

PRACTICE EXERCISES

SINGLE CORRECT CHOICE TYPE QUESTIONS

This section contains Single Correct Choice Type Questions. Each question has four choices (A), (B), (C) and (D), out of which ONLY ONE is correct.

- The amount of heat produced in an electric circuit depends upon the current (I), resistance (R) and time (t). If the errors created in the measurements of the above quantities are 2%, 1% and 1% respectively then the maximum possible error will be
 (A) 1% (B) 2%
 (C) 3% (D) 6%
- The ratio of MKS and CGS units of the coefficient of viscosity is
 (A) 10 (B) 10^2
 (C) 10^{-1} (D) 10^{-2}
- The unit of the reduction factor of tangent galvanometer is
 (A) second (B) ampere
 (C) radian (D) tesla
- Which of the following pairs have the same dimensions?
 (A) Pressure, stress and force
 (B) Work, power and power factor
 (C) Impulse and momentum
 (D) Force, impulse and momentum
- The unit of coefficient of viscosity in MKS system is
 (A) $\text{mkg}^{-1}\text{s}^{-1}$ (B) $\text{kgm}^{-1}\text{s}^{-1}$
 (C) $\text{m}^{-1}\text{s}^{-1}$ (D) mkgs
- The unit of Vander Waal's gas constant a in MKS system will be
 (A) $\text{kgm}^5\text{s}^{-1}$ (B) $\text{kgm}^4\text{s}^{-2}$
 (C) $\text{kgm}^5\text{s}^{-2}$ (D) kgm^5s
- The dimensions of $\frac{1}{\sqrt{\mu\epsilon}}$ are equivalent to the dimensions of
 (A) velocity (B) acceleration
 (C) time (D) energy
- How many significant figures are there in the numbers 108.023 and 0.19?
 (A) 6 and 2 (B) 2 and 6
 (C) 3 and 5 (D) 5 and 3
- The number of particles crossing the unit area normal to x -axis per second is represented by the following formula $n = D \frac{n_2 - n_1}{x_2 - x_1}$, where D is the coefficient of diffusion and n_1 and n_2 are the number of molecules per unit volume at x_1 and x_2 , respectively, then the dimensions of D are
 (A) $M^0L^2T^{-1}$ (B) $M^0L^2T^{-2}$
 (C) M^0LT^{-2} (D) M^0LT^{-1}
- The dimensions of $\frac{L}{R}$ and RC are equivalent to the dimensions of
 (A) time (B) frequency
 (C) wavelength (D) energy
- In the formula $V = d^a E^b$, if V , E and d are the velocity of longitudinal waves, bulk modulus of elasticity and density of the gaseous medium respectively, then the values of a and b are respectively.
 (A) $-\frac{1}{2}$ and $\frac{1}{2}$ (B) $\frac{1}{2}$ and $-\frac{1}{2}$
 (C) $\frac{1}{\sqrt{2}}$ and $\frac{1}{\sqrt{2}}$ (D) $\frac{1}{2}$ and $\frac{1}{2}$
- The dimensional formula for $\frac{1}{2}CV^2$ or $\frac{1}{2}q^2/C$ or $\frac{1}{2}qV$ is
 (A) MLT^{-2} (B) ML^2T^{-2}
 (C) ML^2T^2 (D) $ML^{-2}T^{-3}$
- If force (F), length (L) and time (T) are presumed to be the fundamental units, then the dimensional formula of mass will be
 (A) $FL^{-1}T^2$ (B) $FL^{-1}T^{-2}$
 (C) $FL^{-1}T^{-1}$ (D) FL^2T^2
- If L , C and R denote the inductance, capacitance and resistance respectively, the dimensional formula for C^2LR is
 (A) $ML^{-2}T^{-1}$ (B) $M^0L^0T^3$
 (C) $M^{-1}L^{-2}T^6A^2$ (D) $M^0L^0T^2$

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15. 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) $M^0L^1T^{-1}$ (D) $M^0L^1T^{-1}$ and T
16. The potential energy of a particle varies with distance x from a fixed origin as $U = \frac{A\sqrt{x}}{x^2 + B}$, where A and B are dimensional constants then dimensional formula for AB is
 (A) ML^2T^{-2} (B) $ML^{\frac{11}{2}}T^{-2}$
 (C) $M^2L^2T^{-2}$ (D) $ML^{\frac{13}{2}}T^{-3}$
17. Using dimensional analysis you can check on some results. In the integral $\int \frac{dx}{(2ax - x^2)^{1/2}} = a^n \sin^{-1}\left(\frac{x}{a} - 1\right)$ the value of n is
 (A) 1 (B) -1
 (C) 0 (D) $\frac{1}{2}$
18. The equation of the stationary wave is $y = 2a \sin\left(\frac{2\pi ct}{\lambda}\right) \cos\left(\frac{2\pi x}{\lambda}\right)$. Which of the following statements is wrong?
 (A) The unit of ct is same as that of λ
 (B) The unit of x is same as that of λ
 (C) The unit of $\frac{2\pi c}{\lambda}$ is same as that of $\frac{2\pi x}{\lambda t}$
 (D) The unit of $\frac{c}{\lambda}$ is same as that of $\frac{x}{\lambda}$
19. A physical quantity is measured and its value is found to be nu where n is numerical value and u is unit. Then which of the following relations is true
 (A) $n \propto u^2$ (B) $n \propto u$
 (C) $n \propto \sqrt{u}$ (D) $n \propto \frac{1}{u}$
20. In C.G.S. system the magnitude of the force is 100 dyne. In another system where the fundamental physical quantities are kilogram, metre and minute, the magnitude of the force is
 (A) 0.036 (B) 0.36
 (C) 3.6 (D) 36
21. The temperature of a body on Kelvin scale is found to be X K. When it is measured by a Fahrenheit thermometer, it is found to be $X^\circ\text{F}$. Then X is
 (A) 301.25 (B) 574.25
 (C) 313 (D) 40
22. Which relation is incorrect?
 (A) 1 calorie = 4.18 joule (B) $1\text{ \AA} = 10^{-10}$ m
 (C) 1 MeV = 1.6×10^{-13} J (D) 1 newton = 10^{-6} dyne
23. To determine the Young's modulus of a wire, the formula is $Y = \frac{F L}{A \Delta L}$, where L is the length, A is the area of cross-section of the wire, ΔL is the change in length of the wire when stretched with a force F . The conversion factor to change it from CGS to MKS system is
 (A) 1 (B) 10
 (C) 0.1 (D) 0.01
24. Conversion of 1 MW power on a new system having basic units of mass, length and time as 10 kg, 1 dm and 1 minute respectively is
 (A) 2.16×10^{12} unit (B) 1.26×10^{12} unit
 (C) 2.16×10^{10} unit (D) 2×10^{14} unit
25. In two systems, the relations among velocity, acceleration and force are respectively $v_2 = \frac{\alpha^2}{\beta} v_1$, $a_2 = \alpha \beta a_1$ and $F_2 = \frac{F_1}{\alpha \beta}$. If α and β are constants then mass, length and time in two systems are related to each as
 (A) $M_2 = \frac{\alpha}{\beta} M_1$, $L_2 = \frac{\alpha^2}{\beta^2} L_1$, $T_2 = \frac{\alpha^3 T_1}{\beta}$
 (B) $M_2 = \frac{1}{\alpha^2 \beta^2} M_1$, $L_2 = \frac{\alpha^3}{\beta^3} L_1$, $T_2 = T_1 \frac{\alpha}{\beta^2}$
 (C) $M_2 = \frac{\alpha^3}{\beta^3} M_1$, $L_2 = \frac{\alpha^2}{\beta^2} L_1$, $T_2 = \frac{\alpha}{\beta} T_1$
 (D) $M_2 = \frac{\alpha^2}{\beta^2} M_1$, $L_2 = \frac{\alpha}{\beta^2} L_1$, $T_2 = \frac{\alpha^3}{\beta^3} T_1$
26. If the present units of length, time and mass (m, s, kg) are changed to 100 m, 100 s, and $\frac{1}{10}$ kg, then
 (A) the new unit of velocity is increased 10 times
 (B) the new unit of force is decreased $\frac{1}{1000}$ times
 (C) the new unit of energy is increased 10 times
 (D) the new unit of pressure is increased 1000 times
27. Suppose we employ a system in which the unit of mass equals 100 kg, the unit of length equals 1 km and the unit of time 100 s and call the unit of energy eluoj (joule written in reverse order), then

- (A) 1 eluoj = 10^4 joule (B) 1 eluoj = 10^{-3} joule
 (C) 1 eluoj = 10^{-4} joule (D) 1 joule = 10^3 eluoj
28. If $1 \text{ gcms}^{-1} = x \text{ Ns}$, then number x is equivalent to
 (A) 1×10^{-1} (B) 3×10^{-2}
 (C) 6×10^{-4} (D) 1×10^{-5}
29. A highly rigid cubical block A of small mass M and side L is fixed rigidly onto another cubical block B of the same dimensions and of low modulus of rigidity η such that the lower face of A completely covers the upper face of B . The lower face of B is rigidly held on a horizontal surface. A small force F is applied perpendicular to one of the side faces of A . After the force is withdrawn block A executes small oscillations. The time period of which is given by
 (A) $2\pi\sqrt{\frac{M\eta}{L}}$ (B) $2\pi\sqrt{\frac{L}{M\eta}}$
 (C) $2\pi\sqrt{\frac{ML}{\eta}}$ (D) $2\pi\sqrt{\frac{M}{\eta L}}$
30. If the velocity of light (c), gravitational constant (G) and Planck's constant (h) are chosen as fundamental units, then the dimensions of mass in new system is
 (A) $c^{\frac{1}{2}}G^{\frac{1}{2}}h^{\frac{1}{2}}$ (B) $c^{\frac{1}{2}}G^{-\frac{1}{2}}h^{\frac{1}{2}}$
 (C) $c^{\frac{1}{2}}G^{\frac{1}{2}}h^{-\frac{1}{2}}$ (D) $c^{-\frac{1}{2}}G^{\frac{1}{2}}h^{\frac{1}{2}}$
31. If P represents radiation pressure, C represents speed of light and Q represents radiation energy striking a unit area per second, the non-zero integers x , y and z such that $P^x Q^y C^z$ 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 volume V of water passing through a point of a uniform tube during t seconds is related to the cross-sectional area A of the tube and velocity u of water by the relation $V \propto A^\alpha u^\beta t^\gamma$, which one of the following will be true
 (A) $\alpha = \beta = \gamma$ (B) $\alpha \neq \beta = \gamma$
 (C) $\alpha = \beta \neq \gamma$ (D) $\alpha \neq \beta \neq \gamma$
33. Given that the amplitude A of scattered light is
 (i) directly proportional to the amplitude (A_0) of incident light
 (ii) directly proportional to the volume (V) of the scattered particle
 (iii) inversely proportional to the distance (r) from the scattered particle
 (iv) depends upon the wavelength (λ) of the scattered light then
 (A) $A \propto \frac{1}{\lambda}$ (B) $A \propto \frac{1}{\lambda^2}$
 (C) $A \propto \frac{1}{\lambda^3}$ (D) $A \propto \frac{1}{\lambda^4}$
34. Each side a cube is measured to be 7.203 m. The volume of the cube up to appropriate significant figures is
 (A) 373.714 (B) 373.71
 (C) 373.7 (D) 373
35. Candela is the unit of
 (A) acoustic intensity (B) electric intensity
 (C) luminous intensity (D) magnetic intensity
36. The time taken by sunlight to penetrate a window pane is of the order of
 (A) 10^{-5} s (B) 10^{-7} s
 (C) 10^{-11} s (D) 10^{-19} s
37. Which of the following is the unit of latent heat?
 (A) J (B) J mol^{-1}
 (C) J kg^{-1} (D) $\text{J kg}^{-1} \text{mol}^{-1}$
38. The energy E radiated per unit area per second by a black body at temperature T is given by $E = \sigma T^4$, where σ is the Stefan's constant. The dimensions of σ are
 (A) MT^2K^{-2} (B) $MT^{-3}K^{-4}$
 (C) MT^3K^{-4} (D) $ML^4T^{-3}K^{-4}$
39. If length (L), mass (M) and force (F) are taken as fundamental quantities, then the dimensions of time will be
 (A) $M^{\frac{1}{2}}L^{\frac{1}{2}}F^{-\frac{1}{2}}$ (B) $M^{-\frac{1}{2}}L^{\frac{1}{2}}F^{\frac{1}{2}}$
 (C) $M^2L^2T^{-2}$ (D) $MLF^{\frac{1}{2}}$
40. The surface tension of a liquid is 70 dyne cm^{-1} . It may be expressed in MKS as
 (A) 70 Nm^{-1} (B) $7 \times 10^{-2} \text{ Nm}^{-1}$
 (C) $7 \times 10^2 \text{ Nm}^{-1}$ (D) $7 \times 10^3 \text{ Nm}^{-1}$
41. 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) in terms of none of these

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42. The density of a material is 8 gcc^{-1} . In a system in which the unit of length is 5 cm and unit of mass is 20 g, the density of material will be
 (A) 40 (B) 50
 (C) 24 (D) 80
43. erg m^{-1} can be the unit of the measure of
 (A) force (B) momentum
 (C) power (D) acceleration
44. Which one of the following has the dimensions of pressure?
 (A) $\frac{M}{L^2 T^2}$ (B) $\frac{M}{LT}$
 (C) $\frac{ML}{T^2}$ (D) $\frac{M}{LT^2}$
45. In a particular system, the units 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
 (A) 0.1 N (B) 1 N
 (C) 10 N (D) 100 N
46. The dimensions of resistivity in terms of M, L, T and Q are
 (A) $ML^3 T^{-1} Q^{-2}$ (B) $ML^3 T^{-2} Q^{-1}$
 (C) $ML^2 T^{-1} Q^{-1}$ (D) $MLT Q^{-1}$
47. The SI unit of pressure is
 (A) dyne cm^{-2} (B) atmosphere
 (C) pascal (D) cm of Hg
48. A certain physical quantity is calculated from the formula $\frac{\pi}{3}(a^2 - b^2)h$, where h, a and b are all lengths. The quantity being calculated is
 (A) Velocity (B) Length
 (C) Area (D) Volume
49. Joulesecond is a unit of
 (A) energy (B) momentum
 (C) power (D) angular momentum
50. If $x = at + bt^2 + c$, where x is in metre and t in hour (hr), then the unit of a, b and c are
 (A) $\text{m}, \text{mhr}^{-1}, \text{mhr}^{-2}$ (B) $\text{mhr}^{-1}, \text{mhr}^{-2}, \text{m}$
 (C) $\text{m}^2 \text{hr}^{-1}, \text{mhr}^{-1}, \text{m}$ (D) $\text{mhr}^{-2}, \text{mhr}^{-1}, \text{m}$
51. The dimensions of $\frac{1}{\sqrt{\epsilon_0 \mu_0}}$ are those of
 (A) velocity (B) time
 (C) capacitance (D) distance
52. Taking into account the significant figures, the product of 109.832 and 0.6107 should be written as
 (A) 67.0744 (B) 67.1
 (C) 67.07 (D) 67.074402
53. The dimensions of torque are
 (A) $ML^2 T^{-2}$ (B) MLT^2
 (C) MLT^{-1} (D) MT^{-2}
54. Which of the following quantities has the dimensional formula $ML^2 T^{-3}$?
 (A) Bulk modulus
 (B) Coefficient of viscosity
 (C) Energy
 (D) Power
55. The dimensions of the ratio of angular to linear momentum is
 (A) $M^0 L^1 T^0$ (B) $M^1 L^1 T^1$
 (C) $M^1 L^2 T^{-1}$ (D) $M^{-1} L^{-1} T^{-1}$
56. The random error in the arithmetic mean of 100 observations is x . The random error in the arithmetic mean of 400 observations would be
 (A) $4x$ (B) $\frac{x}{4}$
 (C) $2x$ (D) $\frac{x}{2}$
57. The velocity v of a particle is given in terms of time t by the equation $v = at + \frac{b}{t+c}$. The dimensions of a, b, c are respectively
 (A) L^2, T, LT^2 (B) LT^2, LT, L
 (C) LT^{-2}, L, T (D) L, LT, T^2
58. The dimensions of mc^2 are
 (A) MLT^{-1} (B) $ML^2 T^{-1}$
 (C) $ML^2 T^{-2}$ (D) $ML^2 T^2$
59. Which of the following is not a unit of energy?
 (A) Ws (B) kgms^{-1}
 (C) Nm (D) joule
60. 1 micron (μ) is
 (A) 10^{-9} m (B) 10^{-12} m
 (C) 10^{-6} m (D) 10^{-15} m
61. The unit of Stefan's constant σ is
 (A) $\frac{\text{watt}^4}{\text{m}^2 \text{K}^4}$ (B) $\frac{\text{calorie}}{\text{m}^2 \text{K}^4}$
 (C) $\frac{\text{watt}}{\text{m}^2 \text{K}^4}$ (D) $\frac{\text{joule}}{\text{m}^2 \text{K}^4}$
62. Newtonsecond is a unit of
 (A) force (B) impulse
 (C) momentum (D) energy

