1. Units, Dimensions and Measurement – Multiple Choice Questions

1. Units

1. Light year is a unit of

(a) Time (b) Mass

(c) Distance (d) Energy

2. Which of the following is not represented in correct unit?

(a) $\frac{\text{Stress}}{\text{Strain}} = N/m^2$ (b) Surface tension $= N/m$

(c) Energy $= kg\text{-}m/sec$ (d) Pressure $= N/m^2$

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

(a) $kgms^{-1}$ (b) $kgms^{-2}$

(c) kgs^{-1} (d) kgs

4. Temperature can be expressed as a derived quantity in terms of any of the following

(a) Length and mass

(b) Mass and time

(c) Length, mass and time

(d) None of these

5. $S = A(1 - e^{-Bxt})$, where S is speed and x is displacement. The unit of B is

(a) $m^{-1}s^{-1}$ (b) $m^{-2}s$

(c) s^{-2} (d) s^{-1}

6. *Ampere – hour* is a unit of

(a) Quantity of electricity

(b) Strength of electric current

(c) Power

(d) Energy

7. $1kWh =$

(a) $1000\ W$ (b) $36 \times 10^5 J$

(c) $1000\ J$ (d) $3600\ J$

8. The S.I. unit of gravitational potential is

(a) J (b) $J\text{-}kg^{-1}$

(c) $J\text{-}kg$ (d) $J\text{-}kg^{-2}$

9. Which of the following is not the unit of time?

(a) Micro *second* (b) Leap year

(c) Lunar month (d) Parallactic *second*

10. The unit of *e.m.f.* is

(a) Joule (b) Joule-coulomb

(c) Volt–coulomb (d) Joule/coulomb

11. *Faraday* is the unit of

(a) Charge (b) Emf

(c) Mass (d) Energy

12. Which of the following pairs is wrong?

(a) Pressure-Barometer

(b) Relative density-Pyrometer

(c) Temperature-Thermometer

(d) Earthquake-Seismograph

13. A physical quantity is measured and its value is found to be nu where $n =$ numerical value and $u =$ unit. Then which of the following relations is true

(a) $n \propto u^2$ (b) $n \propto u$

(c) $n \propto \sqrt{u}$ (d) $n \propto \frac{1}{u}$

14. Which of the following is the smallest unit?

(a) *Millimetre* (b) *Angstrom*

(c) *Fermi* (d) *Metre*

15. If $x = at + bt^2$, where x is the distance travelled by the body in kilometre while t is the time in second, then the units of b are

(a) km/s (b) $km\text{–}s$

(c) km/s^2 (d) $km\text{–}s^2$

16. Which is not a unit of electric field

(a) NC^{-1} (b) Vm^{-1}

(c) JC^{-1} (d) $JC^{-1}m^{-1}$

17. The correct value of $0°C$ on the Kelvin scale is

(a) $273.15K$ (b) $272.85\ K$

(c) $273\ K$ (d) $273.2\ K$

18. A new unit of length is so chosen that the speed of light in vacuum is unity. Calculate the distance (in this new unit) between sun and the earth if light takes 8 *min* and 20 *seconds* to reach earth from sun

(a) 300 (b) 400

(c) 500 (d) 600

19. *Joule-second* is the unit of

(a) Work (b) Momentum

(c) Pressure (d) Angular momentum

20. What is the SI unit of permeability?

(a) *Henry* per *metre*

(b) Tesla *metre* per *ampere*

(c) *Weber* per *ampere metre*

(d) All the above units are correct

21. Unit of magnetic moment is

(a) *Ampere–metre*^{2} (b) *Ampere–metre*

(c) *Weber–metre*^{2} (d) *Weber/metre*

22. Curie is a unit of

(a) Energy of γ-rays (b) Half life

(c) Radioactivity (d) Intensity of γ-rays

23. The unit of Stefan's constant σ is

(a) $W\,m^{-2}\,K^{-1}$ (b) $W\,m^{2}\,K^{-4}$

(c) $W\,m^{-2}\,K^{-4}$ (d) $W\,m^{-2}\,K^{4}$

24. The surface tension of a liquid is 70 *dyne / cm* . In MKS system its value is

(a) $70 N/m$ (b) $7\times10^{-2}\ N/m$

(c) $7\times10^{3}\ N/m$ (d) $7\times10^{2}\ N/m$

25. The SI unit of universal gas constant (R) is

(a) *Watt* $K^{-1}mol^{-1}$

(b) *Newton* $K^{-1}mol^{-1}$

(c) *Joule* $K^{-1}\,mol^{-1}$

(d) *Erg* $K^{-1}\,mol^{-1}$

26. The number of significant figures in 0.06900 is

(a) 5 (b) 4

(c) 2 (d) 3

2. Dimensions

1. If the dimensions of a physical quantity are given by $M^aL^bT^c$, then the physical quantity will be

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

2. If L and R are respectively the inductance and resistance, then the dimensions of $\frac{L}{R}$ will be

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

(b) M^0LT^0

(c) M^0L^0T

(d) Cannot be represented in terms of M, L and T

3. If C and R represent capacitance and resistance respectively, then the dimensions of RC are

(a) $M^0L^0T^2$ (b) M^0L^0T

(c) ML^{-1} (d) None of the above

4. The dimensional formula for impulse is

(a) MLT^{-2} (b) MLT^{-1}

(c) ML^2T^{-1} (d) M^2LT^{-1}

5. Out of the following, the only pair that does not have identical dimensions is

(a) Angular momentum and Planck's constant

(b) Moment of inertia and moment of a force

(c) Work and torque

(d) Impulse and momentum

6. The dimensional formula for impulse is same as the dimensional formula for

(a) Momentum

(b) Force

(c) Rate of change of momentum

(d) Torque

7. The equation of state of some gases can be expressed as $\left(P+\frac{a}{V^2}\right)(V-b)=RT$. Here P is the pressure, V is the volume, T is the absolute temperature and a, b, R are constants. The dimensions of 'a' are

