

JAM (2020-2021)
Mock Test No: 1
Subject: Unit and Dimension

Date: 02/02/2020

Time: 1 hour 30 mins

Full Marks: 50

Group	No. of questions attempted	No. of correct answers	No. of wrong answers	Marks obtained	Total
A					
B					
C					

Group A
 $(1 \times 26) = 26$

- There is only one correct option.
- Tick (✓) to the correct option.
- There is a negative marking of 0.25 for each wrong attempt.

1. Which of the following is a common unit of physical quantity in SI system?
(a) A (b) K (c) mol (d) J s⁻¹
2. Boltzmann constant and Planck's constant differ in the dimension of
(a) time and temperature (b) mass and temperature
(c) length and mass (d) length and time
3. If u_1 and u_2 are the units of a physical quantity and n_1, n_2 are the numerical values, then
(a) $\frac{n_1}{n_2} = \frac{u_1}{u_2}$ (b) $\frac{n_2}{n_1} = \frac{u_1}{u_2}$
(c) $\frac{n_1^2}{n_2} = \frac{u_1}{u_2}$ (d) None of the above
4. Which is the dimensional formula of the physical quantity whose dimensional SI unit is Siemen?
(a) $[M^{-1}L^{-2}T^3I^2]$ (b) $[M^{-1}L^{-1}T^3I^3]$
(c) $[M^1L^{-2}T^3I^3]$ (d) $[M^{-1}L^{-2}T^2I^2]$

5. Which is the physical quantity whose dimensional formula is $[M^1L^0T^{-2}]$?
- (a) Bulk Modulus (b) Electric conductance
(c) Surface tension (d) Frequency
6. If $[M^aL^bT^cI^d]$ is the dimensional formula of resistance, then the value of $4a + 5b + c - 2d = 0$
- (a) 15 (b) 10 (c) 8 (d) 12
7. If $[M^aL^bT^c]$ is the dimensional formula of momentum, and $[M^xL^yT^z]$ dimensional formula of energy find the value of $ax + by + cz$ is
- (a) -3 (b) -1 (c) 2 (d) 5
8. Which of the following is a derived unit?
- (a) A (b) mol (c) cd (d) N
9. If the unit of length is doubled, unit of time is halved and unit of momentum is quadrupled, the unit of work change by times.
- (a) $\frac{1}{8}$ (b) $\frac{1}{16}$ (c) 16 (d) 8
10. The unit of energy is 10 J, if the unit of mass is tripled, unit of acceleration is doubled and the unit of length is halved. What will be the new unit of energy?
- (a) 151 J (b) 30 J (c) 300 J (d) 3 J
11. The electric resistance of a conductor is 54Ω . If the unit of mass and length are tripled, units of time and electric current are doubled. Then the value of new electric resistance
- (a) 540Ω (b) 1080Ω (c) 1620Ω (d) 1944Ω
12. Which of the following is dimensionally correct formula
- (a) $V = ut + at$ (b) $v + u = at$
(c) $\frac{V}{u} = at$ (d) $vt = u - a$
13. The dimensional formula of coefficient of viscosity is
- (a) $[ML^{-1}T^{-1}]$ (b) $[M^1L^2T^{-1}]$
(c) $[ML^2T^{-3}]$ (d) $[M^0L^3T^{-1}]$
14. Pair of quantities having same dimensional formula are
- (a) velocity, impulse (b) Force, Weight
(c) Impulse, inertia (d) Angular momentum, Linear momentum
15. If the unit of power is 100 erg min^{-1} , the unit of force is 100 dyn and the unit of time is 100 s , the unit of length is
- (a) $\frac{5}{3} \text{ cm}$ (b) $\frac{2}{3} \text{ cm}$ (c) $\frac{1}{3} \text{ cm}$ (d) none of the above