63. If ΔX is absolute error in the measurement of X and ΔY is absolute error in the measurement of Y , then maximum absolute error in the measurement of difference of X and Y is
 (A) $\pm(\Delta X - \Delta Y)$ (B) $(\Delta X + \Delta Y)$
 (C) $\pm \frac{\Delta X}{\Delta Y}$ (D) $\pm \Delta X \Delta Y$
64. The dimensional formula of universal gravitational constant is
 (A) MLT^{-2} (B) ML^3T^{-2}
 (C) $M^{-1}L^3T^{-2}$ (D) MLT^2
65. If the units of M and L are doubled then the unit of kinetic energy will become
 (A) 8 time (B) 16 time
 (C) 4 time (D) 2 time
66. Dimensional analysis gives
 (A) no information about dimensionless constants
 (B) information about dimensionless constants
 (C) information about dimensionless constants if quantity does not depend upon more than three variables
 (D) information about dimensionless constants if quantity depends upon single variable
67. If force (F), area (A) and density (D) are taken as fundamental quantities, the dimensional formula for Young's modulus will be
 (A) $FA^{-2}D^2$ (B) $FA^{-1}D^0$
 (C) $F^{-1}A^{-1}D^{-1}$ (D) $FA^{-1}D$
68. The dimensions of the coefficient of viscosity are $[ML^{-1}T^{-1}]$. To convert the CGS unit poise (P) to the MKS unit poiseuille (PI), the poise has to be multiplied by
 (A) 10^{-1} (B) 10
 (C) 10^9 (D) 10^7
69. The dimensions of "light-year" are
 (A) LT^{-1} (B) T
 (C) ML^2T^{-2} (D) L
70. The velocity of a particle is given by $v = at^2 + bt + c$. If v is measured in ms^{-1} and t is measured in s , the unit of
 (A) a is ms^{-1}
 (B) b is ms^{-1}
 (C) c is ms^{-1}
 (D) a and b are same but that of c is different
71. The pair having the same dimension is
 (A) angular momentum, work
 (B) work, torque
 (C) potential energy, linear momentum
 (D) kinetic energy, velocity
72. Given that $y = a \cos\left(\frac{t}{p} - qx\right)$, where t represents time in second and x distance in metre. Which of the following statements is true?
 (A) The unit of x is same as that of q .
 (B) The unit of x is same as that of p .
 (C) The unit of t is same as that of q .
 (D) The unit of t is same as that of p .
73. Electronvolt (eV) is a unit of
 (A) charge (B) potential
 (C) energy (D) coulomb repulsion
74. A system has basic dimensions as density $[D]$, velocity $[V]$ and area $[A]$. The dimensional representation of force in this system is
 (A) $[AV^2D]$ (B) $[A^2VD]$
 (C) $[AVD^2]$ (D) $[A^0VD]$
75. A quantity X is given by $\epsilon_0 L \frac{\Delta V}{\Delta t}$, where ϵ_0 is the permittivity of free space, L is a length, ΔV is a potential difference and Δt is a time interval. The dimensional formula for X is the same as that of
 (A) resistance (B) charge
 (C) voltage (D) current
76. The dimensions of time constant $\frac{L}{R}$ during growth and decay of current in an inductive circuit are same as those of
 (A) constant (B) resistance
 (C) current (D) time
77. If the speed of light (c) acceleration due to gravity (g) and pressure (p) are taken as the fundamental quantities, then the dimensions of length will be
 (A) $c^2 g^{-1} p^0$ (B) $cg^0 p^{-1}$
 (C) $c^{-1} gp^0$ (D) $cg^{-1} p^0$
78. If $x = \frac{a}{b}$ and Δa and Δb are the errors in the measurement of a and b , respectively, then the maximum percentage error in the value of x will be

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- (A) $\left(\frac{\Delta a}{a} + \frac{\Delta b}{b}\right) \times 100$ (B) $\left(\frac{\Delta a}{a} - \frac{\Delta b}{b}\right) \times 100$
 (C) $\left(\frac{\Delta a}{a-b} + \frac{\Delta b}{a-b}\right) \times 100$ (D) $\left(\frac{\Delta a}{a-b} - \frac{\Delta b}{a-b}\right) \times 100$
79. If the orbital velocity of a planet is given by $v = G^a M^b R^c$, then
 (A) $a = \frac{1}{3}, b = \frac{1}{3}, c = -\frac{1}{3}$
 (B) $a = \frac{1}{2}, b = \frac{1}{2}, c = -\frac{1}{2}$
 (C) $a = \frac{1}{2}, b = -\frac{1}{2}, c = \frac{1}{2}$
 (D) $a = \frac{1}{2}, b = -\frac{1}{2}, c = -\frac{1}{2}$
80. In an experiment to determine acceleration due to gravity by simple pendulum, a student commits 1% positive error in the measurement of length and 3% negative error in the measurement of time period. The percentage error in the value of g will be
 (A) 7% (B) 10%
 (C) 4% (D) 3%
81. The best method to reduce random errors is
 (A) to change the instrument used for measurement
 (B) to take help of experienced observer
 (C) to repeat the experiment many times and to take the average results
 (D) None of these
82. The least count of an instrument is 0.01 cm. Taking all precautions the most possible error in the measurement can be
 (A) 0.005 cm (B) 0.001 cm
 (C) 0.01 cm (D) 0.02 cm
83. The fundamental frequency of vibration of a stretched string is given by $v = \frac{1}{2l} \sqrt{\frac{T}{m}}$, where the symbols have their usual meanings. The dimensions of m are
 (A) $ML^{-1}T^0$ (B) ML^0T^0
 (C) $ML^{-1}T$ (D) $M^{-1}LT^0$
84. Which of the following pairs has the same dimensions?
 (A) Pressure and density
 (B) Impulse and momentum
 (C) Stress and strain
 (D) Momentum and inertia
85. The dimensions of PV are equivalent to those of
 (A) work (B) force
 (C) pressure (D) volume
86. If ρ is the mean density of the earth, r its radius, g the acceleration due to gravity and G the gravitational constant, on the basis of dimensional consistency, the correct expression is
 (A) $\rho = \frac{3G}{4\pi r g}$ (B) $\rho = \frac{rG}{12\pi g}$
 (C) $\rho = \frac{3g}{4\pi r G}$ (D) $\rho = \frac{3r}{4\pi g G}$
87. The dimension of $\left(\frac{1}{2}\right)\epsilon_0 E^2$ (ϵ_0 : permittivity of free space; E : electric field) is
 (A) MLT^{-1} (B) $ML^{-1}T^{-2}$
 (C) MLT^{-2} (D) ML^2T^{-1}
88. Of the following quantities, which one has dimensions different from the remaining three?
 (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
89. The time dependence of a physical quantity P is given by $P = P_0 \exp(-\alpha t^2)$ where α is a constant and t is time. The constant α
 (A) is dimensionless
 (B) has dimensions of T^{-2}
 (C) has dimensions as that of P
 (D) has dimensions equal to the dimensions of PT^{-2}
90. The dimensional formula of magnetic moment is
 (A) $M^{-2}A$ (B) M^2A
 (C) L^2A (D) $L^{-2}A$
91. If energy E , velocity V and time T are taken as the fundamental units, the dimensional formula for surface tension is
 (A) $EV^{-2}T^{-2}$ (B) $E^{-2}VT^{-2}$
 (C) $E^{-2}V^{-2}T$ (D) $E^{-2}V^{-2}T^{-2}$
92. In the formula $X = 3YZ^2$, X and Z have dimensions of capacitance and magnetic induction respectively. What are the dimensions of Y in MKSQ system?
 (A) $M^{-3}L^{-1}T^3Q^4$ (B) $M^{-3}L^{-2}T^4Q^4$
 (C) $M^{-2}L^{-2}T^4Q^4$ (D) $M^{-3}L^{-2}T^4Q^1$
93. E, m, L, G denote energy, mass, angular momentum and gravitational constant respectively. The dimensions of $\frac{EL^2}{m^5G^2}$ will be that of
 (A) angle (B) length
 (C) mass (D) time

94. Out of the following expressions for the couple per unit twist, time period of a compound pendulum, frequency of a stretched wire and time period of a simple pendulum respectively, the dimensionally inconsistent one is

(A) $C = \frac{\eta\pi r^4}{2l}$ (B) $T = 2\pi\sqrt{\frac{k^2}{g} + \frac{l}{g}}$

(C) $f = \frac{1}{l}\sqrt{\frac{T}{\rho}}$ (D) $T = 2\pi\sqrt{\frac{l}{g}}$

where η is coefficient of rigidity, r is the radius of the wire, K is the radius of gyration, and ρ is mass per unit length and l is the length corresponding to the particular case.

95. In the radioactive decay law $N = N_0 e^{-\lambda t}$, the dimensions of λ are

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

(C) $M^0 L^0 T$ (D) $ML^0 T^{-1}$

96. Planck's constant has the dimensions of
 (A) force (B) energy
 (C) linear momentum (D) angular momentum

97. The SI unit of mobility of charges (μ) is
 (A) $C\text{skg}^{-1}$ (B) $C\text{kgs}^{-1}$
 (C) $C\text{skg}$ (D) $Cs^{-1}\text{kg}^{-1}$

98. 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 the oil is given by $\eta = \frac{p(r^2 - x^2)}{4vl}$ where v is the velocity of oil at a distance x from the axis of the tube. From this relation, the dimensions of viscosity η are

(A) $M^0 L^0 T^0$ (B) MLT^{-1}

(C) $ML^2 T^{-2}$ (D) $ML^{-1} T^{-1}$

99. The SI unit of $\frac{1}{2\pi\sqrt{LC}}$ is equivalent to that of
 (A) time period (B) frequency
 (C) wave length (D) wave number

100. Given that $\tan\theta = \frac{v^2}{rg}$ gives the angle of banking of the cyclist going round the curve. Here v is the speed of cyclist, r is the radius of the curve and g is acceleration due to gravity. Which of the following statements about the relation is true?

- (A) It is both dimensionally as well as numerically correct.
 (B) It is neither dimensionally correct nor numerically correct.
 (C) It is dimensionally correct but not numerically.
 (D) It is numerically correct but not dimensionally.

101. If V denotes the potential difference across the plates of a capacitor of capacitance C , the dimensions of CV^2 are

(A) MLT^{-2}
 (B) M^2LT^{-1}
 (C) ML^2T^{-2}
 (D) not expressible in terms of M, L, T

102. Unit of amplification factor is

(A) ohm (B) mho
 (C) AV^{-1} (D) None of these

103. A physical quantity is represented by the relation $Y = M^a L^b T^{-c}$. If the percentage errors in the measurement of M, L and T are respectively $\alpha\%$, $\beta\%$ and $\gamma\%$, respectively then the total error will be

(A) $(\alpha a + \beta b - \gamma c)\%$ (B) $(\alpha a - \beta b - \gamma c)\%$
 (C) $(\alpha a + \beta b + \gamma c)\%$ (D) $(\alpha a - \beta b + \gamma c)\%$

104. Given that T stands for time period and l stands for the length of simple pendulum. If g is the acceleration due to gravity, then which of the following statements about the relation $T^2 = \left(\frac{l}{g}\right)$ is correct?

- (A) It is correct both dimensionally as well as numerically
 (B) It is neither dimensionally correct nor numerically
 (C) It is dimensionally correct but not numerically
 (D) It is numerically correct but not dimensionally

105. Select the incorrect statement(s).

- (A) If the zero of vernier scale does not coincide with the zero of the main scale, then the vernier calliper is said to be having zero error
 (B) Zero correction has a magnitude equal to zero error but sign is opposite to that of zero error
 (C) Zero error is positive when the zero of vernier scale lies to the left of the zero of the main scale
 (D) Options (B) and (C) are incorrect.

106. 1 cm on the main scale of a vernier calliper is divided into 10 equal parts. If 10 divisions of vernier coincide with 8 small divisions of main scale, then the least count of the calliper is

(A) 0.01 cm (B) 0.02 cm
 (C) 0.05 cm (D) 0.005 cm

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- 107.** The vernier constant of a travelling microscope is 0.001 cm. If 49 main scale divisions coincide with 50 main scale divisions, then the value of 1 main scale division is
 (A) 0.1 mm (B) 0.5 mm
 (C) 0.4 mm (D) 1 mm
- 108.** Which of the following has the largest least count?
 (A) Spherometer (B) Vernier callipers
 (C) Screw gauge (D) Metre scale
- 109.** 1 cm of main scale of a vernier caliper is divided into 10 divisions. The least count of the callipers is 0.005 cm, then the vernier scale must have
 (A) 10 divisions (B) 20 divisions
 (C) 25 divisions (D) 50 divisions
- 110.** Least count of a vernier calliper is $\frac{1}{10N}$ cm. The value of one division on the main scale is 1 mm. Then the number of divisions of the main scale that coincide with N divisions of vernier scale is
 (A) $10N$ (B) $\frac{N}{10}$
 (C) $(N-1)$ (D) $N-10$
- 111.** Each division on the main scale is 1 mm. Which of the following vernier scales give vernier constant equal to 0.01 mm?
 (A) 9 mm divided into 10 divisions
 (B) 90 mm divided into 100 divisions
 (C) 99 mm divided into 100 divisions
 (D) 9 mm divided into 100 divisions
- 112.** The least count of vernier callipers is 0.01 cm. Then the error in the measurement is
 (A) > 0.01 cm (B) ≥ 0.01 cm
 (C) < 0.01 cm (D) ≤ 0.01 cm
- 113.** A person performs an experiment with vernier callipers and takes 100 readings. He repeats the same experiment but now takes 400 readings. Then the probable error is
 (A) the same
 (B) halved
 (C) doubled
 (D) reduced by one fourth
- 114.** Vernier constant is the
 (A) value of one MSD divided by total number of divisions on the main scale
 (B) value of one VSD divided by total number of divisions on the vernier scale
 (C) total number of divisions on the main scale divided by total number of divisions on the vernier scale
 (D) difference between value of one main scale division and one vernier scale division
- 115.** Which of the following uses angular vernier?
 (A) Metre scale (B) Vernier callipers
 (C) Spherometer (D) Both (A) and (B)
- 116.** Screw gauge can measure the diameter of thin wires or similar objects with accuracy upto
 (A) 1 cm (B) 0.1 cm
 (C) 0.01 cm (D) 0.001 cm
- 117.** Pitch of screw of a screw gauge is the
 (A) $\frac{\text{distance moved by thimble on main scale}}{\text{number of rotation of thimble}}$
 (B) $\frac{\text{pitch}}{\text{number of circular scale divisions}}$
 (C) $\frac{\text{number of rotation of thimble}}{\text{number of circular scale divisions}}$
 (D) None of the above
- 118.** Least count of screw gauge is defined as
 (A) $\frac{\text{distance moved by thimble on main scale}}{\text{number of rotation of thimble}}$
 (B) $\frac{\text{pitch of the screw}}{\text{number of circular scale divisions \& head scale}}$
 (C) $\frac{\text{number of rotation of thimble}}{\text{number of circular scale divisions}}$
 (D) None of the above
- 119.** Screw gauge can be used to determine
 (A) Thickness of glass piece
 (B) Diameter of a wire
 (C) To measure thickness of glass piece and to measure diameter of wire
 (D) None of the above
- 120.** Screw gauge contains following scales
 (A) main scale, vernier scale
 (B) main scale, ordinary scale
 (C) main scale, head scale
 (D) only main scale
- 121.** Screw gauge is said to have negative error
 (A) when head scale zeroth division coincides with base line of main scale
 (B) when head scale zeroth division is above with base line of main scale