(a) ML^5T^{-2} (b) $ML^{-1}T^{-2}$

(c) $M^0L^3T^0$ (d) $M^0L^6T^0$

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

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

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

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

(A) Energy density (B) Refractive index

(C) Dielectric constant (D) Young's modulus

(E) Magnetic field

(a) (A) and (D) (b) (A) and (E)

(c) (B) and (D) (d) (C) and (E)

10. The velocity v (in cm/sec) of a particle is given in terms of time t (in sec) by the relation $v = at + \frac{b}{t+c}$; the dimensions of a, b and c are

(a) $a = L^2, b = T, c = LT^2$

(b) $a = LT^2, b = LT, c = L$

(c) $a = LT^{-2}, b = L, c = T$

(d) $a = L, b = LT, c = T^2$

11. $ML^{-1}T^{-2}$ represents

(a) Stress

(b) Young's Modulus

(c) Pressure

(d) All the above three quantities

12. A force F is given by $F = at + bt^2$, where t is time. What are the dimensions of a and b

(a) MLT^{-3} and ML^2T^{-4} (b) MLT^{-3} and MLT^{-4}

(c) MLT^{-1} and MLT^0 (d) MLT^{-4} and MLT^1

13. The fundamental physical quantities that have same dimensions in the dimensional formulae of torque and angular momentum are

(a) Mass, time (b) Time, length

(c) Mass, length (d) Time, mole

14. The physical quantity which has dimensional formula as that of $\frac{\text{Energy}}{\text{Mass} \times \text{Length}}$ is

(a) Force (b) Power

(c) Pressure (d) Acceleration

15. Which of the following pairs of physical quantities does not have same dimensional formula

(a) Work and torque

(b) Angular momentum and Planck's constant

(c) Tension and surface tension

(d) Impulse and linear momentum

16. Pressure gradient has the same dimension as that of

(a) Velocity gradient (b) Potential gradient

(c) Energy gradient (d) None of these

17. In the relation $y = a\cos(\omega t - kx)$, the dimensional formula for k is

(a) $[M^0L^{-1}T^{-1}]$ (b) $[M^0LT^{-1}]$

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

18. "Pascal-Second" has dimension of

(a) Force (b) Energy

(c) Pressure (d) Coefficient of viscosity

19. The constant of proportionality $\frac{1}{4\pi\varepsilon_0}$ in Coulomb's law has the following dimensions

(a) $C^{-2}Nm^2$ (b) $C^2N^{-1}m^{-2}$

(c) C^2Nm^2 (d) $C^{-2}N^{-1}m^{-2}$

20. Dimensions of magnetic field intensity is

(a) $[M^0L^{-1}T^0A^1]$ (b) $[MLT^{-1}A^{-1}]$

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

21. The dimension of quantity (L/RCV) is

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

(c) $[A^{-1}]$ (d) None of these

22. The dimension of $\frac{1}{2}\epsilon_0 E^2$, where ϵ_0 is permittivity of free space and E is electric field, is

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

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

23. If E, M, L and G denote energy, mass, angular momentum and gravitational constant respectively, then the quantity (EL^2/M^5G^2) has the dimensions of

(a) Angle (b) Length

(c) Mass (d) Time

24. The density of a material in CGS system of units is $4g/cm^3$. In a system of units in which unit of length is $10\,cm$ and unit of mass is $100\,g$, the value of density of material will be

(a) 400 (b) 0.04

(c) 0.4 (d) 40

25. The position of a particle at time t is given by the relation $x(t) = \left(\frac{v_0}{\alpha}\right)(1 - e^{-\alpha t})$, where v_0 is a constant and $\alpha > 0$. The dimensions of v_0 and α are respectively

(a) $M^0L^1T^{-1}$ and T^{-1}

(b) $M^0L^1T^0$ and T^{-1}

(c) $M^0L^1T^{-1}$ and LT^{-2}

(d) $M^0L^1T^{-1}$ and T

26. A physical quantity x depends on quantities y and z as follows: $x = Ay + B\tan Cz$, where A, B and C are constants. Which of the following do not have the same dimensions?

(a) x and B (b) C and z^{-1}

(c) y and B/A (d) x and A

27. The frequency of vibration of string is given by $\nu = \frac{p}{2l}\left[\frac{F}{m}\right]^{1/2}$. Here p is number of segments in the string and l is the length. The dimensional formula for m will be

(a) $[M^0LT^{-1}]$ (b) $[ML^0T^{-1}]$

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

28. The Vander Waal's equation of state for real gases is given as $\left(P + \frac{a}{V^2}\right)(V - b) = nRT$ which of the following terms has dimensions different from that of energy

(a) PV (b) $\frac{a}{V^2}$

(c) $\frac{ab}{V^2}$ (d) bP

29. Frequency is the function of density (ρ), length (a) and surface tension (T). Then its value is

(a) $k\rho^{1/2}a^{3/2}/\sqrt{T}$ (b) $k\rho^{3/2}a^{3/2}/\sqrt{T}$

(c) $k\rho^{1/2}a^{3/2}/T^{3/4}$ (d) None of these

30. The velocity of a freely falling body changes as $g^p h^q$ where g is acceleration due to gravity and h is the height. The values of p and q are