16. A book with many printing errors contain four different formulas for the displacement y of a particle undergoing a certain periodic motion : which of the expressions cannot be ruled out on the basis of dimensional arguments? (A is the maximum amplitude, T is the time period and v is the velocity)
- (a) $y = A \sin \left(\frac{2\pi t}{T} \right)$ (b) $y = A \sin (vt)$
 (c) $y = \left(\frac{A}{T} \right) \sin \left(\frac{t}{A} \right)$ (d) $y = \left(\frac{A}{\sqrt{2}} \right) \left(\sin \frac{2\pi\omega}{T} + \cos \frac{2\pi\omega}{T} \right)$
17. For 10^{a+3} , the dimension of a is
- (a) $[M^0L^0T^0]$ (b) $[M^0L^0T^1]$
 (c) $[M^0L^0T^{-1}]$ (d) None of these
18. The velocity of a moving particle depends upon time t as $v = at + \frac{b}{t+c}$. Then dimensional formula for b is,
- (a) $[M^0L^0T^0]$ (b) $[M^0L^1T^0]$
 (c) $[M^0L^1T^{-1}]$ (d) $[m^0L^1T^{-2}]$
19. If P , Q , R are physical quantities, having different dimensions, which of the following combinations can never be a meaningful quantity?
- (a) $\frac{P-Q}{R}$ (b) $PQ - R$ (c) $\frac{PQ}{R}$ (d) $\frac{PR-Q^2}{R}$
20. If Planck's constant h and speed of light in vacuum c are taken as two fundamental quantities, which one of the following cannot, in addition, be taken to express length, mass and time in terms of the three chosen fundamental quantities?
- (a) Mass of electron m_e
 (b) Universal gravitational constant G
 (c) Charge of electron e
 (d) Mass of proton m_p
21. SI unit of pH is
- (a) mol L^{-1} (b) g cm^{-3} (c) unitless (d) g eqv^{-1}

The van der Waals equation is $\left(P + \frac{n^2a}{V^2} \right) (V - nb) = nRT$, where P is pressure, V is the volume and T is the temperature of the given sample of gas. R is called molar gas constant, a and b are called van der Waals constants.

22. The dimensional formula for b is same as that for
- (a) P (b) V (c) PV^2 (d) RT

23. The dimensional formula for a is same as that for
 (a) V^2 (b) P (c) PV^2 (d) RT
24. Which of the following does not possess the same dimensional formula as that for RT
 (a) PV (b) Pb (c) $\frac{a}{V^2}$ (d) $\frac{ab}{V^2}$
25. The dimensional formula for $\frac{ab}{RT}$ is
 (a) $[ML^5T^{-2}]$ (b) $[M^0L^3T^0]$
 (c) $[ML^{-1}T^{-2}]$ (d) $[M^0L^6T^0]$
26. The dimensional formula of RT is same as that of
 (a) energy (b) force
 (c) specific heat (d) latent heat

Group B

27. Match the physical quantities in column A with their dimensional formulae expressed in column B. $(0.5 \times 8) = 4$

Column A	Column B
(1) Angular momentum	(a) $[ML^2T^{-2}]$
(2) Lantent heat	(b) $[ML^2T^{-2}A^{-2}]$
(3) Torque	(c) $[ML^2T^{-1}]$
(4) Capacitance	(d) $[ML^3T^{-3}A^{-2}]$
(5) Inductance	(e) $[M^{-1}L^{-2}T^4A^2]$
(6) Resistivity	(f) $[ML^2T^{-2}A^{-1}]$
(7) Magnetic flux	(g) $[ML^{-1}T^{-2}]$
(8) Magnetic energy density	(h) $[L^2T^{-2}]$

Group C

Fill in the blanks:

$(2 \times 10) = 20$

- SI unit of molar extinction coefficient and absorbance are _____ and _____.
- SI unit of absolute permittivity of vaccum (ϵ_0) and relative permittivity are _____ and _____.
- SI unit of dielectric constant (D) and dipole moment are _____ and _____.

4. Maxwell speed distribution formula is given by $P(c)dc = Ace^{-\frac{mc^n}{2k_B T}}dc$, where terms are of usual significance. SI unit of A and value of n are _____ and _____.
5. For a system of one particle in 1D and 3D, unit of wave functions are _____ and _____.
6. CGS and SI units of polarizability (α) are _____ and _____.
7. The time period and frequency of a simple pendulum are _____ and _____.
8. In the atomic unit mass of H-atom and He atom are _____ and _____. [Assume that mass of proton/neutron = $1835 \times$ mass of electron].
9. In the atomic mass unit ionization potential of H-atom and first ionization potential of He atom are _____ and _____.
10. SI unit of $(\frac{\partial U}{\partial V})_T$ and $(\frac{\partial H}{\partial P})_T$ are _____ and _____.