- (C) when head scale zeroth division is below with base line of main scale
 (D) None of the above
122. For negative error correction is
 (A) positive (B) negative
 (C) no correction (D) None of the above
123. Screw gauge is said to have positive error
 (A) when head scale zeroth division coincides with base line of main scale
 (B) when head scale zeroth division is above with base line of main scale
 (C) when head scale zeroth division is below with base line of main scale
 (D) None of the above
124. For positive error, the correction is
 (A) positive (B) negative
 (C) nil (D) None of the above
125. The diameter D of a wire is measured using screw gauge of zero error. Then
 (A) $D = \left(\begin{array}{c} \text{main} \\ \text{scale} \\ \text{reading} \end{array} \right) + \left(\begin{array}{c} \text{circular} \\ \text{scale} \\ \text{reading} \end{array} \right) \times \left(\begin{array}{c} \text{least} \\ \text{count} \end{array} \right)$
 (B) $D = \left(\begin{array}{c} \text{circular} \\ \text{scale} \\ \text{reading} \end{array} \right) + \left(\begin{array}{c} \text{main} \\ \text{scale} \\ \text{reading} \end{array} \right) \times \left(\begin{array}{c} \text{least} \\ \text{count} \end{array} \right)$
 (C) $D = \left(\begin{array}{c} \text{main} \\ \text{scale} \\ \text{reading} \end{array} \right) + \left(\begin{array}{c} \text{vernier} \\ \text{scale} \\ \text{reading} \end{array} \right) \times \left(\begin{array}{c} \text{least} \\ \text{count} \end{array} \right)$
 (D) None of the above
126. The pitch of a screw gauge is 0.5 mm. Its head scale contains 50 divisions. The least count of the screw gauge is
 (A) 0.01 mm (B) 0.001 mm
 (C) 0.02 mm (D) 0.002 mm
127. Which of the following is correct?
 (A) When the zero of the circular scale advances beyond the reference line, then the zero correction is negative
 (B) When the zero of the circular scale has advanced beyond the reference line, then the zero correction is positive and when the zero of the circular scale is left behind the reference line, then the zero correction is negative
 (C) When the zero of the circular scale is left behind the reference line, then the zero correction is positive
 (D) Both (A) and (C)
128. The vernier of a circular scale has been divided into 30 divisions which coincide with 29 divisions of the main scale, having each division of $\frac{1^\circ}{2}$. The least count of the device is
 (A) $10'$ (B) $30'$
 (C) $0.1'$ (D) $1'$
129. The velocity v of a particle at time t is given by $v = \frac{a}{t} + \frac{bt}{t^2 + c}$. The dimensions of a , b , c are respectively
 (A) LT^{-2} , L , T (B) L , L , T^2
 (C) L , LT , T^{-2} (D) L , L , LT^2
130. What is the unit of k in the relation $U = \frac{ky}{y^2 + a^2}$, where U represents the potential energy, y represents the displacement and a represents the maximum displacement i.e., amplitude?
 (A) ms^{-1} (B) ms
 (C) Jm (D) Js^{-1}
131. For a body moving along x -axis, the distance travelled by body from a reference point is given as function of time t as $x = at^2 + b$, where a and b are constants, then the dimension of \sqrt{ab} is same as
 (A) speed (B) distance travelled
 (C) acceleration (D) None of these
132. If a quantity x is defined by the equation $x = 3CB^2$ where C is capacitance in farad and B represents magnetic field in tesla. The dimensions of x are
 (A) ML^{-2} (B) $ML^{-2}T^{-2}A$
 (C) $ML^{-2}T^{-2}A^2$ (D) $L^{-1}A^{-1}$
133. There are two different quantities A and B having different dimensions. Then which of the following operation is dimensionally correct?
 (A) $A + B$ (B) $A - B$
 (C) $\frac{A}{B}$ (D) $e^{A/B}$
134. The formula $S = ut - \frac{1}{4}at^2$ where S is the distance travelled, u is the initial velocity, a is the acceleration and t is the time is
 (A) dimensionally correct only
 (B) dimensionally incorrect only
 (C) dimensionally and numerically correct
 (D) dimensionally and numerically wrong
135. The dimensional formula of a physical quantity x is $[M^{-1}L^3T^{-2}]$. The error in measuring the quantities M , L and T are 2%, 3% and 4%. The maximum

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- percentage of error that occurs in measuring, the quantity x is
- (A) 9 (B) 10
(C) 14 (D) 19
- 136.** A particle of mass m is executing oscillations about the origin on the x -axis. Its potential energy is $U(x) = K|x|^3$ where K is a positive constant. If the amplitude of oscillation is a then its time period T is
- (A) Proportional to $\frac{1}{\sqrt{a}}$ (B) Independent of a
(C) Proportional to \sqrt{a} (D) Proportional to $a^{3/2}$
- 137.** 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
- (A) $\frac{1}{10}$ N (B) 1 N
(C) 10 N (D) 100 N
- 138.** Force acting on a particle is given by $F = \frac{A-x}{Bt}$, where x is in metre and t is in seconds. The dimensions of B is
- (A) MLT^{-2} (B) $M^{-1}T^{-3}$
(C) $M^{-1}T$ (D) MT^{-1}
- 139.** The viscosity η of a gas depends on the long-range attractive part of the intermolecular force, which varies with molecular separation r according to $F = \mu r^{-n}$ where n is a number and μ is a constant. If η is a function of mass m of the molecules, their mean speed v and the constant μ , then which of following is correct
- (A) $\eta \propto m^{n+1}v^{n+3}\mu^{n-2}$ (B) $\eta \propto m^{\frac{n+1}{n-1}}v^{\frac{n+3}{n-1}}\mu^{\frac{-2}{n-1}}$
(C) $\eta \propto m^n v^{-n} \mu^{-2}$ (D) $\eta \propto m v \mu^{-n}$
- 140.** A science student takes 100 observations in an experiment. Second time he takes 500 observations in the same experiment, by doing so the possible error becomes
- (A) $\frac{1}{5}$ times (B) 5 times
(C) unchanged (D) None of these
- 141.** The dimensions of $\frac{h}{e}$ (h = Planck's constant and e = electronic charge) are same as that of
- (A) magnetic flux (B) electric flux
(C) electric field (D) magnetic field
- 142.** $\frac{E^2}{\mu_0}$ has the dimensions (E = electric field, μ_0 = permeability of free space)
- (A) $[M^2L^3T^{-2}A^2]$ (B) $[MLT^{-4}]$
(C) $[ML^3T^{-2}]$ (D) $[M^{-1}L^2TA^{-2}]$
- 143.** The dimensions of σb^4 (σ = Stefan's constant and b = Wein's constant) are
- (A) $[M^0L^0T^0]$ (B) $[ML^4T^{-3}]$
(C) $[ML^{-2}T]$ (D) $[ML^6T^{-3}]$
- 144.** A quantity X is measured and expressed as $X = Nu$, where N numerical value and u is unit. Which of the following is independent of system of unit chosen?
- (A) N (B) $N \times u$
(C) $\frac{N}{u}$ (D) None of these
- 145.** Which of the following combination of three quantities P , Q , R having different dimension cannot be meaningful?
- (A) $PQ - R$ (B) $PQ - 1$
(C) $\frac{(P-Q)}{R}$ (D) $\frac{PR - Q^2}{QR}$
- 146.** A and B are two physical quantities having different dimensions. Then which of the following operation is dimensionally correct?
- (A) $A + B$ (B) $\log \frac{A}{B}$
(C) $\frac{A}{B}$ (D) $e^{A/B}$
- 147.** For $10^{(at+3)}$, the dimension of a is
- (A) $M^0L^0T^0$ (B) $M^0L^0T^1$
(C) $M^0L^0T^{-1}$ (D) None of these
- 148.** Choose the wrong statement
- (A) The dimensions of $\frac{\omega L}{R}$ are same as that of strain
(B) The dimensions of $\frac{1}{\sqrt{LC}}$ are same as that of angular velocity
(C) The dimension of LCR are same as that of time
(D) None of these
- 149.** After rounding off the number 4621 to 2 significant digits the value becomes
- (A) 4600 (B) 4500
(C) 4700 (D) 4720
- 150.** Which of the following relation cannot be derived using dimensional analysis (Neglect value of constant)

(A) $v = \sqrt{\frac{F}{\mu}}$ (B) $T = 2\pi \sqrt{\frac{l}{g}}$
 (C) $F = 6\pi\eta r v_d$ (D) $F = \frac{Gm_1m_2}{r^2}$

151. Equation of plane progressive transverse wave in a dissipative medium has general form

$$y = Ae^{-\alpha x} \sin \beta(t - Bx)$$

where α , A , B , C are constant, x and y are displacement and t is time. Dimensions of α , β and B respectively are

- (A) $M^0L^{-1}T^0$, $M^0L^{-1}T^{-1}$, M^0LT^{-1}
 (B) $M^0L^1T^0$, $M^0L^0T^{-1}$, $M^0L^{-1}T^1$
 (C) $M^0L^{-1}T^1$, $M^0L^{-1}T$, $M^0L^0T^{-1}$
 (D) $M^0L^{-1}T^0$, $M^0L^0T^{-1}$, $M^0L^{-1}T^1$

152. In a certain system of units, 1 unit of time is 5 sec, 1 unit of mass is 20 kg and unit of length is 10 m. In this system, one unit of power will correspond to

- (A) 16 watt (B) $\frac{1}{16}$ watt
 (C) 25 watt (D) None of these

153. In book, the answer for a particular question is expressed as $b = \frac{ma}{k} \left[\sqrt{1 + \frac{2kl}{ma}} \right]$, where m represents mass, a represents acceleration, l represents length. Then the unit of b should be

- (A) ms^{-1} (B) ms^{-2}
 (C) meter (D) /sec

154. A student performs an experiment to determine the Young's modulus of a wire exactly 2 cm long, by Searle's method. In a particular reading, the student measures the extension in the length of the wire to be 0.8 mm with an uncertainty of ± 0.05 mm at a load of exactly 1 kg. The student also measures the diameter of the wire to be 0.4 mm with an uncertainty of ± 0.01 mm. Take $g = 9.8 \text{ ms}^{-2}$ (exact). The Young's modulus obtained from the reading is

- (A) $(2 \pm 0.3) \times 10^{11} \text{ Nm}^{-2}$
 (B) $(2 \pm 0.2) \times 10^{11} \text{ Nm}^{-2}$
 (C) $(2 \pm 0.1) \times 10^{11} \text{ Nm}^{-2}$
 (D) $(2 \pm 0.05) \times 10^{11} \text{ Nm}^{-2}$

155. The time dependence of physical quantity P is given by $P = P_0 e^{-\alpha t^2 + \beta t + \gamma}$, where α , β , γ are constants and their dimensions are given by (where t is time)

- (A) $M^0L^0T^{-2}$, $M^0L^0T^{-1}$, $M^0L^0T^0$
 (B) M^0L^{-1} , T^{-2} , $M^0L^0T^{-1}$, M^0L^0T
 (C) $M^0L^0T^{-1}$, MLT^{-2} , $M^0L^0T^{-1}$
 (D) M , L , T , MLT^0 , $M^0L^0T^0$

156. The time period of a body under S.H.M. is represented by $T = P^\alpha D^\beta S^\gamma$, where P is pressure, D is density and S is surface tension, then values of α , β and γ are

(Given that surface tension $S = \frac{F}{l}$)

- (A) $-\frac{3}{2}$, $\frac{1}{2}$, 1 (B) 1, 2, $\frac{1}{3}$
 (C) -1, -2, 3 (D) $\frac{1}{2}$, $-\frac{3}{2}$, $-\frac{1}{2}$

157. The relative error in calculating the value of g from the relation $T = 2\pi \sqrt{\frac{l}{g}}$, if the relative errors in calculating T and l are $\pm x$ and $\pm y$ respectively is

- (A) $x + y$ (B) $2x - y$
 (C) $2x + y$ (D) $x - 2y$

158. The dimensions of $\frac{e^2}{4\pi\epsilon_0 hc}$, where e , ϵ_0 , h and c are electronic charge, electric permittivity, Planck's constant and velocity of light in vacuum respectively is

- (A) $[M^0L^0T^0]$ (B) $[M^1L^0T^0]$
 (C) $[M^0L^1T^0]$ (D) $[M^0L^0T^1]$

159. If E be the energy, G is the gravitational constant, I be the impulse and M be the mass, then dimensions of $\frac{GIM^2}{E^2}$ are same as that of

- (A) time (B) mass
 (C) length (D) force

160. The equivalent focal length of a combination of two thin lenses (having focal length f_1 and f_2) can be given by $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$. If errors in measurement of f_1

and f_2 are ± 0.5 cm and ± 0.3 cm and given that $f_1 = f_2$. Then errors in equivalent focal length is

- (A) ± 0.1 (B) ± 0.8
 (C) ± 0.2 (D) ± 0.4

161. If y represents distance and x represents time, dimensions of $\frac{d^2y}{dx^2}$ are

- (A) LT^{-1} (B) L^2T^2
 (C) L^2T^{-1} (D) LT^{-2}

MULTIPLE CORRECT CHOICE TYPE QUESTIONS

This section contains Multiple Correct Choice Type Questions. Each question has four choices (A), (B), (C) and (D), out of which ONE OR MORE is/are correct.

- A student when discussing the properties of a medium (except vacuum) writes

$$\left(\begin{array}{c} \text{Velocity of light} \\ \text{in vacuum} \end{array} \right) = \left(\begin{array}{c} \text{Velocity of light} \\ \text{in medium} \end{array} \right)$$

This formula is

(A) dimensionally correct
 (B) dimensionally incorrect
 (C) numerically incorrect
 (D) dimensionally and numerically correct
- The position of a particle moving along the y -axis is given as $y = At^2 - Bt^3$ where y is measured in metre and t in second. Then

(A) $[A] = LT^{-2}$ (B) $[B] = LT^{-3}$
 (C) $\frac{[A^3]}{[B^2]} = L$ (D) $\frac{[B^3]}{[A^2]} = L$
- Dimensional analysis cannot be used to derive formulae

(A) containing trigonometrical functions
 (B) containing exponential functions
 (C) containing logarithmic functions
 (D) containing dimensionless quantities
- Which of the following is (are) dimensionless?

(A) Refractive index
 (B) Poisson's ratio
 (C) Universal gravitational constant
 (D) Specific gravity
- The equation of the stationary wave is $y = 2A \sin\left(\frac{2\pi ct}{\lambda}\right) \cos\left(\frac{2\pi x}{\lambda}\right)$. Which of the following statement(s) is/are correct?

(A) The unit of ct is same as that of λ
 (B) The unit of x is same as that of λ
 (C) The unit of $2\pi c/\lambda$ is same as that of $2\pi x/\lambda t$
 (D) The unit of c/λ is same as that of x/λ
- Which of the following can be expressed as dynecm^{-2} ?

(A) Pressure
 (B) Longitudinal stress
 (C) Young's modulus of elasticity
 (D) Viscosity
- The pair(s) having same dimensions is/are

(A) Torque and work
 (B) Angular momentum and work
 (C) Energy and Young's modulus
 (D) Light year and wavelength
- The pairs of physical quantities that possess same dimensions is/are

(A) Renold's number and coefficient of friction
 (B) Curie and frequency of light wave
 (C) Latent heat and gravitational potential
 (D) Planck constant and torque
- If dimensions of length are expressed as $G^x c^y h^z$, where G , c and h are the universal gravitational constant, speed of light and Planck constant respectively, then

(A) $x = \frac{1}{2}, y = \frac{1}{2}$ (B) $x = \frac{1}{2}, z = \frac{1}{2}$
 (C) $y = -\frac{3}{2}, z = \frac{1}{2}$ (D) $y = \frac{1}{2}, z = \frac{3}{2}$
- Choose the correct statement(s)

(A) A dimensionally correct equation may be correct
 (B) A dimensionally correct equation may be incorrect
 (C) A dimensionally incorrect equation may be correct
 (D) A dimensionally incorrect equation must be incorrect
- Out of the following unit(s), the one(s) measuring energy is/are

(A) kWhr (B) $(\text{volt})^2(\text{sec})(\text{ohm})^{-1}$
 (C) $(\text{pascal})(\text{foot})^2$ (D) $(\text{weber})(\text{ampere})$
- Consider three quantities; $x = \frac{E}{B}$, $y = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$ and $z = \frac{l}{CR}$. Here l is the length of a wire, C is a capacitance and R is a resistance. All other symbols have standard meanings

(A) x, y have the same dimensions
 (B) x, z have the same dimensions
 (C) y, z have the same dimensions
 (D) None of the three pairs have the same dimensions
- Dimensions of light year are the same as those of

(A) leap year (B) wavelength
 (C) radius of gyration (D) propagation constant
- Which of the following is/are not a unit of time?