(a) $1, \frac{1}{2}$ (b) $\frac{1}{2}, \frac{1}{2}$

(c) $\frac{1}{2}, 1$ (d) 1,1

31. If P represents radiation pressure, c represents speed of light and Q represents radiation energy striking a unit area per second, then non-zero integers x, y and z such that $P^xQ^yc^z$ is dimensionless, are

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

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

32. The frequency of vibration f of a mass m suspended from a spring of spring constant K is given by a relation of this type, $f = Cm^xK^y$; where C is a dimensionless quantity. The value of x and y are

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

33. The velocity of water waves v may depend upon their wavelength λ, the density of water ρ and the acceleration due to gravity g. The method of dimensions gives the relation between these quantities as

(a) $v^2 \propto \lambda g^{-1}\rho^{-1}$ (b) $v^2 \propto g\lambda\rho$

(c) $v^2 \propto g\lambda$ (d) $v^2 \propto g^{-1}\lambda^{-3}$

34. If mass is measure in units of α kg, length in β m and time in γ s then calorie would be

(a) $4.2\alpha\beta^2\gamma^{-2}$ (b) $4.2\alpha^{-1}\beta^2\gamma^2$

(c) $4.2\alpha^{-1}\beta^{-2}\gamma^2$ (d) $4.2\alpha^{-2}\beta^{-1}\gamma^{-2}$

35. A small steel ball of radius r is allowed to fall under gravity through a column of a viscous liquid of coefficient of viscosity η. After some time, the velocity of the ball attains a constant value known as terminal velocity v_T. The terminal velocity depends on (i) the mass of the ball m, (ii) η, (iii) r and (iv) acceleration due to gravity g. Which of the following relations is dimensionally correct?

(a) $v_T \propto \frac{mg}{\eta r}$ (b) $v_T \propto \frac{\eta r}{mg}$

(c) $v_T \propto \eta rmg$ (d) $v_T \propto \frac{mgr}{\eta}$

36. In a system of units if force (F), acceleration (A) and time (T) are taken as fundamental units then the dimensional formula of energy is

(a) FA^2T (b) FAT^2

(c) F^2AT (d) FAT

37. If the speed of light (c), acceleration due to gravity (g) and pressure (p) are taken as the fundamental quantities, then the dimension of gravitational constant is

(a) $c^2g^0p^{-2}$ (b) $c^0g^2p^{-1}$

(c) cg^3p^{-2} (d) $c^{-1}g^0p^{-1}$

38. If the time period (T) of vibration of a liquid drop depends on surface tension (S), radius (r) of the drop and density (ρ) of the liquid, then the expression of T is

(a) $T = k\sqrt{\rho r^3/S}$ (b) $T = k\sqrt{\rho^{1/2}r^3/S}$

(c) $T = k\sqrt{\rho r^3/S^{1/2}}$ (d) None of these

39. If energy (E), velocity (v) and force (F) be taken as fundamental quantity, then what are the dimensions of mass

(a) Ev^2 (b) Ev^{-2}

(c) Fv^{-1} (d) Fv^{-2}

40. If force (F), length (L) and time (T) are assumed to be fundamental units, then the dimensional formula of the mass will be

(a) $FL^{-1}T^2$ (b) $FL^{-1}T^{-2}$

(c) $FL^{-1}T^{-1}$ (d) FL^2T^2

41. The speed of light (c), gravitational constant (G) and Planck's constant (h) are taken as the fundamental units in a system. The dimension of time in this new system should be

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

42. If momentum (p), area (A) and time (T) are taken to be fundamental quantities, then energy has the dimensional formula

(a) $[pA^{-1}T^{1}]$ (b) $[p^{2}AT]$

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

43. Consider the following equation of Bernouilli's theorem.

$P+\frac{1}{2}\rho V^2+\rho gh=K$ (constant)

The dimensions of K/P are same as that of which of the following

(a) Thrust (b) Pressure

(c) Angle (d) Viscosity

3. Errors of Measurement

1. If the error in the measurement of radius of a sphere is 2%, then the error in the determination of volume of the sphere will be

(a) 8% (b) 2%

(c) 4% (d) 6%

2. A physical quantity X is given by $X=\frac{2k^3l^2}{m\sqrt{n}}$. The percentage error in the measurements of k, l, m and n are 1%, 2%, 3% and 4% respectively. The value of X is uncertain by

(a) 8% (b) 10%

(c) 12% (d) None of the above

3. A student measures the distance traversed in free fall of a body, initially at rest in a given time. He uses this data to estimate g, the acceleration due to gravity. If the maximum percentage errors in measurement of the distance and the time are e_1 and e_2 respectively, the percentage error in the estimation of g is

(a) e_2-e_1 (b) e_1+2e_2

(c) e_1+e_2 (d) e_1-2e_2

4. Measure of two quantities along with the precision of respective measuring instrument is $A=2.5\,ms^{-1}\pm0.5\,ms^{-1}$, $B=0.10\,s\pm0.01\,s$ The value of AB will be

(a) $(0.25\pm0.08)m$

(b) $(0.25\pm0.5)m$

(c) $(0.25\pm0.05)m$

(d) $(0.25\pm0.135)m$

5. You measure two quantities as $A=1.0\,m\pm0.2\,m$ $B=2.0\,m\pm0.2\,m$ we should report correct value for $\sqrt{AB}$ as

