# Shiksha Classes, Bhandara

**Physics**

**Topic : Physical World and Measurement** **M.M. : 180**

**Marking Scheme:**
**(i) Each question is allotted 4 (four) marks for each correct response.**
**(ii) ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.**

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**Q.1** The dimensional formula for the modulus of rigidity is –
(1) $ML^2T^{-2}$ (2) $ML^{-1}T^{-3}$
(3) $ML^{-2}T^{-2}$ (4) $ML^{-1}T^{-2}$

**Q.2** Out of the following, the only pair that does not have identical dimensions is –
(1) Angular momentum and Planck's constant
(2) Moment of inertia and moment of a force
(3) Work and torque
(4) Impulse and momentum

**Q.3** The frequency of vibration f of a mass m suspended from a spring of spring constant K is given by a relation of this type $f = Cm^xK^y$; where C is a dimensionless quantity. The value of x and y are –
(1) $x = \frac{1}{2}, y = \frac{1}{2}$ (2) $x = -\frac{1}{2}, y = -\frac{1}{2}$
(3) $x = \frac{1}{2}, y = -\frac{1}{2}$ (4) $x = -\frac{1}{2}, y = \frac{1}{2}$

**Q.4** The equation of a wave is given by $Y = A\sin\omega\left(\frac{x}{v} - k\right)$, where ω is the angular velocity and v is the linear velocity. The dimension of k is –
(1) LT (2) T
(3) $T^{-1}$ (4) $T^2$

**Q.5** The velocity of a freely falling body changes as $g^ph^q$ where g is acceleration due to gravity and h is the height. The values of p and q are –
(1) 1, 1/2 (2) 1/2, 1/2
(3) 1/2, 1 (4) 1, 2

**Q.6** If energy (E), velocity (v) and force (F) be taken as fundamental quantity, then what are the dimensions of mass
(1) $Ev^2$ (2) $Ev^{-2}$
(3) $Fv^{-1}$ (4) $Fv^{-2}$

**Q.7** A physcial quantity x depends on quantities y and z as follows: x = Ay + B tan Cz, where A, B and C are constants. Which of the following do not have the same dimensions
(1) x and B (2) C and $z^{-1}$
(3) y and B/A (4) x and A

**Q.8** The frequency (f) of a wire oscillating with a length $\ell$, in p loops, under a tension T is given by $f = \frac{p}{2\ell}\sqrt{\frac{T}{\mu}}$ where μ = linear density of the wire. If the error made in determining length, tension and linear density be 1%, 2% and 4%, then find the percentage error in the calculated frequency.
(1) 4% (2) 2%
(3) 1% (4) 5%

**Q.9** The density of a sphere is measured by measuring its mass and diameter. If, it is known that the maximum percentage errors in the measurement are 2% and 3%, then find the maximum percentage error in the measurement of density?
(1) 15% (2) 18%
(3) 9% (4) 11%

**Q.10** The physical quantities not having same dimensions are –
(1) Momentum and Planck's constant
(2) Stress and Young's modulus
(3) Speed and $(\mu_0\varepsilon_0)^{-1/2}$
(4) Torque and work

**Q.11** Dimensions of $\frac{1}{\mu_0\varepsilon_0}$, where symbols have their usual meaning, are –
(1) $[L^{-2}T^2]$ (2) $[L^2T^{-2}]$
(3) $[LT^{-1}]$ (4) $[L^{-1}T]$

**Q.12** Which of the following units denotes the dimensions $ML^2/Q^2$, where Q denotes the electric charge –
(1) $H/m^2$ (2) Weber (Wb)
(3) $Wb/m^2$ (4) Henry (H)

**Q.13** Which of the following pairs of physical quantities does not have same dimensional formula?
(1) Work and torque.
(2) Angular momentum and Planck's constant.

(3) Tension and surface tension.
(4) Impulse and linear momentum.

**Q.14** A quantity X is given by $\varepsilon_0 L \frac{\Delta V}{\Delta t}$ where $\varepsilon_0$ is the permittivity of free space, L is a length, $\Delta V$ is a potential difference and $\Delta t$ is a time interval. The dimensional formula for X is the same as that of
(1) Resistance (2) Charge
(3) Voltage (4) Current

**Q.15** If momentum (P), area (1) and time (t) are taken to be fundamental quantities, then energy has the dimensional formula
(1) $[P^1A^{-1}t^1]$ (2) $[P^2A^1t^1]$
(3) $[P^1A^{-1/2}t^1]$ (4) $[P^1A^{1/2}t^{-1}]$

**Q.16** The SI unit of the inductance, the henry can by written as
(1) weber/ampere
(2) volt-second/ampere
(3) joule/(ampere)$^2$
(4) All of these