(A) parsec (B) light year
 (C) micron (D) second

15. Choose the pairs of physical quantities, which have identical dimensions.
- (A) Impulse and linear momentum
 (B) Planck constant and angular momentum
 (C) Moment of inertia and moment of force
 (D) Young's modulus and pressure
16. The dimensions of energy per unit volume are the same as those of
- (A) work (B) stress
 (C) pressure (D) modulus of elasticity
17. $\left(\frac{B^2}{\mu_0}\right)$ has the same dimensional formula as that of (B is the magnetic field induction and μ_0 is absolute permeability of free space)
- (A) energy density
 (B) magnetic energy per unit volume
 (C) magnetic intensity
 (D) intensity of magnetisation
18. Which of the following is/are correct?
- (A) The term science is derived from a Latin verb which means 'to know'
 (B) The term physics is derived from a Greek word which means 'nature'
 (C) L is the symbol of unit of a physical quantity
 (D) Physics is an exact science because it is based on the experimental measurements
19. In international system of units, there are seven base quantities whose units are defined. Which physical quantities do not have a prefix with their units?
- (A) Amount of substance
 (B) Thermodynamic temperature
 (C) Luminous intensity
 (D) Mass
20. Which of the following is/are the units of mass?
- (A) kgf (B) metric ton
 (C) quintal (D) amu
21. Which of the following can be expressed as Nm^{-2} ?
- (A) Energy density of electric field
 (B) Bulk modulus of elasticity
 (C) Pressure of 1 mm mercury column
 (D) Compressional stress
22. Which of the following physical quantities have dimensions zero in mass, 2 in length and -2 in time?
- (A) Latent heat
 (B) Potential energy per unit mass
 (C) Gravitational potential
 (D) Spring constant
23. Which of the following is/are true regarding significant figures?
- (A) All non-zero digits are significant
 (B) The zeros appearing in the middle of a number are significant, while those at the end of a number without a decimal point are ambiguous
 (C) The powers of 10 are counted while counting the number of significant figures
 (D) Greater the number of significant figures in a measurements smaller is the percentage error
24. Which of the following cannot be considered to be the most accurate?
- (A) 200 m (B) 20×10^1 m
 (C) 2×10^2 m (D) Data insufficient
25. The focal length (f) of a curved mirror is related to the object distance u and the image distance v in accordance with the mathematical relation, $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$. The maximum relative error in calculating the focal length f of the mirror is
- (A) $\frac{\Delta f}{f^2} = \frac{\Delta u}{u^2} + \frac{\Delta v}{v^2}$
 (B) $\frac{\Delta f}{f} = \frac{1}{\Delta u/u} + \frac{1}{\Delta v/v}$
 (C) $\frac{\Delta f}{f} = \frac{uv}{u+v} \left(\frac{\Delta v}{v^2} + \frac{\Delta v}{v^2} \right)$
 (D) $\frac{\Delta f}{f} = \frac{\Delta u}{u} + \frac{\Delta v}{v} + \frac{\Delta u}{u+v} + \frac{\Delta v}{u+v}$
26. In the equation, $y = a \cos\left(\frac{t}{p} - qx\right)$, where t represents time in second and x represents distance in metre. Which of the following statement(s) is/are false?
- (A) The unit of x is same as that of q
 (B) The unit of x is same as that of p
 (C) The unit of t is same as that of q
 (D) The unit of t is same as that of p
27. In the relation, $y = A \sin\left[\frac{2\pi}{\lambda}(ct - x)\right]$, where y and x are measured in metre. Which of the following statement(s) is/are false?
- (A) The unit of λ is same as that of x and A
 (B) The unit of λ is same as that of x but not of A
 (C) The unit of c is same as that of x
 (D) The unit of $(ct - x)$ is same as that of $\frac{2\pi}{\lambda}$

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28. Identify the pair(s) having identical dimensions.
- (A) Linear momentum and moment of force
 (B) Planck constant and angular momentum
 (C) Pressure and modulus of elasticity
 (D) Work and torque
29. Which of the following is/are true?
- (A) The order of magnitude of 501 is 3
 (B) The order of magnitude of 499 is 2
 (C) The order of 2^{30} is nearly 10^{90}
 (D) The unit of reduction factor of a tangent galvanometer is ampere
30. The velocity, acceleration and force in two systems of units are related to each other as under
- (i) $v' = \frac{\alpha^2}{\beta} v$ (ii) $a' = (\alpha\beta)a$
- (iii) $F' = \left(\frac{1}{\alpha\beta}\right)F$

where, all the primed symbols belong to one system of units and the unprimed symbols belong to the other system of units. Here α and β are dimensionless constants. Which of the following is/are correct?

- (A) The standard of length in each of these two systems are related to each other as $l' = \frac{\alpha^3}{\beta^3} l$
- (B) The standard of mass in each of these two systems are related to each other as $m' = \left(\frac{1}{\alpha^2\beta^2}\right)m$
- (C) The standard of time in each of these two systems are related to each other as $t' = \left(\frac{\alpha}{\beta^2}\right)t$
- (D) The standard of momentum in each of these two systems are related to each other as $p' = \left(\frac{1}{\beta^3}\right)p$

REASONING BASED QUESTIONS

This section contains Reasoning type questions, each having four choices (A), (B), (C) and (D) out of which ONLY ONE is correct. Each question contains STATEMENT 1 and STATEMENT 2. You have to mark your answer as

Bubble (A) If both statements are TRUE and STATEMENT 2 is the correct explanation of STATEMENT 1.

Bubble (B) If both statements are TRUE but STATEMENT 2 is not the correct explanation of STATEMENT 1.

Bubble (C) If STATEMENT 1 is TRUE and STATEMENT 2 is FALSE.

Bubble (D) If STATEMENT 1 is FALSE but STATEMENT 2 is TRUE.

- Statement-1:** The light year and wavelength have dimensions of length.

Statement-2: Both light year and wavelength represent distances.
- Statement-1:** The fundamental units selected in a particular system are the velocity of light, $3 \times 10^8 \text{ ms}^{-1}$, acceleration due to gravity is 10 ms^{-2} and the mass of proton is $1.67 \times 10^{-27} \text{ kg}$.

Statement-2: The value of time in such a system is $3 \times 10^7 \text{ s}$.
- Statement-1:** Surface energy stands for energy and not for energy per unit area.

Statement-2: Dimensional formula of surface energy is $[MT^{-2}]$.
- Statement-1:** The density of earth is given by $\rho = \frac{3g}{4\pi R_e G}$, where R_e stands for the radius of earth.

Statement-2: $g = \frac{GM}{R_e^2}$.
- Statement-1:** The value of 1 micron is equal to 10^{-6} m .

Statement-2: Micron is the unit for measuring microscopic distance.
- Statement-1:** The dimensional formula for electrostatic potential is $[ML^2T^{-3}A^{-1}]$.

Statement-2: Electrostatic potential is directly proportional to work done.
- Statement-1:** Distance travelled in a particular second has the dimensions same as that of distance.

Statement-2: Velocity is the displacement covered per unit time.
- Statement-1:** When percentage errors in the measurement of mass and velocity are 1% and 2% respectively, the percentage error in the measure of kinetic energy (E) is 5%.

Statement-2: The relative error in Kinetic Energy or $E = \frac{1}{2}mv^2$ is $\frac{\Delta E}{E} = \frac{\Delta m}{m} + \frac{2\Delta v}{v}$.

9. **Statement-1:** The quantity $\frac{1}{\sqrt{\mu_0 \epsilon_0}}$ is numerically equal to velocity of light and has dimensional formula same as that of velocity.
Statement-2: μ_0 is permeability of free space and ϵ_0 is the permittivity of free space.
10. **Statement-1:** Specific gravity is measured by hygrometer.
Statement-2: Thermometer is an instrument which is used to measure the temperature of a body.
11. **Statement-1:** The error in the measurement of radius of the sphere is 0.3%. The permissible error in its surface area is 0.6%.
Statement-2: The permissible relative error is calculated by the formula $\frac{\Delta A}{A} = 4 \frac{\Delta r}{r}$.
12. **Statement-1:** Pressure can be subtracted from the pressure gradient.
Statement-2: Only like quantities can be added or subtracted from each other.
13. **Statement-1:** Method of dimensions cannot be used for deriving formula containing trigonometrical ratios.
Statement-2: This is because trigonometrical ratios have no dimensions.
14. **Statement-1:** A fundamental quantity is the one that does not depend upon other quantities.
Statement-2: Length, mass and time are derived quantities.
15. **Statement-1:** In any mathematical relation between physical quantities the dimensions on both the sides must be the same.
Statement-2: The dimensions of a physical quantity are the powers raised on fundamental units to obtain the derived units of that physical quantity.
16. **Statement-1:** The unit used for measuring nuclear cross section is barn.
Statement-2: 1 barn = 10^{-4} m^2
17. **Statement-1:** In the relation, $f = \frac{1}{2l} \sqrt{\frac{T}{m}}$ where symbols have usual meanings, m represents linear mass density.
Statement-2: Linear mass density is $m = \frac{\text{Mass}}{\text{Volume}}$
18. **Statement-1:** Avogadro number is a dimensionless constant.
Statement-2: It is number of atoms in 1 gram mole.
19. **Statement-1:** The time period of a simple pendulum is given by the formula, $T = 2\pi \sqrt{\frac{l}{g}}$.
Statement-2: According to the principle homogeneity of dimensional formula, only that formula is correct, where the dimensions of left hand side is equal to the dimensional formula of right hand side.
20. **Statement-1:** AU is a much bigger unit than Å.
Statement-2: 1 AU = $1.5 \times 10^{11} \text{ m}$ and $1 \text{ Å} = 10^{-10} \text{ m}$
21. **Statement-1:** The mass of largest stone that can be moved by flowing river depends on velocity v of river, density ρ and acceleration due to gravity g .
Statement-2: It can be shown that m is proportional to the sixth power of v .
22. **Statement-1:** Pressure has the dimensions same as that of energy density.
Statement-2: Energy density = $\frac{\text{Energy}}{\text{Volume}} = \text{Pressure}$
23. **Statement-1:** The graph between P and Q is a straight line, when $\frac{P}{Q} = \text{constant}$.
Statement-2: The straight line graph means the slope of the graph is constant.
24. **Statement-1:** If $x = \frac{a^\ell b^m}{c^n}$, then $\frac{\Delta x}{x} = \ell \frac{\Delta a}{a} + m \frac{\Delta b}{b} + n \frac{\Delta c}{c}$, where $\frac{\Delta a}{a}$, $\frac{\Delta b}{b}$ and $\frac{\Delta c}{c}$ are the fractional errors in the values of a , b and c , respectively.
Statement-2: The above relation is valid only when $\Delta a \ll a$, $\Delta b \ll b$ and $\Delta c \ll c$.
25. **Statement-1:** If $x = \frac{a^\ell b^m}{c^n}$, then $\frac{\Delta x}{x} = \ell \frac{\Delta a}{a} + m \frac{\Delta b}{b} - n \frac{\Delta c}{c}$, where Δa , Δb and Δc are the increments in the values of a , b and c , respectively.
Statement-2: The above relation is valid only when $\Delta a \ll a$, $\Delta b \ll b$ and $\Delta c \ll c$.

LINKED COMPREHENSION TYPE QUESTIONS

This section contains Linked Comprehension Type Questions or Paragraph based Questions. Each set consists of a Paragraph followed by questions. Each question has four choices (A), (B), (C) and (D), out of which only one is correct. (For the sake of competitiveness there may be a few questions that may have more than one correct options)

Comprehension 1

The following set of quantities have been observed to possess the same dimensional formulae.

- A: Velocity, speed, distance covered in n th second.
 B: Acceleration, retardation, gravitational _____.
 C: Work, energy, heat, internal energy, moment of _____.
 D: Force, thrust, weight, energy _____.
 E: Surface tension, surface _____, spring constant.
 F: Pressure, stress, _____ density, Young's modulus, Bulk modulus.

Based on the above information answer the following questions.

- In B, the blank space is best filled with
 (A) field (B) potential
 (C) intensity (D) force
- In C, the blank space is best filled with
 (A) torque (B) force
 (C) momentum (D) velocity
- In D, the blank space is best filled with
 (A) density (B) rate
 (C) gradient (D) None of these
- In E, the blank space is best filled with
 (A) density (B) energy
 (C) area (D) None of these
- In F, the blank space is best filled with
 (A) energy (B) number
 (C) mass (D) force

Comprehension 2

The vander Waals equation is $\left(p + \frac{a}{V^2}\right)(V - b) = RT$,

where p is pressure, V is molar volume and T is the temperature of the given sample of gas. R is called molar gas constant, a and b are called vander Wall constants.

Based on the above information answer the following questions.

- The dimensional formula for b is same as that for
 (A) p (B) V
 (C) pV^2 (D) RT

- The dimensional formula for a is same as that for
 (A) V^2 (B) p
 (C) pV^2 (D) RT
- 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) $\frac{ab}{V^2}$
- The dimensional formula for $\frac{ab}{RT}$ is
 (A) ML^5T^{-2} (B) $M^0L^3T^0$
 (C) $ML^{-1}T^{-2}$ (D) $M^0L^6T^0$
- The dimensional formula of RT is same as that of
 (A) energy (B) force
 (C) specific heat (D) latent heat

Comprehension 3

Dimensional analysis is a good method to find the dependency of a physical quantity on other physical quantities. Assume that the velocity of light c , universal gravitational constant G and the Plank's constant h be chosen as the fundamental units. Based on the above facts, answer the following questions.

- In this new system, mass will have a dimensional formula given by
 (A) $c^{\frac{1}{2}}G^{-\frac{1}{2}}h^{\frac{1}{2}}$ (B) $c^{\frac{3}{2}}G^{\frac{1}{2}}h^{\frac{1}{2}}$
 (C) $c^{-\frac{5}{2}}G^{\frac{1}{2}}h^{\frac{1}{2}}$ (D) None of these
- In this new system, length will have a dimensional formula given by
 (A) $c^{\frac{1}{2}}G^{-\frac{1}{2}}h^{\frac{1}{2}}$ (B) $c^{\frac{3}{2}}G^{\frac{1}{2}}h^{\frac{1}{2}}$
 (C) $c^{-\frac{5}{2}}G^{\frac{1}{2}}h^{\frac{1}{2}}$ (D) None of these
- In this new system, time will be expressed as
 (A) $c^{\frac{1}{2}}G^{-\frac{1}{2}}h^{\frac{1}{2}}$ (B) $c^{\frac{3}{2}}G^{\frac{1}{2}}h^{\frac{1}{2}}$
 (C) $c^{-\frac{5}{2}}G^{\frac{1}{2}}h^{\frac{1}{2}}$ (D) None of these

Comprehension 4

Measurements always have uncertainties. If you measure the thickness of the cover of the book "MECHANICS-I by RAHUL SARDANA" using an ordinary ruler, then your measurement may be reliable only to the nearest millimeter and your result may be 2 mm (say). It would be absolutely wrong to state this result as 2.00 mm till we are not aware of the limitations of the measuring device. Based on the above facts, answer the following questions.

14. The percentage error in measuring a distance of about 50 cm with a meter stick having callibrations upto 1 mm is
 (A) 0.1% (B) 0.2%
 (C) 0.3% (D) 0.4%
15. The percentage error in measuring a mass of about 1 g with a balance having a least count 0.1 mg is
 (A) 0.04% (B) 0.03%
 (C) 0.02% (D) 0.01%
16. The percentage error in measuring a time interval of 4 minute with a stop watch having least count of 0.2 s is
 (A) 5% (B) 0.06%
 (C) 0.08% (D) 0.10%

Comprehension 5

The following set of quantities have been observed to possess the same dimensional formulae.

- A: _____, Planck's constant and energy per unit _____.
- B: Frequency, angular frequency, angular _____ and _____ gradient.
- C: _____ field strength and _____ potential gradient.
- D: _____ and latent heat.
- E: _____ and strain.

Based on the above information answer the following questions.

17. In A, the blank space is best filled with
 (A) momentum in both blanks
 (B) energy in first blank and angular momentum in the second blank
 (C) angular momentum in first blank and frequency in the second blank
 (D) frequency in the first blank and angular momentum in the second blank
18. In B, the missing blank(s) are best filled as
 (A) speed at both blanks
 (B) speed at first blank, energy at second blank

- (C) energy at first blank, speed at second blank
 (D) energy at both blanks

19. In C, the blank space is best filled by
 (A) electric at both
 (B) electric at first, gravitational at second
 (C) gravitational at first, electric at second
 (D) gravitational at both
20. In D, the blank space is best filled by
 (A) gravitational potential
 (B) kinetic energy per unit mass
 (C) gravitational potential energy per unit mass
 (D) None of these
21. In E, the blank space is best filled by
 (A) angle (B) velocity of light
 (C) fine structure constant (D) Plank's constant

Comprehension 6

A particle is moving along a straight line and variable force F is acting on this F at any time t is given by

$$F = A + \frac{B}{t} + \frac{Ct}{D+t^2}$$

where A , B , C and D are constant. Based on the above facts, answer the following questions.