(a) $1.4\,m\pm0.4\,m$ (b) $1.41\,m\pm0.15\,m$

(c) $1.4\,m\pm0.3\,m$ (d) $1.4\,m\pm0.2\,m$

6. The period of oscillation of a simple pendulum is given by $T=2\pi\sqrt{\frac{l}{g}}$ where l is about 100 cm and is known to have $1mm$ accuracy. The period is about $2s$. The time of 100 oscillations is measured by a stop watch of least count 0.1 s. The percentage error in g is

(a) 0.1% (b) 1%

(c) 0.2% (d) 0.8%

7. The numbers 2.745 and 2.735 on rounding off to 3 significant figures will give

(a) 2.75 and 2.74 (b) 2.74 and 2.73

(c) 2.75 and 2.73 (d) 2.74 and 2.74

8. The mass and volume of a body are $4.237\,g$ and $2.5\,cm^3$, respectively. The density of the material of the body in correct significant figures is

(a) $1.6048\,g\,cm^{-3}$ (b) $1.69\,g\,cm^{-3}$

(c) $1.7\,g\,cm^{-3}$ (d) $1.695\,g\,cm^{-3}$

9. The length and breadth of a rectangular sheet are $16.2\,cm$ and $10.1\,cm$, respectively. The area of the sheet in appropriate significant figures and error is

(a) $164\pm3\,cm^2$ (b) $163.62\pm2.6\,cm^2$

(c) $163.6\pm2.6\,cm^2$ (d) $163.62\pm3\,cm^2$

10. Which of the following measurement is most precise

(a) 5.00 mm (b) 5.00 cm

(c) 5.00 m (d) 5.00 km

11. The mean length of an object is $5\,cm$. Which of the following measurements is most accurate

(a) 4.9 cm (b) 4.805 cm

(c) 5.25 cm (d) 5.4 cm

12. In a vernier callipers, one main scale division is x cm and n division of the vernier scale coincide with $(n-1)$ divisions of the main scale. The least count (in cm) of the callipers is

(a) $\left(\frac{n-1}{n}\right)x$ (b) $\frac{nx}{(n-1)}$

(c) $\frac{x}{n}$ (d) $\frac{x}{(n-1)}$

41. The speed of light (c), gravitational constant (G) and Planck's constant (h) are taken as the fundamental units in a system. The dimension of time in this new system should be

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

42. If momentum (p), area (A) and time (T) are taken to be fundamental quantities, then energy has the dimensional formula

(a) $[pA^{-1}T^{1}]$ (b) $[p^{2}AT]$

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

43. Consider the following equation of Bernouilli's theorem.

$P+\frac{1}{2}\rho V^2+\rho gh=K$ (constant)

The dimensions of K/P are same as that of which of the following

(a) Thrust (b) Pressure

(c) Angle (d) Viscosity

3. Errors of Measurement

1. If the error in the measurement of radius of a sphere is 2%, then the error in the determination of volume of the sphere will be

(a) 8% (b) 2%

(c) 4% (d) 6%

2. A physical quantity X is given by $X=\frac{2k^3l^2}{m\sqrt{n}}$. The percentage error in the measurements of k, l, m and n are 1%, 2%, 3% and 4% respectively. The value of X is uncertain by

(a) 8% (b) 10%

(c) 12% (d) None of the above

3. A student measures the distance traversed in free fall of a body, initially at rest in a given time. He uses this data to estimate g, the acceleration due to gravity. If the maximum percentage errors in measurement of the distance and the time are e_1 and e_2 respectively, the percentage error in the estimation of g is

(a) e_2-e_1 (b) e_1+2e_2

(c) e_1+e_2 (d) e_1-2e_2

4. Measure of two quantities along with the precision of respective measuring instrument is $A=2.5\,ms^{-1}\pm0.5\,ms^{-1}$, $B=0.10\,s\pm0.01\,s$ The value of AB will be

(a) $(0.25\pm0.08)m$

(b) $(0.25\pm0.5)m$

(c) $(0.25\pm0.05)m$

(d) $(0.25\pm0.135)m$

5. You measure two quantities as $A=1.0\,m\pm0.2\,m$ $B=2.0\,m\pm0.2\,m$ we should report correct value for $\sqrt{AB}$ as

(a) $1.4\,m\pm0.4\,m$ (b) $1.41\,m\pm0.15\,m$

(c) $1.4\,m\pm0.3\,m$ (d) $1.4\,m\pm0.2\,m$

6. The period of oscillation of a simple pendulum is given by $T=2\pi\sqrt{\frac{l}{g}}$ where l is about 100 cm and is known to have $1mm$ accuracy. The period is about $2s$. The time of 100 oscillations is measured by a stop watch of least count 0.1 s. The percentage error in g is

(a) 0.1% (b) 1%

(c) 0.2% (d) 0.8%

7. The numbers 2.745 and 2.735 on rounding off to 3 significant figures will give

(a) 2.75 and 2.74 (b) 2.74 and 2.73

(c) 2.75 and 2.73 (d) 2.74 and 2.74

8. The mass and volume of a body are $4.237\,g$ and $2.5\,cm^3$, respectively. The density of the material of the body in correct significant figures is