**Q.17** A body travels uniformly a distance of (13.8 ± 0.2) m in a time (4.0 ± 0.3) s. Its velocity with error limits is
(1) (3.5 ± 0.6) m s$^{-1}$ (2) (3.5 ± 0.3) m s$^{-1}$
(3) (6.1 ± 0.6) m s$^{-1}$ (4) (6.1 ± 0.3) m s$^{-1}$

**Q.18** Which of the following group have different dimension
(1) Potential difference, EMF, voltage
(2) Pressure, stress, Young's modulus
(3) Heat, energy, work done
(4) Dipole moment, electric flux, electric field

**Q.19** The mass and volume of a body are 4.237 g and 2.5 cm$^3$, respectively. The density of the material of the body in correct significant figures is –
(1) 1.6948 g cm$^{-3}$ (2) 1.69 g cm$^{-3}$
(3) 1.7 g cm$^{-3}$ (4) 1.695 g cm$^{-3}$

**Q.20** Young's modulus of steel is $1.9 \times 10^{11}$ N/m$^2$. When expressed in CGS units of dynes/cm$^2$, it will be equal to (1N = $10^5$dyne, 1m$^2$ = $10^4$ cm$^2$)
(1) $1.9 \times 10^{10}$ (2) $1.9 \times 10^{11}$
(3) $1.9 \times 10^{12}$ (4) $1.9 \times 10^{13}$

**Q.21** To find the distance d over which a signal can be seen clearly in foggy conditions, a railways-engineer uses dimensional 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
(1) 1 (2) 2
(3) 3 (4) 4

**Q.22** Assuming that the mass m of the largest stone that can be moved by a flowing river depends upon the velocity v of the water, its density ρ and the acceleration due to gravity g. Then m is directly proportional to :
(1) $v^3$ (2) $v^4$
(3) $v^5$ (4) $v^6$

**Q.23** A spherical body of mass m and radius r is allowed to fall in a medium of viscosity η. The time in which the velocity of the body increases from zero to 0.63 times, the terminal velocity (v) is called time constant (τ). Dimensionally τ can be represented by :
(1) $\frac{mr^2}{6\pi\eta}$ (2) $\sqrt{\left(\frac{6\pi mr\eta}{g^2}\right)}$
(3) $\frac{m}{6\pi\eta rv}$ (4) None of these

**Q.24** The moment of inertia of a body rotating about a given axis is 6.0 kg m$^2$ in the SI system. What is the value of the moment of inertia in a system of units in which the unit of length is 5 cm and the unit of mass is 10 g ?
(1) $2.4 \times 10^3$ (2) $2.4 \times 10^5$
(3) $6.0 \times 10^3$ (4) $6.0 \times 10^5$

**Q.25** If force, acceleration and time are taken as fundamental quantities, then the dimensions of length will be-
(1) $FT^2$ (2) $F^{-1}A^2T^{-1}$
(3) $FA^2T$ (4) $AT^2$

**Q.26** A calorie is a unit of heat or energy and it equals about 4.2J where 1J = 1 kg m$^2$ s$^{-2}$. Suppose we employ a system of units in which the unit of mass equals α kg, the unit of length equals β m, the unit of time is γs. Find the magnitude of Calorie in terms of the new units.
(1) 4.2 $\alpha^{-1}\beta^{-2}\gamma^2$ (2) 4.2 $\alpha^{-1}\beta^{2}\gamma^2$
(3) 4.2 $\alpha\beta^{-2}\gamma^2$ (4) 4.2 $\alpha^{-2}\beta^{-2}\gamma^{-2}$

**Q.27** A book with many printing errors contains four different formulas for the displacement y of a particle undergoing a certain periodic motion :
(a) $y = a \sin 2\pi t/T$
(b) $y = a \sin vt$
(c) $y = (a/T) \sin (t/a)$
(d) $y = \frac{a}{\sqrt{2}}\left[\sin\frac{2\pi t}{T} + \cos\frac{2\pi t}{T}\right]$
(Here, a = maximum displacement of the particle,
v = speed of the particle, T = time-period of motion). Rule out the wrong formulas on dimensional grounds.
(1) a, b, c (2) b and c
(3) c and d (4) a and d

**Q.28** The ratio of the dimension of Placnk's constant and that of the moment of inertia is the dimension of –
(1) time (2) frequency
(3) angular momentum (4) velocity

**Q.29** The velocity v of a particle at time t is given by $v = at + \frac{b}{t+c}$, where a, b and c are constant. The dimensions of a, b and c are respectively –
(1) $L^2$, T and $LT^2$ (2) $LT^2$, LT and L
(3) L, LT and $T^2$ (4) $LT^{-2}$, L and T