22. The dimensional formula of C is
 (A) $[MLT^{-2}]$ (B) $[MLT^{-1}]$
 (C) $[MLT^{-3}]$ (D) $[ML]$
23. The dimensions of B is equal to dimensions of
 (A) Force (B) Power
 (C) Linear momentum (D) Energy
24. Dimensions of $\left(\frac{1}{\sqrt{D}}\right)$ is equal to dimension of
 (A) frequency (B) time
 (C) length (D) force

Comprehension 7

Angular velocity of ceiling fan depends upon (i) applied voltage (V), (ii) resistance (R) of the coil of fan, (iii) mass (m) of fan and (iv) length (l) of the fan-blades. Given that the dimensional formula for voltage V is $ML^2T^{-3}A^{-1}$ and the resistance is defined as $R = \frac{V}{i}$, where i is the current flowing. Based on the above facts, answer the following questions.

25. Angular velocity of fan is proportional to
 (A) $R^{-1/3}$ (B) $R^{-2/3}$
 (C) $R^{-3/2}$ (D) None of these

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26. By what factor angular velocity of fan will increase if applied voltage is increase 8 times
 (A) 8 (B) 4
 (C) 2 (D) 3
27. Length of blade of fan is increased from 10 inch to 14.4 inch keeping mass and coil-resistance same. How many times applied voltage needs to be increased as to keep angular velocity constant
 (A) 1.44 times (B) 1.25 times
 (C) 2.07 times (D) 1.2 times

Comprehension 8

The potential energy of a particle varies with distance x from a fixed origin as $U = \frac{A\sqrt{x}}{x+B}$, where A and B are constants. Based on the above facts, answer the following questions.

28. The dimension of AB is
 (A) $ML^{5/2}T^{-2}$ (B) $ML^{3/2}T^{-2}$
 (C) $ML^{1/2}T^{-2}$ (D) $ML^{7/2}T^{-2}$
29. The dimension of $\frac{A}{B^2}$ is
 (A) $ML^{3/2}T^{-2}$ (B) $ML^{1/2}T^{-2}$
 (C) $ML^{-1/2}T^{-2}$ (D) $ML^{-1/2}T^2$
30. The dimension of $\frac{A^2}{B}$ is
 (A) $M^2L^2T^{-2}$ (B) $M^2L^2T^{-4}$
 (C) $M^2L^4T^{-2}$ (D) $M^2L^{-4}T^{-4}$

Comprehension 9

If energy (E), velocity (V) and force (F) be taken as fundamental quantities. Based on the above facts, answer the following questions.

31. Dimensional formula for surface tension is
 (A) E^1V^{-2} (B) $E^{-1}F^2$
 (C) $E^{-1}VF^2$ (D) E^1V^2
32. Dimensional formula for angular momentum is
 (A) $E^{-2}V^1F^1$ (B) $E^{-2}V^1F^{-1}$
 (C) $E^2V^{-1}F^1$ (D) $E^2V^{-1}F^{-1}$
33. Dimensional formula for time is
 (A) $EV^{-1}F^{-1}$ (B) EV^2F^{-1}
 (C) $EV^{-1}F$ (D) EVF^2

Comprehension 10

A gas bubble, from an explosion under water, oscillates with a period T proportional to $p^a d^b E^c$, where p is the static pressure, d is the density of water and E is the total energy of explosion. Based on the above facts, answer the following questions.

34. The value of a is
 (A) $-\frac{5}{6}$ (B) $\frac{1}{2}$
 (C) $-\frac{1}{2}$ (D) 1
35. The value of b is
 (A) $-\frac{5}{6}$ (B) $\frac{1}{2}$
 (C) $-\frac{1}{2}$ (D) 1
36. The value of c is
 (A) $-\frac{5}{6}$ (B) $\frac{1}{2}$
 (C) $\frac{1}{3}$ (D) 1

Comprehension 11

If Force (F), acceleration (A) and time (T) is considered to be fundamental quantities. Based on the above facts, answer the following questions.

37. The dimensions of torque are
 (A) $FA^{-1}T^2$ (B) FA^2T^{-1}
 (C) FAT^{-2} (D) FAT^2
38. The dimensions of velocity are
 (A) AT (B) AT^2
 (C) A^2T (D) FA^2T
39. The dimensions of momentum are
 (A) FT^2 (B) F^2T
 (C) FT (D) FT^{-1}

Comprehension 12

The distance travelled by a particle is given by

$$y = D \ln \left(1 + \frac{At}{\lambda^2} \right) + B \sin(Cx^2)$$

here x and y are length, λ is wavelength and t is time. Based on the above facts, answer the following questions.

40. The dimensions of A and C are
 (A) L^2T^{-1}, L^2 (B) L^2T^{-1}, L^{-2}
 (C) $L^{-2}T^1, L^{-2}$ (D) $L^{-2}T^{-1}, L^2$
41. Which pair has same dimensions
 (A) A, B (B) B, C
 (C) C, D (D) B, D

Comprehension 13

If pressure of a gas is given by

$$P = \frac{\alpha^2}{\beta} \sin\left(\frac{\alpha h}{k_B \theta}\right)$$

where h is the Plank's constant

k_B is the Boltzmann constant

θ is the absolute temperature

Based on the above facts, answer the following questions.

42. The dimensions of β are
 (A) $[M^1L^0T^0]$ (B) $[M^0L^0T^0]$
 (C) $[M^{-1}LT^0]$ (D) None of these
43. Which of the following is not dimensionless
 (A) αt (B) $\frac{\beta P}{\alpha^2}$
 (C) $\frac{h}{k\theta}$ (D) $\frac{BI}{L^2}$
- (I : Moment of inertia, L : length and t : time)

Comprehension 14

The equation of state of gas is

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

here, P is the pressure, V is the volume, T is the absolute temperature and a , b and R are constants. Based on the above facts, answer the following questions.

44. The dimensions of a are
 (A) ML^5T^{-2}
 (B) ML^5T^2
 (C) MLT
 (D) $M^2L^5T^{-2}$
45. The dimensions of b are
 (A) MLT
 (B) $M^0L^3T^0$
 (C) ML^3T^0
 (D) ML^3T^1
46. The dimensions of R are
 (A) $ML^2T^{-2}K$
 (B) $ML^2T^{-2}K^{-1}$
 (C) $MLT^{-2}K^{-1}$
 (D) $MLT^{-2}K$

MATRIX MATCH/COLUMN MATCH TYPE QUESTIONS

Each question in this section contains statements given in two columns, which have to be matched. The statements in **COLUMN-I** are labelled A, B, C and D, while the statements in **COLUMN-II** are labelled p, q, r, s (and t). Any given statement in **COLUMN-I** can have correct matching with **ONE OR MORE** statement(s) in **COLUMN-II**. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following examples:

If the correct matches are $A \rightarrow p, s$ and t ; $B \rightarrow q$ and r ; $C \rightarrow p$ and q ; and $D \rightarrow s$ and t ; then the correct darkening of bubbles will look like the following:

	p	q	r	s	t
A	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
B	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
C	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

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1. Match the following

Column-I	Column-II
(A) $\frac{R}{L}$	(p) Time
(B) CR	(q) Frequency
(C) $\frac{E}{B}$	(r) Speed
(D) $\frac{1}{\mu_0 \epsilon_0}$	(s) Kinetic energy
	(t) Kinetic energy per unit mass

2. Match the following

Column-I	Column-II
(A) Stress	(p) Pressure
(B) Strain	(q) Energy density
(C) Modulus of elasticity	(r) Angle
(D) Torque	(s) Energy
	(t) Fine structure constant

3. Match the following

Column-I	Column-II
(A) Specific heat	(p) $ML^2T^{-2}K^{-1}$
(B) Boltzmann's constant	(q) $MT^{-3}K^{-4}$
(C) Wien's constant	(r) LK
(D) Stefan's constant	(s) $L^2T^{-2}K^{-1}$
	(t) $ML^2T^{-3}K^{-4}$

4. Match the units/dimensions in COLUMN-I with the physical quantities in COLUMN-II

Column-I	Column-II
(A) ML^2T^{-1}	(p) Impulse
(B) Js	(q) Planck's constant
(C) MLT^{-1}	(r) Angular momentum

Column-I	Column-II
(D) Energy per unit frequency	(s) Linear momentum
	(t) $\sqrt{2mE}$

5. Match the units given in COLUMN-I with the physical quantities in COLUMN-II

Column-I	Column-II
(A) Nm^{-2}	(p) Force constant
(B) Nm^{-1}	(q) Surface energy of a liquid
(C) Nm	(r) Stress
(D) $kg\,s^{-2}$	(s) Bulk modulus
	(t) Torque

6. Match COLUMN-I with COLUMN-II

Column-I	Column-II
(A) Dimensionless quantity	(p) Angle
(B) Young's modulus	(q) Mechanical equivalent of heat
(C) $Jcal^{-1}$	(r) $kg\,m^{-1}s^{-2}$
(D) pascal	(s) Thermal conductivity
	(t) Fine structure constant (α)

7. Match the units/dimensions in COLUMN-I with the physical quantities/expressions in COLUMN-II

Column-I	Column-II
(A) Jkg^{-1}	(p) $\frac{k_B T}{m}$
(B) $M^0L^2T^{-2}K^{-1}$	(q) Mean square velocity
(C) $M^0L^2T^{-2}$	(r) Latent heat
(D) JK^{-1}	(s) Specific heat
	(t) Entropy

(Continued)

8. Match the following

Column-I	Column-II
(A) Stress	(p) Pressure
(B) Strain	(q) Energy density
(C) Modulus of elasticity	(r) Angle
(D) Torque	(s) Energy
	(t) Renold's number (n_R)

(All symbols used have their standard meanings)

9. Some physical quantities are given in **COLUMN-I** and some possible SI units in which these quantities may be expressed are given in **COLUMN-II**. Match the physical quantities in **COLUMN-I** with the units in **COLUMN-II**.

Column-I	Column-II
(A) $GM_e M_s$ G—universal gravitational constant, M_e —mass of the earth, M_s —mass of the sun.	(p) (volt) (coulomb) (metre)
(B) $\frac{3RT}{M}$ R—universal gas constant, T—absolute temperature, M—molar mass.	(q) (kilogram) (metre) ³ (second) ⁻²
(C) $\frac{F^2}{q^2 B^2}$ F—force, q—charge, B—magnetic field.	(r) (metre) ² (second) ⁻²
(D) $\frac{GM_e}{R_e}$ G—universal gravitational constant, M_e —mass of the earth, R_e —radius of the earth.	(s) (farad) (volt) ² (kg) ⁻¹

10. Match the following

Column-I	Column-II
(A) Young's modulus	(p) $L^2 T^{-2}$
(B) Gravitational potential	(q) $M^{-1} L^3 T^{-2}$
(C) Latent heat	(r) $ML^{-1} T^{-2}$
(D) Gravitational constant	(s) $ML^2 T^{-2}$

11. Match the following

Column-I	Column-II
(A) Coefficient of viscosity	(p) Dimensionless
(B) Strain	(q) Unitless
(C) Angle	(r) $ML^{-1} T^{-1}$
(D) Stress	(s) $ML^{-1} T^{-2}$

12. In the column given below:

- C stands for capacitance
- R stands for resistance
- k stands for Boltzmann constant
- c stands for speed of light
- e stands for electronic charge
- H stands for Henry

Column-I	Column-II
(A) $\frac{e^2}{2h\epsilon_0 c}$	(p) Joule
(B) $\sqrt{\frac{R^2 C^2}{\mu_0 \epsilon_0}}$	(q) Dimensionless
(C) $k_B T$	(r) m^{-1}
(D) $\frac{e^4 m}{8\epsilon_0^2 h^3 c}$	(s) Unitless

13. Match the physical quantities given in **COLUMN-I** with dimensional formula expressed in **COLUMN-II** in tabular form

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Column-I	Column-II
(A) Coefficient of viscosity	(p) MLT^{-1}
(B) Angular momentum	(q) ML^2T^{-2}
(C) Torque	(r) LT^{-1}
(D) $\frac{1}{\sqrt{\mu_0\epsilon_0}}$	(s) $ML^{-1}T^{-1}$

14. Match the physical quantities given in **COLUMN-I** with unit expressed in **COLUMN-II** in tabular form

Column-I	Column-II
(A) Pressure	(p) Watt
(B) Power	(q) Pascal
(C) Charge	(r) Hertz
(D) Frequency	(s) Coulomb

15. Match the following

Column-I	Column-II
(A) Young's modulus	(p) L^2T^{-2}
(B) Gravitational potential	(q) $M^{-1}L^3T^{-2}$
(C) Latent heat	(r) $ML^{-1}T^{-2}$
(D) Gravitational constant	(s) ML^2T^{-2}

16. Match the following

Column-I	Column-II
(A) Electric potential	(p) $ML^2T^{-2}A^{-2}$
(B) Resistance	(q) $ML^2T^{-3}A^{-1}$
(C) Capacitance	(r) $ML^2T^{-3}A^{-2}$
(D) Inductance	(s) $M^{-1}L^{-2}T^4A^2$

17. Match the following

Column-I	Column-II
(A) Coefficient of viscosity	(p) Dimensionless
(B) Strain	(q) Unitless
(C) Angle	(r) $ML^{-1}T^{-1}$
(D) Stress	(s) $ML^{-1}T^{-2}$

18. The Stefan-Boltzman's constant is not a fundamental constant and one can write it in terms of fundamental constant and written as $\sigma = ah^\alpha C^\beta G^\gamma k_B^\delta$, a is dimensionless constant, h is planck constant, C is speed of light, G is universal gravitational constant and k_B is Boltzman constant.

Column-I	Column-II
(A) α	(p) -2
(B) β	(q) -3
(C) γ	(r) 4
(D) δ	(s) 0

19. Match **COLUMN-I** with **COLUMN-II** in regard to dimensions of physical quantities mentioned in **COLUMN-I** and dimensions of physical quantities in **COLUMN-II**.

Column-I	Column-II
(A) Kinetic energy	(p) Pressure
(B) Energy density	(q) Torque
(C) Planck constant	(r) Angular momentum
(D) Efficiency of carnot cycle	(s) Longitudinal strain

INTEGER/NUMERICAL ANSWER TYPE QUESTIONS

In this section, the answer to each question is a numerical value obtained after doing series of calculations based on the data given in the question(s).

1. The dimensional formula of $\frac{EJ^2}{M^5G^2}$, where E , M , J and G denote energy, mass, angular momentum and gravitational constant is $M^aL^bT^c$. Then find values of a , b , c .

2. The quantity $\frac{e^x}{2h\epsilon_0c}$ has dimensional formula $M^0L^0T^0$. Calculate x .

3. The rate of flow (V) of a liquid flowing through a pipe of radius r and pressure gradient p is given by Poiseuille's equation

$$V = \frac{\pi r^x}{8 \eta^z} p^y$$

Then calculate x , y , z .

4. A new system is formed such that it uses force, energy and velocity as fundamental quantities with units

20 N, 200 J and 5 ms^{-1} . Calculate the units of mass, length and time in this new system.

5. Consider a new system of units in which the unit of mass is α kg, unit of length is β m and that of time is γ s. The value of calorie in the new system is calculated to be $4.2\alpha^{-x}\beta^{-y}\gamma^z$. Find the values of x , y , z .

6. According to Kepler's Laws of planetary motion, the planets move around the sun in nearly circular orbits. Assuming that the period of rotation depends upon radius of the orbit (r), mass of sun (M) and Universal Gravitational Constant (G) as

$$T^a = 4\pi^2 \frac{r^b}{M^c G^d}$$

Find a , b , c and d .