(a) $1.6048\,g\,cm^{-3}$ (b) $1.69\,g\,cm^{-3}$

(c) $1.7\,g\,cm^{-3}$ (d) $1.695\,g\,cm^{-3}$

9. The length and breadth of a rectangular sheet are $16.2\,cm$ and $10.1\,cm$, respectively. The area of the sheet in appropriate significant figures and error is

(a) $164\pm3\,cm^2$ (b) $163.62\pm2.6\,cm^2$

(c) $163.6\pm2.6\,cm^2$ (d) $163.62\pm3\,cm^2$

10. Which of the following measurement is most precise

(a) 5.00 mm (b) 5.00 cm

(c) 5.00 m (d) 5.00 km

11. The mean length of an object is $5\,cm$. Which of the following measurements is most accurate

(a) 4.9 cm (b) 4.805 cm

(c) 5.25 cm (d) 5.4 cm

12. In a vernier callipers, one main scale division is x cm and n division of the vernier scale coincide with $(n-1)$ divisions of the main scale. The least count (in cm) of the callipers is

(a) $\left(\frac{n-1}{n}\right)x$ (b) $\frac{nx}{(n-1)}$

(c) $\frac{x}{n}$ (d) $\frac{x}{(n-1)}$

13. Choose the incorrect statement out of the following

(a) Every measurement by any measuring instrument has some error

(b) Every calculated physical quantity that is based on measured values has some error

(c) A measurement can have more accuracy but less precision and vice versa

(d) The percentage error is different from relative error

4. IIT-JEE/AIEEE

1. If L, C and R represent inductance, capacitance and resistance respectively, then which of the following does not represent dimensions of frequency **[1984]**

(a) $\frac{1}{RC}$ (b) $\frac{R}{L}$

(c) $\frac{1}{\sqrt{LC}}$ (d) $\frac{C}{L}$

2. Dimensional formula for angular momentum is **[1983]**

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

(c) MLT^{-1} (d) $M^0L^2T^{-2}$

3. The dimensional formula for the modulus of rigidity is **[1982]**

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

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

4. The dimensional formula for Planck's constant (h) is **[1985]**

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

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

5. Dimensional formula of capacitance (or farad) is **[1983]**

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

(c) $MLT^{-4}A^2$ (d) $M^{-1}L^{-2}T^{-4}A^{-2}$

6. Which of the following groups have different dimensions? **[2005]**

(a) Potential difference, EMF, voltage

(b) Pressure, stress, young's modulus

(c) Heat, energy, work-done

(d) Dipole moment, electric flux, electric field

7. The dimensions of permittivity ε_0 are **[2013]**

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

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

8. Inductance L can be dimensionally represented as **[1983]**

(a) $ML^2T^{-2}A^{-2}$ (b) $ML^2T^{-4}A^{-3}$

(c) $ML^{-2}T^{-2}A^{-2}$ (d) $ML^2T^4A^3$

9. Dimensional formula of magnetic flux is **[1982]**

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

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

10. Dimensional formula for latent heat is **[1983]**

(a) $M^0L^2T^{-2}$ (b) MLT^{-2}

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

11. The quantity $X = \frac{\varepsilon_0 LV}{t}$: ε_0 is the permittivity of free space, L is length, V is potential difference and t is time. The dimensions of X are same as that of **[2001]**

(a) Resistance (b) Charge

(c) Voltage (d) Current

12. In the relation $P = \frac{\alpha}{\beta} e^{-\frac{\alpha Z}{k\theta}}$ P is pressure, Z is the distance, k is Boltzmann's constant and θ is the temperature. The dimensional formula of β will be **[2004]**

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

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

13. A wire has a mass $0.3 \pm 0.003\ g$, radius $0.5 \pm 0.005\ mm$ and length $6 \pm 0.06\ cm$. The maximum percentage error in the measurement of its density is **[2004]**

(a) 1 (b) 2

(c) 3 (d) 4

14. A student measures the time period of 100 oscillations of a simple pendulum four times. That data set is 90 s, 91 s, 95 s and 92 s. If the minimum division in the measuring clock is 1 s, then the reported mean time should be **[2006]**

(a) $92 \pm 5.0s$ (b) $92 \pm 1.8s$

(c) $92 \pm 3s$ (d) $92 \pm 2s$

15. Using the expression $2d \sin\theta = \lambda$, one calculates the values of d by measuring the corresponding angles θ in the range 0 to 90°. The wavelength λ is exactly known and the error in θ is constant for all values of θ. As θ increases from 0° **[2013]**

(a) The absolute error in d remains constant

(b) The absolute error in d increases

(c) The fractional error in d remains constant

(d) The fractional error in d decreases

16. The current voltage relation of diode is given by $I = (e^{1000V/T} - 1)mA$, where the applied voltage V is in volts and the temperature T is in degree Kelvin. If a student makes an error measuring $\pm 0.01\,V$ while measuring the current of 5 mA at 300 K, what will be the error in the value of current in mA **[2014]**

(a) 0.2 mA (b) 0.02 mA

(c) 0.5 mA (d) 0.05 mA

17. A student performs an experiment for determination of $g = \frac{4\pi^2 l}{T^2}$ and he commits an error of Δl. For that he takes the time of n oscillations with the stop watch of least count ΔT and he commits a human error of 0.1 sec. For which of the following data, the measurement of g will be most accurate **[2006]**

Δl	ΔT	n	Ampli. of oscill.
(a) 5 mm	0.2sec	10	5mm
(b) 5 mm	0.2sec	20	5mm
(c) 5 mm	0.1sec	20	1mm
(d) 1 mm	0.1sec	50	1mm