**Q.30** Dimensions of resistance in an electrical circuit, in terms of mass M, length L, time T and current I, would be –
(1) $ML^2T^{-2}$ (2) $ML^{-1}T^{-1}I^{-1}$
(3) $ML^2T^{-3}I^{-2}$ (4) $ML^2T^{-3}I^{-1}$

**Q.31** Which two of the following five physical parameters have the same dimensions ?
(a) Energy density (b) Refractive index
(c) Dielectric constant (d) Young's modulus
(e) Magnetic field
(1) (a) and (e) (2) (b) and (d)
(3) (c) and (e) (4) (a) and (d)

**Q.32** If the error in the measurement of radius of a sphere is 2 %, then the error in the determination of volume of the sphere will be –
(1) 2 % (2) 4 %
(3) 6 % (4) 8 %

**Q.33** If the dimensions of a physical quantity are given by $M^a L^b T^c$, then the physical quantity will be:
(1) Velocity if a = 1, b = 0, c = –1
(2) Acceleration if a = 1, b = 1, c = –2
(3) Force if a = 0, b = –1, c = –2
(4) Pressure if a = 1, b = –1, c = –2

**Q.34** 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 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.
(1) $2\pi\sqrt{\frac{M\eta}{L}}$ (2) $2\pi\sqrt{\frac{L}{M\eta}}$
(3) $2\pi\sqrt{\frac{ML}{\eta}}$ (4) $2\pi\sqrt{\frac{M}{\eta L}}$

**Q.35** Which one of the following groups have quantities that do not have the same dimensions
(1) Pressure, stress (2) Velocity, speed
(3) Force, impulse, (4) Work, energy

**Q.36** The dimensions of Planck's constant are same as
(1) Energy (2) Power
(3) Momentum (4) Angular momentum

**Q.37** The unit of permittivity of free space, $\varepsilon_0$ is –
(1) $\text{Coulomb}^2/(\text{Newton-metre})^2$
(2) Coulomb/Newton-metre
(3) $\text{Newton-metre}^2/\text{ Coulomb}^2$
(4) $\text{Coulomb}^2/\text{Newton-metre}^2$

**Q.38** You measure two quantities as
A = 1.0 m ± 0.2m, B = 2.0 m ± 0.2 m. We should report correct value for $\sqrt{AB}$ as:
(1) 1.4 m ± 0.4 m (2) 1.41m ± 0.15 m
(3) 1.4m ± 0.3 m (4) 1.4m ± 0.2 m

**Q.39** Match List I with List II and select the correct answer using the codes given below the lists:

| List I | List II |
|---|---|
| (P) Boltzmann constant | (1) $[ML^2T^{-1}]$ |
| (Q) Coefficient of viscosity | (2) $[ML^{-1}T^{-1}]$ |
| (R) Planck's constant | (3) $[MLT^{-3}K^{-1}]$ |
| (S) Thermal conductivity | (4) $[ML^2T^{-2}K^{-1}]$ |

Codes:
(1) (P) -3, (Q) - 1, (R) - 2, (S) - 4

(2) (P) - 3, (Q) - 2, (R) - 1, (S) - 4
(3) (P) - 4, (Q) - 2, (R) - 1, (S) - 3
(4) (P) - 4, (Q) - 1, (R) - 2, (S) - 3

**Q.40** Which of the following reading is most accurate-
(1) 4.00 cm (2) 0.004 mm
(3) 40.00 cm (4) 4.00 m

**Q.41** The surface tension of a liquid is 70 dyne/cm. In MKS system its value is.
(1) 70 N/m (2) $7 \times 10^{-2}$ N/m
(3) $7 \times 10^{3}$ N/m (4) $7 \times 10^{2}$ N/m

**Q.42** The unit of electric charge may be expressed as
(1) ampere-newton-meter/watt
(2) ampere-volt
(3) ampere/second
(4) ampere-ohm

**Q.43** The dimensions of physical quantity X in the equation Force = X/Density is given by.
(1) $M^1L^4T^{-2}$ (2) $M^2L^{-2}T^{-1}$
(3) $M^2L^{-2}\,T^{-2}$ (4) $M^1L^{-2}T^{-1}$

**Q.44** With the usual notations, the following equation $S_t = u + \frac{1}{2} a\,(2t - 1)$ is.
(1) Only numerically correct
(2) Only dimensionally correct
(3) Both numerically and dimensionally correct.
(4) Neither numerically nor dimensionally correct

**Q.45** An athletic coach told his team that muscle times speed equals power. What dimensions does he view for muscle.
(1) $MLT^{-2}$ (2) $ML^2T^{-2}$
(3) $MLT^2$ (4) L