ARCHIVE: JEE MAIN

1. [Online April 2019]

In SI units, the dimensions of $\sqrt{\frac{\epsilon_0}{\mu_0}}$ is

- (A) $AT^2M^{-1}L^{-1}$ (B) $AT^{-3}ML^{\frac{3}{2}}$
(C) $A^{-1}TML^3$ (D) $A^2T^3M^{-1}L^{-2}$

2. [Online April 2019]

If Surface tension (S), Moment of inertia (I) and Planck's constant (h), were to be taken as the fundamental units, the dimensional formula for linear momentum would be

- (A) $S^{\frac{1}{2}}I^{\frac{3}{2}}h^{-1}$ (B) $S^{\frac{3}{2}}I^{\frac{1}{2}}h^0$
(C) $S^{\frac{1}{2}}I^{\frac{1}{2}}h^{-1}$ (D) $S^{\frac{1}{2}}I^{\frac{1}{2}}h^0$

3. [Online April 2019]

In a simple pendulum experiment for determination of acceleration due to gravity (g), time taken for 20 oscillations is measured by using a watch of 1 second least count. The mean value of time taken comes out to be 30 s. The length of pendulum is measured by using a meter scale of least count 1 mm and the value obtained is 55.0 cm. The percentage error in the determination of g is close to

- (A) 6.8% (B) 0.2%
(C) 3.5% (D) 0.7%

4. [Online April 2019]

In the density measurement of a cube, the mass and edge length are measured as (10.00 ± 0.10) kg and (0.10 ± 0.01) m, respectively. The error in the measurement of density is

- (A) 2100 kgm^{-3} (B) 3100 kgm^{-3}
(C) 6400 kgm^{-3} (D) 1100 kgm^{-3}

5. [Online April 2019]

The area of a square is 5.29 cm^2 . The area of 7 such squares taking into account the significant figures is

- (A) 37.03 cm^2 (B) 37.0 cm^2
(C) 37.030 cm^2 (D) 37 cm^2

6. [Online April 2019]

In the formula $X = 5YZ^2$, X and Z have dimensions of capacitance and magnetic field, respectively. What are the dimensions of Y in SI units?

- (A) $[M^{-2}L^{-2}T^6A^3]$ (B) $[M^{-1}L^{-2}T^4A^2]$
(C) $[M^{-2}L^0T^{-4}A^{-2}]$ (D) $[M^{-3}L^{-2}T^8A^4]$

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7. [Online April 2019]

Which of the following combinations has the dimension of electrical resistance (ϵ_0 is the permittivity of vacuum and μ_0 is the permeability of vacuum)?

- (A) $\sqrt{\frac{\epsilon_0}{\mu_0}}$ (B) $\frac{\epsilon_0}{\mu_0}$
 (C) $\sqrt{\frac{\mu_0}{\epsilon_0}}$ (D) $\frac{\mu_0}{\epsilon_0}$

8. [Online January 2019]

The pitch and the number of divisions, on the circular scale, for a given screw gauge are 0.5 mm and 100 respectively. When the screw gauge is fully tightened without any object, the zero of its circular scale lies 3 divisions below the mean line. The readings of the main scale and the circular scale, for a thin sheet, are 5.5 mm and 48 respectively, the thickness of this sheet is

- (A) 5.725 mm (B) 5.740 mm
 (C) 5.755 mm (D) 5.950 mm

9. [Online January 2019]

Expression for time in terms of G (universal gravitational constant), h (Planck constant) and c (speed of light) is proportional to

- (A) $\sqrt{\frac{Gh}{c^5}}$ (B) $\sqrt{\frac{c^3}{Gh}}$
 (C) $\sqrt{\frac{Gh}{c^3}}$ (D) $\sqrt{\frac{hc^5}{G}}$

10. [Online January 2019]

The density of a material in SI units is 128 kgm^{-3} . In certain units in which the unit of length is 25 cm and the unit of mass is 50 g, the numerical value of density of the material is

- (A) 640 (B) 410
 (C) 40 (D) 16

11. [Online January 2019]

The diameter and height of a cylinder are measured by a meter scale to be $12.6 \pm 0.1 \text{ cm}$ and $34.2 \pm 0.1 \text{ cm}$, respectively. What will be the value of its volume in appropriate significant figures?

- (A) $4264 \pm 81 \text{ cm}^3$ (B) $4300 \pm 80 \text{ cm}^3$
 (C) $4260 \pm 80 \text{ cm}^3$ (D) $4264.4 \pm 81.0 \text{ cm}^3$

12. [Online January 2019]

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 β is

- (A) $M^0L^2T^{-4}$ (B) M^2LT^{-4}
 (C) MLT^{-2} (D) $M^2L^2T^{-2}$

13. [Online January 2019]

If speed (V), acceleration (A) and force (F) are considered as fundamental units, the dimension of Young's modulus will be

- (A) $V^{-2}A^2F^{-2}$ (B) $V^{-2}A^2F^2$
 (C) $V^{-4}A^2F$ (D) $V^{-4}A^{-2}F$

14. [Online January 2019]

The least count of the main scale of a screw gauge is 1 mm. The minimum number of divisions on its circular scale required to measure $5 \mu\text{m}$ diameter of a wire is

- (A) 200 (B) 50
 (C) 100 (D) 500

15. [Online January 2019]

Let l , r , c and v represent inductance, resistance, capacitance and voltage, respectively. The dimension of $\frac{1}{rcv}$ in SI units will be

- (A) $[A^{-1}]$ (B) $[LA^{-2}]$
 (C) $[LT^2]$ (D) $[LTA]$

16. [2018]

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

- (A) 2.5% (B) 3.5%
 (C) 4.5% (D) 6%

17. [Online 2018]

In a screw gauge, 5 complete rotations of the screw cause it to move a linear distance of 0.25 cm. There are 100 circular scale divisions. The thickness of a wire measured by this screw gauge gives a reading of 4 main scale divisions and 30 circular scale divisions. Assuming negligible zero error, the thickness of the wire is

- (A) 0.3150 cm (B) 0.2150 cm
 (C) 0.4300 cm (D) 0.0430 cm

18. [Online 2018]

The relative error in the determination of the surface area of a sphere is α . Then the relative error in the determination of its volume is

- (A) $\frac{3}{2}\alpha$ (B) α
 (C) $\frac{5}{2}\alpha$ (D) $\frac{2}{3}\alpha$

19. [Online 2018]

The characteristic distance at which quantum gravitational effects are significant, the Planck length, can be determined from a suitable combination of the fundamental physical constants G , \hbar and c . Which of the following correctly gives the Planck length?

- (A) $G\hbar^2c^3$ (B) $G^2\hbar c$
 (C) $\left(\frac{G\hbar}{c^3}\right)^{1/2}$ (D) $G^{1/2}\hbar^2c$

20. [Online 2018]

The percentage errors in quantities P , Q , R and S are 0.5%, 1%, 3% and 1.5% respectively in the measurement of a physical quantity $A = \frac{P^3Q^2}{\sqrt{RS}}$. The maximum percentage error in the value of A will be

- (A) 6.5% (B) 8.5%
 (C) 6% (D) 7.5%

21. [Online 2018]

The relative uncertainty in the period of a satellite orbiting around the earth is 10^{-2} . If the relative uncertainty in the radius of the orbit is negligible, the relative uncertainty in the mass of the earth is

- (A) 6×10^{-2} (B) 10^{-2}
 (C) 2×10^{-2} (D) 3×10^{-2}

22. [Online 2017]

Time (T), velocity (C) and angular momentum (h) are chosen as fundamental quantities instead of mass, length and time. In terms of these, the dimensions of mass would be

- (A) $[M] = [TC^{-2}h]$ (B) $[M] = [T^{-1}C^{-2}h^{-1}]$
 (C) $[M] = [T^{-1}C^{-2}h]$ (D) $[M] = [T^{-1}C^2h]$

23. [Online 2017]

A physical quantity P is described by the relation $P = a^{1/2}b^2c^3d^{-4}$. If the relative errors in the measurement of a , b , c and d respectively, are 2%, 1%, 3% and 5%, then the relative error in P will be

- (A) 25% (B) 12%
 (C) 8% (D) 32%

24. [2016]

A student measures the time period of 100 oscillations of a simple pendulum four times. The 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

- (A) 92 ± 2 s (B) 92 ± 5 s
 (C) 92 ± 1.8 s (D) 92 ± 3 s

25. [Online 2016]

In the following ' I ' refers to current and other symbols have their usual meaning. Choose the option that corresponds to the dimensions of electrical conductivity

- (A) $M^{-1}L^{-3}T^3I$ (B) $M^{-1}L^{-3}T^3I^2$
 (C) $M^{-1}L^3T^3I$ (D) $ML^{-3}T^{-3}I^2$

26. [Online 2016]

A , B , C and D are four different physical quantities having different dimensions. None of them is dimensionless. But we know that the equation $AD = C \ln(BD)$ holds true. Then which of the combination is not a meaningful quantity?

- (A) $\frac{C}{BD} - \frac{AD^2}{C}$ (B) $A^2 - B^2C^2$
 (C) $\frac{A}{B} - C$ (D) $\frac{(A-C)}{D}$

27. [Online 2015]

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

- (A) $u = \frac{e^2c}{\hbar a_0}$ (B) $u = \frac{e^2\hbar}{ca_0}$
 (C) $u = \frac{e^2a_0}{\hbar c}$ (D) $u = \frac{\hbar c}{e^2a_0}$

28. [Online 2015]

If electronic charge e , electron mass m , speed of light in vacuum c and Planck's constant h are taken as fundamental quantities, the permeability of vacuum μ_0 can be expressed in units of

- (A) $\left(\frac{\hbar c}{me^2}\right)$ (B) $\left(\frac{h}{me^2}\right)$
 (C) $\left(\frac{h}{ce^2}\right)$ (D) $\left(\frac{mc^2}{\hbar e^2}\right)$

29. [Online 2015]

A beaker contains a fluid of density ρ kgm^{-3} , specific heat S $\text{Jkg}^{-1} \text{ }^\circ\text{C}^{-1}$ and viscosity η . The beaker is filled up to height h . To estimate the rate of heat transfer per

unit area $\left(\frac{\dot{Q}}{A}\right)$ by convection when beaker is put on a hot plate, a student proposes that it should depend on η , $\left(\frac{S\Delta\theta}{h}\right)$ and $\left(\frac{1}{\rho g}\right)$ when $\Delta\theta$ (in $^\circ\text{C}$) is the difference in the temperature between the bottom and top of the fluid. In that situation the correct option for $\left(\frac{\dot{Q}}{A}\right)$ is

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- (A) $\eta \frac{S\Delta\theta}{h}$ (B) $\eta \left(\frac{S\Delta\theta}{h} \right) \left(\frac{1}{\rho g} \right)$
 (C) $\frac{S\Delta\theta}{\eta h}$ (D) $\left(\frac{S\Delta\theta}{\eta h} \right) \left(\frac{1}{\rho g} \right)$

30. [2014]

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

- (A) A screw gauge having 50 divisions in the circular scale and pitch as 1 mm.
 (B) A meter scale.
 (C) 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.
 (D) A screw gauge having 100 divisions in the circular scale and pitch as 1 mm.

31. [2013]

Let $[\epsilon_0]$ denote the dimensional formula of the permittivity of vacuum. If $M =$ mass, $L =$ length, $T =$ time and $A =$ electric current, then

- (A) $[\epsilon_0] = [M^{-1}L^2T^{-1}A]$
 (B) $[\epsilon_0] = [M^{-1}L^{-3}T^2A]$
 (C) $[\epsilon_0] = [M^{-1}L^{-3}T^4A^2]$
 (D) $[\epsilon_0] = [M^{-1}L^2T^{-1}A^{-2}]$

32. [2012]

Resistance of a given wire is obtained by measuring the current flowing in it and the voltage difference applied across it. If the percentage errors in the measurement of the current and the voltage difference are 3% each, then error in the value of resistance of the wire is

- (A) zero (B) 1%
 (C) 3% (D) 6%

33. [2010]

The respective number of significant figures for the numbers 23.023, 0.0003 and 2.1×10^{-3} are

- (A) 4, 4, 2 (B) 5, 1, 2
 (C) 5, 1, 5 (D) 5, 5, 2

ARCHIVE: JEE ADVANCED

Single Correct Choice Type Problems

In this section each question has four choices (A), (B), (C) and (D), out of which ONLY ONE is correct.

1. [JEE (Advanced) 2017]

Consider an expanding sphere of instantaneous radius R whose total mass remains constant. The expansion is such that the instantaneous density ρ remains uniform throughout the volume. The rate of fractional change in density $\left(\frac{1}{\rho} \frac{d\rho}{dt} \right)$ is constant. The velocity v of any point of the surface of the expanding sphere is proportional to

- (A) R (B) $\frac{1}{R}$
 (C) R^3 (D) $R^{\frac{2}{3}}$

2. [JEE (Advanced) 2017]

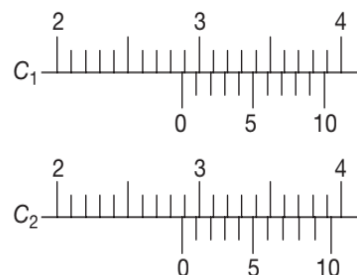
A person measures the depth of a well by measuring the time interval between dropping a stone and receiving the sound of impact with the bottom of the well. The error in his measurement of time is $\delta T = 0.01$ s and he measures the depth of the well to be $L = 20$ m. Take the acceleration due to gravity $g = 10 \text{ ms}^{-2}$ and

the velocity of sound is 300 ms^{-1} . Then the fractional error in the measurement, $\frac{\delta L}{L}$, is closest to

- (A) 1% (B) 5%
 (C) 3% (D) 0.2%

3. [JEE (Advanced) 2016]

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



- (A) 2.87 and 2.86 (B) 2.87 and 2.87
 (C) 2.87 and 2.83 (D) 2.85 and 2.82

4. [JEE (Advanced) 2013]

The diameter of a cylinder is measured using a vernier callipers 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 24th division of the vernier scale exactly coincides with one of the main scale divisions.

The diameter of the cylinder is

- (A) 5.112 cm (B) 5.124 cm
 (C) 5.136 cm (D) 5.148 cm

5. [IIT-JEE 2012]

In the determination of Young's modulus $\left(Y = \frac{4MLg}{\pi ld^2} \right)$

by using Searle's method, a wire of length $L = 2$ m 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 is

- (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 times that due to the error in the measurement of l .

6. [IIT-JEE 2011]

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

- (A) 0.9% (B) 2.4%
 (C) 3.1% (D) 4.2%

7. [IIT-JEE 2010]

A vernier callipers has 1 mm marks on the main scale. It has 20 equal divisions on the vernier scale which match with 16 main scale divisions. For this vernier callipers, the least count is

- (A) 0.02 mm (B) 0.05 mm
 (C) 0.1 mm (D) 0.2 mm

8. [IIT-JEE 2008]

Students I, II and III perform an experiment for measuring the acceleration due to gravity (g) using a simple pendulum. They use different lengths of the pendulum and/or record time for different number of oscillations. The observations are shown in the table.

Least count for length = 0.1 cm, Least count for time = 0.1 s

Student	Length of the pendulum (cm)	Number of oscillations (n)	Total time for (n) oscillations (s)	Time period (s)
I	64.0	8	128.0	16.0
II	64.0	4	64.0	16.0
III	20.0	4	36.0	9.0

If E_I , E_{II} and E_{III} are the percentage errors in g , i.e.,

$\left(\frac{\Delta g}{g} \times 100 \right)$ for students I, II and III respectively

- (A) $E_I = 0$ (B) E_I is minimum
 (C) $E_I = E_{II}$ (D) E_{II} is maximum

9. [IIT-JEE 2007]

A student performs an experiment to determine the Young's modulus of a wire, exactly 2 m long, by Searle's method. In a particular reading, the student measures the extension in the length of the wire to be 0.8 mm with an uncertainty of ± 0.05 mm at a load of exactly 1 kg. The student also measures the diameter of the wire to be 0.4 mm with an uncertainty of ± 0.01 mm. Take $g = 9.8 \text{ ms}^{-2}$ (exact). The young's modulus obtained from the reading is close to

- (A) $(2 \pm 0.3) 10^{11} \text{ Nm}^{-2}$
 (B) $(2 \pm 0.2) \times 10^{11} \text{ Nm}^{-2}$
 (C) $(2 \pm 0.1) \times 10^{11} \text{ Nm}^{-2}$
 (D) $(2 \pm 0.05) \times 10^{11} \text{ Nm}^{-2}$

10. [IIT-JEE 2007]

In the experiment to determine the speed of sound using a resonance column

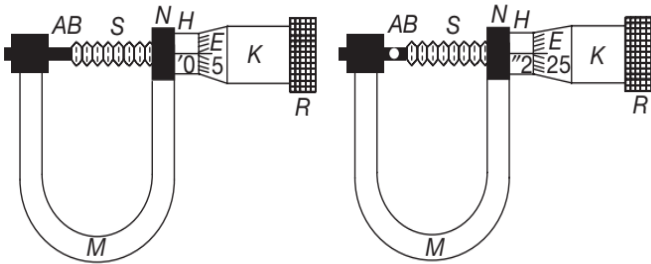
- (A) prongs of the tuning fork are kept in a vertical plane.
 (B) prongs of the tuning fork are kept in a horizontal plane.