18. A student measured the length of a rod and wrote it as 3.50 cm. Which instrument did he use to measure it? **[2014]**

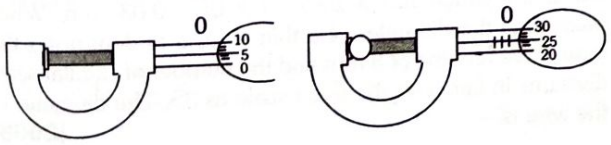
(a) A meter scale

(b) A vernier calliper where the 10 divisions in vernier scale matches with 9 division in main scale and main scale has 10 divisions in 1 cm

(c) A screw gauge having 100 divisions in the circular scale and pitch as 1 mm

(d) A screw gauge having 50 divisions in the circular scale and pitch as 1 mm

19. The circular divisions of shown screw gauge are 50. It moves 0.5 mm on main scale in one rotation. The diameter of the ball is **[2006]**



(a) 2.25 mm (b) 2.20 mm

(c) 1.20 mm (d) 1.25 mm

20. In the determination of Young's modulus $\left(Y = \frac{4MLg}{\pi ld^2}\right)$ by using Searle's method, a wire of length $L = 2m$ and diameter $d = 0.5\,mm$ is used. For a load $M = 2.5\,kg$, an extension $l = 0.25\,mm$ in the length of the wire is observed. Quantities d and l are measured using a screw gauge and a micrometer, respectively. They have the same pitch of 0.5 mm. The number of divisions on their circular scale is 100. The contributions to the maximum probable error of the Y measurement **[2012]**

(a) Due to the errors in the measurements of d and l are the same

(b) Due to the error in the measurement of d is twice that due to the error in the measurement of l

(c) Due to the error in the measurement of l is twice that due to the error in the measurement of d

(d) Due to the error in the measurement of d is four time that due to the error in the measurement of l

21. The density of a solid ball is to be determined in an experiment. The diameter of the ball is measured with a screw gauge, whose pitch is 0.5 mm and there are 50 divisions on the circular scale. The reading on the main scale is 2.5 mm and that on the circular scale is 20 divisions. If the measured mass of the ball has a relative error of 2%, the relative percentage error in the density is **[2011]**

(a) 0.9% (b) 2.4%

(c) 3.1% (d) 4.2%

22. The diameter of a cylinder is measured using a vernier calipers with no zero error. It is found that the zero of the vernier scale lies between 5.10 cm and 5.15 cm of the main scale. The vernier scale has 50 division equivalent to 2.45 cm. The 24^{th} division of the vernier scale exactly coincides with one of the main scale divisions. The diameter of the cylinder is **[2013]**

(a) 5.112 cm (b) 5.124 cm

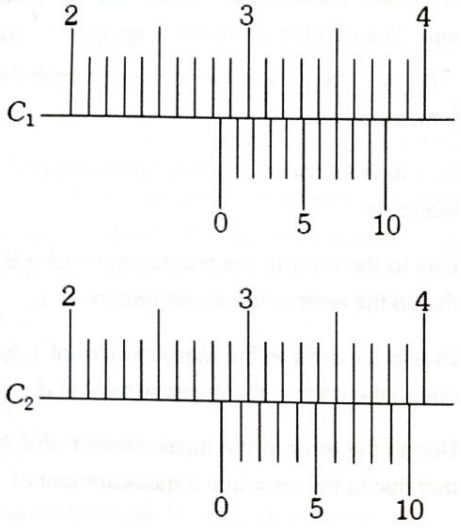
(c) 5.136 cm (d) 5.148 cm

23. A screw gauge with a pitch of 0.5 mm and a circular scale with 50 divisions is used to measure the thickness of a thin sheet of Aluminium. Before starting the measurement, it is found that when the two jaws of the screw gauge are brought in contact, the 45^{th} division coincides with the main scale line and that the zero of the main scale is barely visible. What is the thickness of the sheet if the main scale reading is 0.5 mm and the 25^{th} division coincides with the main scale line **[2016]**

(a) 0.80 mm (b) 0.70 mm

(c) 0.50 mm (d) 0.75 mm

24. There are two Vernier calipers both of which have 1 cm divided into 10 equal divisions on the main scale. The Vernier scale of one of the calipers (C_1) has 10 equal division that correspond to 9 main scale divisions. The Vernier scale of the other caliper (C_2) has 10 equal divisions that correspond to 11 main scale divisions. The readings of the two caliper are shown in the figure. The measured values (in cm) by caliper C_1 and C_2 respectively, are **[2016]**



(a) 2.87 and 2.86 (b) 2.87 and 2.87

(c) 2.87 and 2.83 (d) 2.85 and 2.82

25. The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{\frac{L}{g}}$. Measured value of L is 20.0 *cm* known to 1 mm accuracy and time for 100 oscillations of the pendulum is found to be 90 *s* using a wrist watch of 1 *s* resolution. The accuracy in the determination of g is **[2015]**

(a) 2% (b) 3%

(c) 1% (d) 5%

26. The density of a material in the shape of a cube is determined by measuring three sides of the cube and its mass. If the relative errors in measuring the mass and length are respectively 1.5% and 1% the maximum error in determining the density is **[2018]**

