.	(1)	**9.**	(4)	**10.**	(3)	**11.**	(3)	**12.**	(1)	**13.**	(2)	**14.**	(4)
15.	(3)	**16.**	(2)	**17.**	(2)	**18.**	(1)	**19.**	(2)	**20.**	(4)	**21.**	(1)
22.	(1)	**23.**	(4)	**24.**	(3)	**25.**	(4)	**26.**	(2)	**27.**	(1)	**28.**	(3)

JEE-Advanced (Previous Year Questions)

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. $[ML^2T^{-2}K^{-1}]$

Codes:

	P	Q	R	S
(A)	3	1	2	4
(B)	3	2	1	4
(C)	4	2	1	3
(D)	4	1	2	3

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 find that d is proportional to $S^{1/n}$. The value of n is: **[JEE(Advanced)-2014]**

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) **[JEE(Advanced)-2015]**

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

PARAGRAPH "X"

In electromagnetic theory, the electric and magnetic phenomena are related to each other. Therefore, the dimensions of electric and magnetic quantities must also be related to each other. In the questions below, [E] and [B] stand for dimensions of electric and magnetic fields respectively, while $[\in_0]$ and $[\mu_0]$ stand for dimensions of the permittivity and permeability of free space respectively. [L] and [T] are dimensions of length and time respectively. All the quantities are given in SI units.

(There are two questions based on Paragraph "X", the question given below is one of them)

4. The relation between [E] and [B] is: **[JEE(Advanced)-2018]**

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

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

5. The relation between $[\in_0]$ and $[\mu_0]$ is: **[JEE(Advanced)-2018]**

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

6. 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(Advanced)-2019]

(A) The dimension of force is L^{-3} (B) The dimension of linear momentum is L^{-1}

(C) The dimension of energy is L^{-2} (D) The dimension of power is L^{-5}

7. Sometimes it is convenient to construct a system of units so that all quantities can be expressed in terms of only one physical quantity. In one such system, dimensions of different quantities are given in terms of a quantity X as follows: [position] = $[X^{\alpha}]$; [Speed] =$[X^{\beta}]$; [acceleration] = $[X^{p}]$; [Linear momentum] = $[X^{q}]$; [force] = $[X^{f}]$. Then **[JEE(Advanced)-2020]**

(A) $\alpha + p = 2\beta$ (B) $p + q - r = \beta$ (C) $p - q + r = \alpha$ (D) $p + q + r = \beta$

Ans. (A,B)

8. A physical quantity $\vec{S}$ is defined as $\vec{S} = \left(\vec{E} \times \vec{B}\right) / \mu_0$, 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 dimension of which of the following quantity(ies)? **[JEE(Advanced)-2021]**

(A) $\frac{\text{Energy}}{\text{Charge} \times \text{Current}}$ (B) $\frac{\text{Force}}{\text{Length} \times \text{Time}}$

(C) $\frac{\text{Energy}}{\text{Volume}}$ (D) $\frac{\text{Power}}{\text{Area}}$

Ans. (B,D)

9. 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 $k = \frac{1}{4\pi \in_0}$, where $\in_0$ 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(Advanced)-2022]

Ans. 4

ANSWER KEY

1.	(C)	**2.**	3	**3.**	(AC)	**4.**	(C)	**5.**	(D)	**6.**	(ABC)	**7.**	(AB)
8.	(BD)	**9.**	4								