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- (C) in one of the two resonances observed, the length of the resonating air column is close to the wavelength of sound in air.
- (D) in one of the two resonances observed, the length of the resonating air column is close to half of the wavelength of sound in air.

11. [IIT-JEE 2006]

The circular scale of a screw gauge has 50 divisions and pitch of 0.5 mm. Find the diameter of sphere. Main scale reading is 2.



- (A) 1.2 mm (B) 1.25 mm
(C) 2.20 mm (D) 2.25 mm

12. [IIT-JEE 2006]

A student performs an experiment for determination of $g \left(= \frac{4\pi^2 l}{T^2} \right)$, $l \approx 1 \text{ m}$, and he commits an error of Δl . For T he takes the time of n oscillations with the stop watch of least count ΔT and he commits a human error of 0.1 s. For which of the following data, the measurement of g will be most accurate.

- (A) $\Delta L = 0.5$, $\Delta T = 0.1$, $n = 20$
(B) $\Delta L = 0.5$, $\Delta T = 0.1$, $n = 50$
(C) $\Delta L = 0.5$, $\Delta T = 0.01$, $n = 20$
(D) $\Delta L = 0.1$, $\Delta T = 0.05$, $n = 50$

13. [IIT-JEE 2005]

Which of the following sets have different dimensions?

- (A) Pressure, Young's modulus, Stress
(B) Emf, Potential difference, Electric Potential
(C) Heat, Work done, Energy
(D) Dipole moment, Electric flux, Electric field

14. [IIT-JEE 2004]

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

- (A) 1 (B) 2
(C) 3 (D) 4

15. [IIT-JEE 2004]

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

- (A) $[M^0 L^2 T^0]$ (B) $[M^1 L^2 T^1]$
(C) $[M^1 L^0 T^{-1}]$ (D) $[M^0 L^2 T^{-1}]$

16. [IIT-JEE 2003]

A cube has a side of length $1.2 \times 10^{-2} \text{ m}$. Calculate its volume

- (A) $1.7 \times 10^{-6} \text{ m}^3$ (B) $1.73 \times 10^{-6} \text{ m}^3$
(C) $1.70 \times 10^{-6} \text{ m}^3$ (D) $1.732 \times 10^{-6} \text{ m}^3$

17. [IIT-JEE 2001]

A quantity X is given by $\epsilon_0 L \frac{\Delta V}{\Delta t}$, where ϵ_0 is the permittivity of free space, L is a length, ΔV is a potential difference and Δt is a time interval. The dimensional formula for X is the same as that of

- (A) resistance (B) charge
(C) voltage (D) current

18. [IIT-JEE 2000]

The dimension of $\left(\frac{1}{2} \right) \epsilon_0 E^2$ (ϵ_0 : permittivity of free space; E : electric field) is

- (A) MLT^{-1} (B) $ML^{-1}T^{-2}$
(C) MLT^{-2} (D) ML^2T^{-1}

19. [IIT-JEE 1995]

In the formula $X = 3YZ^2$, X and Z have dimensions of capacitance and magnetic induction respectively. What are the dimensions of Y in MKSQ system?

- (A) $M^{-3}L^{-1}T^3Q^4$ (B) $M^{-3}L^{-2}T^4Q^4$
(C) $M^{-2}L^{-2}T^4Q^4$ (D) $M^{-3}L^{-2}T^4Q^1$

20. [IIT-JEE 1992]

A highly rigid cubical block A of small mass M and side L is fixed rigidly onto another cubical block B of the same dimensions and of low modulus of rigidity η such that the lower face of A completely covers the upper face of B . The lower face of B is rigidly held on a horizontal surface. A small force F is applied perpendicular to one of the side faces of A . After the force is withdrawn block A executes small oscillations. The time period of which is given by

- (A) $2\pi\sqrt{\frac{M\eta}{L}}$ (B) $2\pi\sqrt{\frac{L}{M\eta}}$
 (C) $2\pi\sqrt{\frac{ML}{\eta}}$ (D) $2\pi\sqrt{\frac{M}{\eta L}}$

21. [IIT-JEE 1991]

If L , R , C and V respectively represent inductance resistance, capacitance and potential difference, then the dimensions of $\frac{L}{RCV}$ are the same as those of

- (A) current (B) $\frac{1}{\text{current}}$
 (C) charge (D) $\frac{1}{\text{charge}}$

22. [IIT-JEE 1990]

If E , M , J and G respectively denote energy, mass, angular momentum and gravitational constant, then $\frac{EJ^2}{M^5G^2}$ has the dimensions of

- (A) length (B) angle
 (C) mass (D) time

Multiple Correct Choice Type Problems

In this section each question has four choices (A), (B), (C) and (D), out of which ONE OR MORE is/are correct.

1. [JEE (Advanced) 2019]

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?

- (A) The dimension of force is L^{-3}
 (B) The dimension of power is L^{-5}
 (C) The dimension of linear momentum is L^{-1}
 (D) The dimension of energy is L^{-2}

2. [JEE (Advanced) 2016]

A length-scale (l) depends on the permittivity (ϵ) of a dielectric material. Boltzmann's constant (k_B), the absolute temperature (T), the number per unit volume (n) of certain charged particles and the charge (q) carried by each of the particles. Which of the following expression(s) for l is(are) dimensionally correct?

- (A) $l = \sqrt{\left(\frac{nq^2}{\epsilon k_B T}\right)}$ (B) $l = \sqrt{\left(\frac{\epsilon k_B T}{nq^2}\right)}$
 (C) $l = \sqrt{\left(\frac{q^2}{\epsilon n^{2/3} k_B T}\right)}$ (D) $l = \sqrt{\left(\frac{q^2}{\epsilon n^{1/3} k_B T}\right)}$

3. [JEE (Advanced) 2016]

In an experiment to determine the acceleration due to gravity g , the formula used for the time period of a periodic motion is $T = 2\pi\sqrt{\frac{7(R-r)}{5g}}$. The values

of R and r are measured to be (60 ± 1) mm and (10 ± 1) mm, respectively. In five successive measurements, the time period is found to be 0.52 s, 0.56 s, 0.57 s, 0.54 s and 0.59 s. The least count of the watch used for the measurement of time period is 0.01 s. Which of the following statement(s) is(are) true?

- (A) The error in the measurement of r is 10%
 (B) The error in the measurement of T is 3.57%
 (C) The error in the measurement of T is 2%
 (D) The error in the determined value of g is 11%

4. [JEE (Advanced) 2015]

Planck's constant h , speed of light c and gravitational constant G are used to form a unit of length L and a unit of mass M . Then the correct option(s) is(are)

- (A) $M \propto \sqrt{c}$ (B) $M \propto \sqrt{G}$
 (C) $L \propto \sqrt{h}$ (D) $L \propto \sqrt{G}$

5. [JEE (Advanced) 2015]

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)

- (A) $\mu_0 I^2 = \epsilon_0 V^2$ (B) $\epsilon_0 I = \mu_0 V$
 (C) $I = \epsilon_0 c V$ (D) $\mu_0 c I = \epsilon_0 V$

6. [JEE (Advanced) 2015]

Consider a vernier calliper in which each 1 cm on the main scale is divided into 8 equal divisions and a screw gauge with 100 divisions on its circular scale. In the vernier callipers, 5 divisions of the Vernier scale coincide with 4 divisions on the main scale and in the screw gauge, one complete rotation of the circular scale moves it by two divisions on the linear scale. Then

- (A) if the pitch of the screw gauge is twice the least count of the Vernier callipers, the least count of the screw gauge is 0.01 mm
 (B) if the pitch of the screw gauge is twice the least count of the vernier calliper, the least count of the screw gauge is 0.05 mm
 (C) if the least count of the linear scale of the screw gauge is twice the least count of the vernier callipers, the least count of the screw gauge is 0.01 mm.
 (D) if the least count of the linear scale of the screw gauge is twice the least count of the Vernier calliper, the least count of the screw gauge is 0.005 mm.

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7. [JEE (Advanced) 2010]

A student uses a simple pendulum of exactly 1 m length to determine g , the acceleration due to gravity. He uses a stop watch with the least count of 1 s for this and records 40 s for 20 oscillations. For this observation, which of the following statement(s) is/are true?

- (A) Error ΔT in measuring T , the time period, is 0.05 s
 (B) Error ΔT in measuring T , the time period, is 1 s
 (C) Percentage error in the determination of g is 5%
 (D) Percentage error in the determination of g is 2.5%

8. [IIT-JEE 1998]

Let $[\epsilon_0]$ denotes the dimensional formula of the permittivity of the vacuum and $[\mu_0]$ that of the permeability of the vacuum. If $M = \text{mass}$, $L = \text{length}$, $T = \text{Time}$ and $I = \text{electric current}$, then

- (A) $[\epsilon_0] = M^{-1}L^{-3}T^2I$ (B) $[\epsilon_0] = M^{-1}L^{-3}T^4I^2$
 (C) $[\mu_0] = MLT^{-2}I^{-2}$ (D) $[\mu_0] = ML^2T^{-1}I$

9. [IIT-JEE 1998]

The SI unit of the inductance, the henry can be written as

- (A) $\frac{\text{weber}}{\text{ampere}}$ (B) $\frac{\text{volt-second}}{\text{ampere}}$
 (C) $\frac{\text{joule}}{(\text{ampere})^2}$ (D) ohm-second

10. [IIT-JEE 1995]

The pairs of physical quantities that possess same dimensions is/are

- (A) Reynold's number and coefficient of friction
 (B) Curie and frequency of light wave
 (C) Latent heat and gravitational potential
 (D) Planck's constant and torque

11. [IIT-JEE 1992]

If the dimensions of length are expressed as $G^x c^y h^z$; where G , c and h are the universal gravitational constant, speed of light and Planck's constant respectively, then

- (A) $x = \frac{1}{2}$, $y = \frac{1}{2}$ (B) $x = \frac{1}{2}$, $z = \frac{1}{2}$
 (C) $y = \frac{1}{2}$, $z = \frac{3}{2}$ (D) $y = -\frac{3}{2}$, $z = \frac{1}{2}$

12. [IIT-JEE 1986]

The pair(s) having same dimensions is/are

- (A) Torque and work
 (B) Angular momentum and work

- (C) Energy and Young's modulus
 (D) Light year and wavelength

13. [IIT-JEE 1984]

L , C and R represent the physical quantities inductance, capacitance and resistance respectively. The combinations which have the dimensions of frequency are

- (A) $\frac{1}{RC}$ (B) $\frac{R}{L}$
 (C) $\frac{1}{\sqrt{LC}}$ (D) $\frac{C}{L}$

Linked Comprehension Type Problems

This section contains Linked Comprehension Type Questions or Paragraph based Questions. Each set consists of a Paragraph followed by questions. Each question has four choices (A), (B), (C) and (D), out of which only one is correct. (For the sake of competitiveness there may be a few questions that may have more than one correct options)

Comprehension 1

[JEE (Advanced) 2018]

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 $[\epsilon_0]$ 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 above paragraph, the question given below is one of them).

1. The relation between $[E]$ and $[B]$ is

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

2. The relation between $[\epsilon_0]$ and $[\mu_0]$ is

- (A) $[\mu_0] = [\epsilon_0][L]^2[T]^{-2}$
 (B) $[\mu_0] = [\epsilon_0][L]^{-2}[T]^2$
 (C) $[\mu_0] = [\epsilon_0]^{-1}[L]^2[T]^{-2}$
 (D) $[\mu_0] = [\epsilon_0]^{-1}[L]^{-2}[T]^2$

Comprehension 2

[JEE (Advanced) 2018]

If the measurement errors in all the independent quantities are known, then it is possible to determine the error in any dependent quantity. This is done by the use of series expansion and truncating the expansion at the first power of the error. For example, consider the relation $z = \frac{x}{y}$. If the

errors in x , y and z are Δx , Δy and Δz respectively,

$$\text{then } z \pm \Delta z = \frac{x \pm \Delta x}{y \pm \Delta y} = \frac{x}{y} \left(1 \pm \frac{\Delta x}{x} \right) \left(1 \pm \frac{\Delta y}{y} \right)^{-1}.$$

The series expansion for $\left(1 \pm \frac{\Delta y}{y} \right)^{-1}$, to first power in $\frac{\Delta y}{y}$, is $1 \mp \left(\frac{\Delta y}{y} \right)$. The relative errors in independent variables are always added. So, the error in z will be

$$\Delta z = z \left(\frac{\Delta x}{x} + \frac{\Delta y}{y} \right)$$

The above derivation makes the assumption that $\frac{\Delta x}{x} \ll 1$, $\frac{\Delta y}{y} \ll 1$. Therefore, the higher powers of these quantities are neglected.

(There are two questions based on above paragraph, the question given below is one of them)

3. Consider the ratio $r = \frac{(1-a)}{(1+a)}$ to be determined by measuring a dimensionless quantity a . If the error in the measurement of a is $\Delta a \left(\frac{\Delta a}{a} \ll 1 \right)$, then what is the error Δr in determining r ?

- (A) $\frac{\Delta a}{(1+a)^2}$ (B) $\frac{2\Delta a}{(1+a)^2}$
 (C) $\frac{2\Delta a}{(1-a)^2}$ (D) $\frac{2a\Delta a}{(1-a)^2}$

4. In an experiment, the initial number of radioactive nuclei is 3000. It is found that 1000 ± 40 nuclei decayed in the first 1 s. For $|x| \ll 1$, $\ln(1+x) = x$ up to first power in x . The error $\Delta \lambda$, in the determination of the decay constant λ in s^{-1} , is

- (A) 0.04 (B) 0.03
 (C) 0.02 (D) 0.01

Comprehension 3

[JEE (Advanced) 2011]

A dense collection of equal number of electrons and positive ions is called neutral plasma. Certain solids containing fixed positive ions surrounded by free electrons can be treated as neutral plasma. Let N be the number density of free electrons, each of mass m . When the electrons are subjected to an electric field, they are displaced relatively away from the heavy positive ions. If the electric field becomes zero, the electrons begin to oscillate about the positive ions with a natural angular frequency ω_p , which is called the plasma frequency.

To sustain the oscillations, a time varying electric field needs to be applied that has an angular frequency ω , where a part of the energy is absorbed and a part of it is reflected. As ω approaches ω_p , all the free electrons are set to resonance together and all the energy is reflected. This is the explanation of high reflectivity of metals.

5. Taking the electronic charge as e and the permittivity as ϵ_0 , use dimensional analysis to determine the correct expression for ω_p

- (A) $\sqrt{\frac{Ne}{m\epsilon_0}}$ (B) $\sqrt{\frac{m\epsilon_0}{Ne}}$
 (C) $\sqrt{\frac{Ne^2}{m\epsilon_0}}$ (D) $\sqrt{\frac{m\epsilon_0}{Ne^2}}$

6. Estimate the wavelength at which plasma reflection will occur for a metal having the density of electrons $N \approx 4 \times 10^{27} \text{ m}^{-3}$. Take $\epsilon_0 \approx 10^{-11}$ and $m \approx 10^{-30}$, where these quantities are in proper SI units
 (A) 800 nm (B) 600 nm
 (C) 300 nm (D) 200 nm

Matrix Match/Column Match Type Questions

Each question in this section contains statements given in two columns, which have to be matched. The statements in **COLUMN-I** are labelled A, B, C and D, while the statements in **COLUMN-II** are labelled p, q, r, s (and t). Any given statement in **COLUMN-I** can have correct matching with **ONE OR MORE** statement(s) in **COLUMN-II**. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following examples:

If the correct matches are $A \rightarrow p, s$ and t ; $B \rightarrow q$ and r ; $C \rightarrow p$ and q ; and $D \rightarrow s$ and t ; then the correct darkening of bubbles will look like the following:

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	p	q	r	s	t
A	(p)	(q)	(r)	(s)	(t)
B	(p)	(q)	(r)	(s)	(t)
C	(p)	(q)	(r)	(s)	(t)
D	(p)	(q)	(r)	(s)	(t)

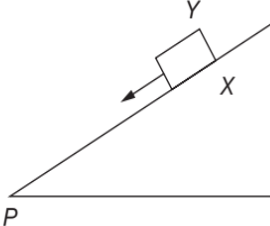
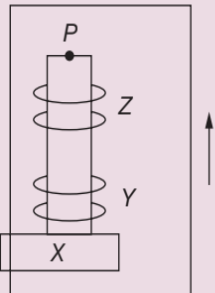
1. [IIT-JEE 2009]

COLUMN-II gives certain systems undergoing a process. COLUMN-I suggests changes in some of the parameters related to the system. Match the statements in COLUMN-I to the appropriate process(es) from COLUMN-II.