(a) 4.5% (b) 6%

(c) 2.5% (d) 3.5%

27. The dimension of magnetic field in M, L, T and C (coulomb) is given as **[2008]**

(a) $MT^2\,C^{-2}$ (b) $MT^{-1}\,C^{-1}$

(c) $MT^{-2}\,C^{-1}$ (d) $MLT^{-1}\,C^{-1}$

28. Out of the following pairs, which one does not have identical dimensions **[2005]**

(a) Moment of inertia and moment of force

(b) Work and torque

(c) Angular momentum and Planck's constant

(d) Impulse and momentum

29. Which of the two have same dimensions **[2002]**

(a) Force and strain

(b) Force and stress

(c) Angular velocity and frequency

(d) Energy and strain

30. The physical quantities not having same dimensions are **[2003]**

(a) Speed and $(\mu_0\varepsilon_0)^{-1/2}$

(b) Torque and work

(c) Momentum and Planck's constant

(d) Stress and Young's modulus

31. Dimensions of $\frac{1}{\mu_0\varepsilon_0}$, where symbols have their usual meaning, are **[2003]**

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

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

32. The resistance $R=\frac{V}{i}$ where $V=100\pm5$ *volts* and $i=10\pm0.2$ *amperes*. What is the total error in R **[2012]**

(a) 5% (b) 7%

(c) 5.2% (d) $\frac{5}{2}$ %

33. A screw gauge gives the following reading when used to measure the diameter of a wire. **[2011]**

Main scale reading: 0 *mm*

Circular scale reading: 52 divisions

Given that 1 *mm* on main scale corresponds to 100 divisions of the circular scale.

The diameter of wire from the above data is

(a) 0.52 *cm* (b) 0.052 *cm*

(c) 0.026 *cm* (d) 0.005 *cm*

34. In an experiment the angles are required to be measured using an instrument. 29 divisions of the main scale exactly coincide with the 30 divisions of the vernier scale. If the smallest division of the main scale is half-a-degree (=0.5°) then the least count of the instrument is **[2009]**

(a) One minute (b) Half minute

(c) One degree (d) Half degree

35. Two full turns of the circular scale of a screw gauge cover a distance of 1 mm on its main scale. The total number of divisions on the circular scale is 50. Further, it is found that the screw gauge has a zero error of – 0.03 mm. While measuring the diameter of a thin wire, a student notes the main scale reading of 3 mm and the number of circular scale divisions in line with the main scale as 35. The diameter of the wire is **[2008]**

(a) 3.73 *mm* (b) 3.67 *mm*

(c) 3.38 *mm* (d) 3.32 *mm*

36. A spectrometer gives the following reading when used to measure the angle of a prism. **[2012]**

Main scale reading : 58.5 degree

Vernier scale reading : 09 divisions

Given that 1 division on main scale corresponds to 0.5 degree. Total divisions on the vernier scale is 30 and match with 29 divisions of the main scale. The angle of the prism from the above data

(a) 58.59 *Degree* (b) 58.77 *Degree*

(c) 58.65 *Degree* (d) 59 *Degree*

5. NEET/AIPMT

1. If dimensions of critical velocity v_c of a liquid flowing through a tube are expressed as $[\eta^x \rho^y r^z]$, where η, ρ 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 **[2015]**

(a) $-1, -1, 1$ (b) $-1, -1, -1$

(c) $1, 1, 1$ (d) $1, -1, -1$

2. If energy (E), velocity (V) and time (T) are chosen as the fundamental quantities, the dimensional formula of surface tension will be **[2015]**

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

(c) $[E^{-2}V^{-1}T^{-3}]$ (d) $[EV^{-2}T^{-1}]$

3. 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 dimension of length **[2016]**

(a) $\sqrt{\frac{Gc}{h^{3/2}}}$ (b) $\frac{\sqrt{hG}}{c^{3/2}}$

(c) $\frac{\sqrt{hG}}{c^{5/2}}$ (d) $\sqrt{\frac{hc}{G}}$

4. A physical quantity of the dimensions of length that can be formed out of c, G and $\frac{e^2}{4\pi\epsilon_0}$ is [c is velocity of light, G is universal constant of gravitation and e is charge] **[2017]**

(a) $\frac{1}{c^2}\left[G\frac{e^2}{4\pi\epsilon_0}\right]^{1/2}$ (b) $c^2\left[G\frac{e^2}{4\pi\epsilon_0}\right]^{1/2}$

(c) $\frac{1}{c^2}\left[\frac{e^2}{G4\pi\epsilon_0}\right]^{1/2}$ (d) $\frac{1}{c}G\frac{e^2}{4\pi\epsilon_0}$

5. A physical quantity A is related to four observations a, b, c and d as follows, $A = \frac{a^2b^3}{c\sqrt{d}}$. The percentage errors of measurement in a, b, c and d are 1%,3%,2% and 2% respectively. What is the percentage error in the quantity A **[2013]**

(a) 12% (b) 7%

(c) 5% (d) 14%

6. A student measured the diameter of a small steel ball using a screw gauge of least count 0.001 *cm*. The main scale reading is 5 *mm* and zero of circular scale division coincides with 25 division above the reference level. If screw gauge has a zero error of –0.004 *cm*, the correct diameter of the ball is **[2018]**