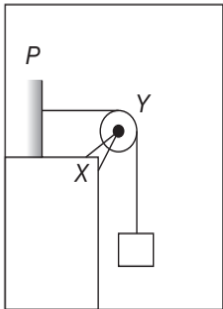
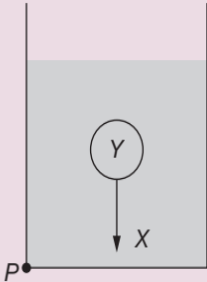
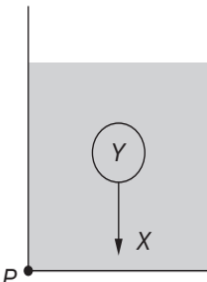
COLUMN-I	COLUMN-II
(A) The energy of the system is increased.	(p) System: A capacitor, initially uncharged. Process: It is connected to a battery.
(B) Mechanical energy is provided to the system, which is converted into energy of random motion of its parts.	(q) System: A gas in an adiabatic container fitted with an adiabatic piston. Process: The gas is compressed by pushing the piston.
(C) Internal energy of the system is converted into its mechanical energy.	(r) System: A gas in a rigid container. Process: The gas gets cooled due to colder atmosphere surrounding it.
(D) Mass of the system is decreased.	(s) System: A heavy nucleus, initially at rest. Process: The nucleus fissions into two fragments of nearly equal masses and some neutrons are emitted.
	(t) System: A resistive wire loop. Process: The loop is placed in a time varying magnetic field perpendicular to its plane.

2. [IIT-JEE 2009]

COLUMN-II shows five systems in which two objects are labelled as X and Y . Also in each case a point P is shown. COLUMN-I gives some statements about X and/or Y . Match these statements to the appropriate system(s) from COLUMN-II.

COLUMN-I	COLUMN-II
(A) The force exerted by X on Y has a magnitude Mg .	(p) Block Y of mass M left on a fixed inclined plane X , slides on it with a constant velocity. <div style="text-align: center;">  </div>
(B) The gravitational potential energy of X is continuously increasing.	(q) Two ring magnets Y and Z , each of mass M , are kept in frictionless vertical plastic stand so that they repel each other. Y rests on the base X and Z hangs in air in equilibrium. P is the topmost point of the stand on the common axis of the two rings. The whole system is in a lift that is going up with a constant velocity. <div style="text-align: center;">  </div>

(Continued)

COLUMN-I	COLUMN-II
(C) Mechanical energy of the system X + Y is continuously decreasing.	<p>(r) A pulley Y of mass m_0 is fixed to a table through a clamp X. A block of mass M hangs from a string that goes over the pulley and is fixed at point P of the table. The whole system is kept in a lift that is going down with a constant velocity.</p> 
(D) The torque of the weight of Y about point P is zero.	<p>(s) A sphere Y of mass M is put in a non-viscous liquid X kept in a container at rest. The sphere is released and it moves down in the liquid.</p> 
	<p>(t) A sphere Y of mass M is falling with its terminal velocity in a viscous liquid X kept in a container.</p> 

3. [IIT-JEE 2007]

Some physical quantities are given in COLUMN-I and some possible SI units in which these quantities may be expressed are given in COLUMN-II. Match the physical quantities in COLUMN-I with the units in COLUMN-II.

COLUMN-I	COLUMN-II
(A) $GM_e M_s$ G – universal gravitational constant, M_e – mass of the earth, M_s – mass of the sun.	(p) (volt) (coulomb) (metre)
(B) $\frac{3RT}{M}$ R – universal gas constant, T – absolute temperature, M – molar mass.	(q) (kilogram) (metre) ³ (second) ⁻²
(C) $\frac{F^2}{q^2 B^2}$ F – force, q – charge, B – magnetic field.	(r) (metre) ² (second) ⁻²
(D) $\frac{GM_e}{R_e}$ G – universal gravitational constant, M_e – mass of the earth, R_e – radius of the earth.	(s) (farad) (volt) ² (kg) ⁻¹

Integer/Numerical Answer Type Questions

In this section, the answer to each question is a numerical value obtained after series of calculations based on the data provided in the question(s).

1. [JEE (Advanced) 2019]

An optical bench has 1.5 m long scale having four equal divisions in each cm. While measuring the focal length of a convex lens, the lens is kept at 75 cm mark of the scale and the object pin is kept at 45 cm mark. The image of the object pin on the other side of the lens overlaps with image pin that is kept at 135 cm mark. In this experiment, the percentage error in the measurement of the focal length of the lens is

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2. [JEE (Advanced) 2018]

A steel wire of diameter 0.5 mm and Young's modulus $2 \times 10^{11} \text{ Nm}^{-2}$ carries a load of mass m . The length of the wire with the load is 1 m . A vernier scale with 10 divisions is attached to the end of this wire. Next to the steel wire is a reference wire to which a main scale, of least count 1 mm , is attached. The 10 divisions of the vernier scale correspond to 9 divisions of the main scale. Initially, the zero of vernier scale coincides with the zero of main scale. If the load on the steel wire is increased by 1.2 kg , the vernier scale division which coincides with a main scale division is (Take, $g = 10 \text{ ms}^{-2}$ and $\pi = 3.2$)

3. [JEE (Advanced) 2015]

The energy of a system as a function of time t is given as $E(t) = A^2 \exp(-\alpha t)$, where $\alpha = 0.2 \text{ s}^{-1}$. The measurement of A has an error of 1.25% . If the error in the measurement of time is 1.50% , the percentage error in the value of $E(t)$ at $t = 5 \text{ s}$ is

4. [JEE (Advanced) 2014]

To find the distance d over which a signal can be seen clearly in foggy conditions, a railway 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 finds that d is proportional to $S^{1/n}$. The value of n is

5. [JEE (Advanced) 2014]

During Searle's experiment, zero of the vernier scale lies between $3.20 \times 10^{-2} \text{ m}$ and $3.25 \times 10^{-2} \text{ m}$ of the main scale. The 20th division of the vernier scale exactly coincides with one of the main scale divisions. When an additional load of 2 kg is applied to the wire, the zero of the vernier scale still lies between $3.20 \times 10^{-2} \text{ m}$ and $3.25 \times 10^{-2} \text{ m}$ of the main scale but now the 45th division of vernier scale coincides with one of the main scale divisions. The length of the thin metallic wire is 2 m and its cross-sectional area is $8 \times 10^{-7} \text{ m}^2$. The least count of the vernier scale is $1 \times 10^{-5} \text{ m}$. The maximum percentage error in the Young's modulus of the wire is

ANSWER KEYS—TEST YOUR CONCEPTS AND PRACTICE EXERCISES

Test Your Concepts-I (Based on Principle of Homogeneity: Verification)

- 1 in mass, 0 in length, -2 in time
- Yes
- $M^0L^0T^0$
- $m^{-3}L^{-2}T^4Q^4$
- True
- A : no units, B : m^2
- No, $\tan\theta = \frac{v}{u}$

Test Your Concepts-II (Based on Principle of Homogeneity: Conversion)

- $4.18\alpha^{-1}\beta^{-2}\gamma^2$ new units
- 10^9 erg
- 10 poise
- 8 kg
- 50 new units
- 746 W
- $p \propto \rho v^4 v^3$ and $\sigma \propto \frac{\rho v^3}{v}$
- 500 new units of length
- 10^4 kg
- 1.4 kWm^{-2}

Test Your Concepts-III (Based on Principle of Homogeneity: Dependence)

- $T = k\sqrt{\frac{r^3 d}{S}}$
- $kp^{\frac{5}{6}}d^{\frac{1}{2}}E^{\frac{1}{3}}$

$$3. k\sqrt{\frac{m\ell}{f}}$$

$$4. k\left(\frac{W}{\eta r}\right)$$

$$5. k\left(\frac{r^4}{\eta}\right)^p$$

$$6. k\left(\frac{\eta}{\rho d^2}\right)$$

$$7. k\left(\frac{S}{rgd}\right)$$

$$9. \rho g^4 v^6$$

- (a) $Kv^{-1}FT$
(b) $KvFT$

Test Your Concepts-IV (Based on Errors, Significant Figures, Vernier Calliper and Screw Gauge)

- $(4 \pm 0.65) \Omega$, $4 \Omega \pm 16.25\%$
- $8.1 \text{ gcc}^{-1} \pm 3.6\%$
- $\frac{1}{10N}$ cm
- 43.7 cm^3
- 5, 3, 2, 3, 5, 2, 2
- 7.36, 8.33, 9.44, 15.8, 7.37, 9.44, 15.8
- (a) 11.4; (b) 2.4; (c) 44; (d) 108
- (a) 0.01 cm; (b) 10.23 cm
- 6.4 mm
- Actual length will be 0.05 cm less than the measured length.

Single Correct Choice Type Questions

1. D	2. A	3. B	4. C	5. B	6. C	7. A	8. A	9. A	10. A
11. A	12. B	13. A	14. B	15. A	16. B	17. C	18. D	19. D	20. C
21. B	22. D	23. C	24. A	25. B	26. B	27. A	28. D	29. D	30. B
31. B	32. B	33. B	34. C	35. C	36. C	37. C	38. B	39. A	40. B
41. D	42. B	43. A	44. D	45. A	46. A	47. C	48. D	49. D	50. B
51. A	52. C	53. A	54. D	55. A	56. D	57. C	58. C	59. B	60. C

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61. C	62. B	63. B	64. C	65. A	66. A	67. B	68. B	69. D	70. C
71. B	72. D	73. C	74. A	75. D	76. D	77. A	78. A	79. B	80. A
81. C	82. C	83. A	84. B	85. A	86. C	87. B	88. D	89. B	90. C
91. A	92. B	93. A	94. B	95. B	96. D	97. A	98. D	99. B	100. A
101. C	102. D	103. C	104. C	105. C	106. B	107. B	108. D	109. B	110. C
111. C	112. D	113. B	114. D	115. C	116. D	117. A	118. B	119. C	120. C
121. B	122. A	123. C	124. B	125. A	126. A	127. B	128. D	129. B	130. C
131. A	132. A	133. C	134. A	135. D	136. A	137. A	138. C	139. B	140. A
141. A	142. B	143. B	144. B	145. C	146. C	147. C	148. C	149. A	150. D
151. D	152. A	153. C	154. B	155. A	156. A	157. C	158. A	159. A	160. C
161. D									

Multiple Correct Choice Type Questions

1. A, C	2. A, B, C	3. A, B, C, D	4. A, B, D	5. C	6. A, B, C
7. A, D	8. A, B, C	9. B, C	10. A, B, C	11. A, B, D	12. A, B, C
13. B, C	14. A, B, C	15. A, B, D	16. B, C, D	17. A, B	18. A, B, D
19. A, B, C	20. B, C, D	21. A, B, C, D	22. A, B, C	23. A, B, D	24. B, C
25. A, C	26. A, B, C	27. B, C, D	28. B, C, D	29. A, B, D	30. A, B, C, D

Reasoning Based Questions

1. A	2. B	3. D	4. A	5. A	6. B	7. D	8. A	9. A	10. D
11. C	12. D	13. A	14. C	15. B	16. C	17. C	18. D	19. C	20. A
21. B	22. A	23. A	24. A	25. A					

Linked Comprehension Type Questions

1. A, C	2. B	3. C	4. B	5. A	6. B	7. C	8. C	9. D	10. A
11. A	12. B	13. C	14. B	15. D	16. C	17. C	18. A	19. A, D	20. A, B, C
21. A, C	22. B	23. C	24. A	25. A	26. B	27. D	28. A	29. C	30. B
31. B	32. D	33. A	34. A	35. B	36. C	37. D	38. A	39. C	40. B
41. D	42. C	43. C	44. A	45. B	46. B				

Matrix Match/Column Match Type Questions

1. A → (q)	B → (p)	C → (r)	D → (t)
2. A → (p, q)	B → (r, t)	C → (p, q)	D → (s)
3. A → (s)	B → (p)	C → (r)	D → (q)
4. A → (q, r)	B → (q)	C → (p, s, t)	D → (q)
5. A → (r, s)	B → (p, q)	C → (t)	D → (p, q)
6. A → (p, t)	B → (r)	C → (q)	D → (r)
7. A → (r)	B → (s)	C → (p, q, r)	D → (t)

8. $A \rightarrow (p, q)$	$B \rightarrow (r, t)$	$C \rightarrow (p, q)$	$D \rightarrow (s)$
9. $A \rightarrow (p, q)$	$B \rightarrow (r, s)$	$C \rightarrow (r, s)$	$D \rightarrow (r, s)$
10. $A \rightarrow (r)$	$B \rightarrow (p)$	$C \rightarrow (p)$	$D \rightarrow (q)$
11. $A \rightarrow (r)$	$B \rightarrow (p, q)$	$C \rightarrow (p)$	$D \rightarrow (s)$
12. $A \rightarrow (q, s)$	$B \rightarrow (r)$	$C \rightarrow (p)$	$D \rightarrow (r)$
13. $A \rightarrow (s)$	$B \rightarrow (p)$	$C \rightarrow (q)$	$D \rightarrow (r)$
14. $A \rightarrow (q)$	$B \rightarrow (p)$	$C \rightarrow (s)$	$D \rightarrow (r)$
15. $A \rightarrow (r)$	$B \rightarrow (p)$	$C \rightarrow (p)$	$D \rightarrow (q)$
16. $A \rightarrow (q)$	$B \rightarrow (r)$	$C \rightarrow (s)$	$D \rightarrow (p)$
17. $A \rightarrow (r)$	$B \rightarrow (p, q)$	$C \rightarrow (p)$	$D \rightarrow (s)$
18. $A \rightarrow (q)$	$B \rightarrow (p)$	$C \rightarrow (s)$	$D \rightarrow (r)$
19. $A \rightarrow (q)$	$B \rightarrow (p)$	$C \rightarrow (r)$	$D \rightarrow (s)$

Integer/Numerical Answer Type Questions

1. $a=0, b=0, c=0$	2. $x=2$	3. $x=4, y=1, z=1$
4. 8 kg, 10 m and 2 s	5. $x=1, y=1, z=2$	6. $a=2, b=3, c=1, d=1$

ARCHIVE: JEE MAIN

1. D	2. D	3. A	4. C	5. B	6. D	7. C	8. C	9. A	10. C
11. C	12. B	13. C	14. A	15. A	16. C	17. B	18. A	19. C	20. A
21. C	22. C	23. D	24. A	25. B	26. A, D	27. C	28. C	29. A	30. C
31. C	32. D	33. B							

ARCHIVE: JEE ADVANCED

Single Correct Choice Type Problems

1. A	2. A	3. C	4. B	5. C	6. C	7. D	8. B	9. B	10. A
11. A	12. D	13. D	14. D	15. A	16. A	17. D	18. B	19. B	20. D
21. B	22. B								

Multiple Correct Choice Type Problems

1. A, C, D	2. B, D	3. A, B, D	4. A, C, D	5. A, C
6. B, C	7. A, C	8. B, C	9. A, B, C, D	10. A, B, C
11. B, D	12. A, D	13. A, B, C		

Linked Comprehension Type Questions

1. C	2. D	3. B	4. C	5. C	6. B
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Matrix Match/Column Match Type Questions

- | | | | |
|---------------------------------|---------------------------|---------------------------|------------------------|
| 1. $A \rightarrow (p, q, s, t)$ | $B \rightarrow (q)$ | $C \rightarrow (s)$ | $D \rightarrow (s)$ |
| 2. $A \rightarrow (p, t)$ | $B \rightarrow (q, s, t)$ | $C \rightarrow (p, r, t)$ | $D \rightarrow (q)$ |
| 3. $A \rightarrow (p, q)$ | $B \rightarrow (r, s)$ | $C \rightarrow (r, s)$ | $D \rightarrow (r, s)$ |

Integer/Numerical Answer Type Questions

- | | | | | |
|---------|------|--------------|------|------|
| 1. 1.39 | 2. 3 | 3. $\pm 4\%$ | 4. 3 | 5. 4 |
|---------|------|--------------|------|------|