(a) 0.521 *cm* (b) 0.525 *cm*

(c) 0.053 *cm* (d) 0.529 *cm*

6. AIIMS

1. The difference in the lengths of a mean solar day and a sidereal day is about **[2003]**

(a) 1 *min* (b) 4 *min*

(c) 15 *min* (d) 56 *min*

2. Parsec is a unit of **[2005]**

(a) Distance (b) Velocity

(c) Time (d) Angle

3. The dimensions of universal gravitational constant are **[2000]**

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

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

4. The dimensional formula of angular velocity is **[1998]**

(a) $M^0L^0T^{-1}$ (b) MLT^{-1}

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

5. Planck's constant has the dimensions (unit) of **[1985]**

(a) Energy (b) Linear momentum

(c) Work (d) Angular momentum

6. Dimensions of coefficient of viscosity are **[1993]**

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

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

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

(a) Stress and pressure

(b) Angle and strain

(c) Tension and surface tension

(d) Planck's constant and angular momentum

8. The ratio of the dimension of Planck's constant and that of moment of inertia is the dimension of **[2010]**

(a) Frequency (b) Velocity

(c) Angular momentum (d) Time

9. Dimension of R is **[2005]**

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

(c) $ML^{-1}T^{-2}$ (d) None of these

10. Of the following quantities, which one has dimensions different from the remaining three **[1987]**

(a) Energy per unit volume

(b) Force per unit area

(c) Product of voltage and charge per unit volume

(d) Angular momentum per unit mass

11. Dimensions of permeability are **[2003]**

(a) $A^{-2}M^1L^1T^{-2}$ (b) MLT^{-2}

(c) ML^0T^{-1} (d) $A^{-1}MLT^2$

12. The dimensions of inter atomic force constant are **[1993]**

(a) MT^{-2} (b) MLT^{-1}

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

13. E, m, l and G denote energy, mass, angular momentum and gravitational constant respectively, then the dimensions of $\frac{El^2}{m^5G^2}$ are **[1985]**

(a) Angle (b) Length

(c) Mass (d) Time

14. The dimensions of universal gas constant is **[2010]**

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

(c) $[ML^3T^{-1}\theta^{-1}]$ (d) None of these

15. If the constant of gravitation (G), Planck's constant (h) and the velocity of light (c) be chosen as fundamental units. The dimension of the radius of gyration is **[2008]**

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

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

16. The speed (v) of ripples on the surface of water depends on surface tension (σ), density (ρ) and wavelength (λ). The square of speed (v) is proportional to **[2007]**

(a) $\frac{\sigma}{\rho\lambda}$ (b) $\frac{\rho}{\sigma\lambda}$

(c) $\frac{\lambda}{\sigma\rho}$ (d) $\rho\lambda\sigma$

7. Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below:

(a) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of the assertion.

(c) If assertion is true but reason is false.

(d) If the assertion and reason both are false.

(e) If assertion is false but reason is true.

1. Assertion : The error in the measurement of radius of the sphere is 0.3% The permissible error in its surface area is 0.6%.

Reason : The permissible error is calculated by the formula $\frac{\Delta A}{A} = \frac{4\Delta r}{r}$

2. Assertion : Linear mass density has the dimensions of $[M^1L^{-1}T^0]$.

Reason : Because density is always mass per unit volume but not always.

3. Assertion : Avogadro number is the number of atoms in one gram mole.

Reason : Avogadro number is a dimensionless constant.

4. Assertion : Units of Rydberg constant R is m^{-1}

Reason : It follows from Bohr's formula $\bar{v} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

5. Assertion : Out of three measurements l = 0.7 m; l = 0.70 m and l = 0.700 m, the last one is most accurate.

Reason : In every measurement, only the last significant digit is not accurately known.

6. Assertion : In the relation $f = \frac{1}{2l}\sqrt{\frac{T}{m}}$, where symbols have standard meaning, m represents linear mass density.

Reason : The frequency has the dimensions of inverse of time.

7 Assertion : The time period of a pendulum is given by the formula, $T = 2\pi\sqrt{g/l}$

Reason : According to the principle of homogeneity of dimensions, only that formula is correct in which the dimensions of L.H.S. is equal to dimensions of R.H.S.

1. Units, Dimensions and Measurement – Answers Keys

1. Units

1	c	2	c	3	c	4	d	5	a
6	a	7	b	8	b	9	d	10	d
11	a	12	b	13	d	14	c	15	c
16	c	17	a	18	c	19	d	20	d
21	a	22	c	23	c	24	b	25	c
26	b								

2. Dimensions

1	a	2	c	3	b	4	b	5	b
6	a	7	a	8	c	9	a	10	c
11	d	12	b	13	c	14	d	15	c
16	d	17	c	18	d	19	a	20	a
21	c	22	c	23	a	24	d	25	a
26	d	27	c	28	b	29	d	30	b
31	b	32	d	33	c	34	c	35	a
36	b	37	b	38	a	39	b	40	a
41	a	42	d	43	c				

3. Errors of Measurement

1	d	2	c	3	b	4	a	5	d
6	c	7	d	8	c	9	a	10	a
11	a	12	c	13	d				

4. IIT-JEE/AIEEE

1	d	2	b	3	d	4	c	5	a
6	d	7	b	8	a	9	a	10	a
11	d	12	a	13	d	14	d	15	d
16	a	17	d	18	b	19	c	20	a
21	c	22	b	23	a	24	c	25	b
26	a	27	b	28	a	29	c	30	c
31	d	32	b	33	b	34	a	35	c
36	c								

5. NEET/AIPMT

1	d	2	b	3	b	4	a	5	d
6	d								

6. AIIMS

1	b	2	a	3	b	4	a	5	d
6	c	7	c	8	a	9	b	10	d
11	a	12	a	13	a	14	a	15	a
16	a								

7. Assertion & Reason

1	c	2	c	3	a	4	a	5	b
6	b	7	e						