Chapter- 1&2

PHYSICAL WORLD AND MEASUREMENT

Very Short Answer Type Questions

01. Obtain a relation between microsecond & nanosecond.

02. The volume of a cube of side 1 cm is equal to _____ m^3.

03. The relative density of lead is 4.3. Its density is _____ gcm^{-3} or _____ kgm^{-3}.

04. G = 6.67 x 10^{-11} Nm^2 $(kg)^{-2}$ = _____ $(cm)^3$. S^{-2}. g^{-1}.

05. Define parsec.

06. Name four units used in the measurement of extremely short distances.

Short Answer Type Questions (2 marks):

07. State four physical quantities having the same dimensional formula.

08. Classify physical quantities based on dimensions.

09. Check the correctness of the equations. (i) v = u + at (ii) $S = ut + \frac{1}{2}at^2$

(iii) $v^2 - u^2 = 2as$ (iv) $T = 2\pi\sqrt{4}g$

10. If the unit of length, mass & time each be doubled. What increase in the unit of work takes place?

11. The velocity of a particle is given by $v = a + \frac{b}{t} + ct^2$ where a, b & c are constant. Find the unit and dimensional formula of a, b & c.

12. If $force = \frac{x}{density} + c$ is it dimensionally correct? Find the dimension of 'x'?

13. In the gas equation $\left[p + \frac{a}{V^2}\right][V - b] = RT$, where 'T' is absolute temperature, 'p' is the pressure & 'V' is volume. What are the dimensions of constants 'a' & 'b'?

14. Convert force of 15 dynes into newton dimensionally.

15. The density of water in the C.G.S system is 1 g/cm^3. Find its value in the SI system dimensionally.

16. $y = \frac{x}{acceleration}\sin\left[\frac{x.force}{velocity}\right]$, find the units of x.

17. 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) $y = (a/T)\sin\frac{t}{a}$ (d) $y = \left(a/\sqrt{2}\right)\left(\sin\frac{2\pi t}{T} + \cos\frac{2\pi t}{T}\right)$

(a = maximum displacement of particle, v = speed of the particle, T = time period of motion). Role out the wrong formulas on dimensional grounds.

18. When the planet Jupiter is at a distance of 824.7 million kilometers from Earth, its angular diameter is measured to be 35.72" of arc. Calculate the diameter of Jupiter.

19. $\Pr essure = \frac{y^2}{velocity}\log\left\{\frac{x \times force}{z^2} + \frac{y}{z}\right\}$, so, find x, y & z dimensionally.

20. Check the correctness of equation, $V=\sqrt{\frac{2GM}{R}}$, where 'V' is escape velocity, G = gravitational constant, M is the mass of earth & R is the radius of Earth.

21. Check the accuracy of the equation $\lambda=\frac{h}{m^2V}$, where, is the wavelength, 'h' is the Planck's constant, 'm' is the mass & 'V' is the velocity.

22. The centripetal force depends on the mass of the planet, radius of the orbit & velocity of the planet. So derive an expression for the centripetal force with the help of dimensional analysis.

23. The force of viscosity (F) acting on a spherical body moving through a fluid depends upon its velocity (v), radius (r) & co-efficient of viscosity (η) of fluid. Find the expression for F using dimensional analysis.

Long Answer Type Questions (5 marks)

24. We measure the period of oscillation of a simple pendulum. In successive measurements, the readings turn out to be 2.63 s, 2.56 s, 2.42 s, 2.71s, 2.80s. Calculate the absolute error, relative error & % error.

25. Two forces F_1 & F_2 acting simultaneously on a particle are measured as follows, $F_1=(36\pm0.3)N$, $F_2=(23\pm0.5)N$. What will be the resultant if they act in the same direction & opposite direction?

26. The sides of a rectangle are measured to be $(20\pm0.2)m$ & $(10\pm0.1)m$. Find the perimeter of a rectangle with error limits.

27. Focal lengths of spherical mirrors can be measured to be (3.5 ± 0.1) cm & (2.5 ± 0.2) cm. Calculate the sum & difference in their focal length with error limits.

28. Two resistances (5.1 ± 0.03) Ω and (2.6 ± 0.03) Ω are connected in series in a circuit. Calculate the total resistance of the circuit with error limits.

29. Determine the area of a platform whose length and breadth are measured as (123 ± 0.5) m & (75 ± 0.3)m.

30. Find the relative error in Z if $Z = \frac{A^4 B^{1/3}}{CD^{3/2}}$.

31. Describe four fundamental forces in nature.

MODEL QUESTIONS

Very Short Answer Type Questions

01. How many electrons would have to be ejected from a body to decrease its mass by 0.03 milligram? The mass of one electron is 9.1×10^{-31} kg.

02. A body moves with a velocity of 36 km/h. What is its velocity in ms^{-1}?

03. Convert an acceleration of 20 ms^{-2} into km h^{-2} ?

04. Obtain a relation between

Microsecond & nanosecond

05. How many electrons should be added into a body to make it heavier by 5 nanograms?

06. The volume of a cube of side 1 cm is equal to ...m^3.

Short Answer Type Questions

07. State four physical quantities having the same dimensional formula.

08. Classify physical quantities based on dimensions.

09. State the limitation of dimensional formula.

10. What is the dimensional formula for torque?

11. If the unit of length mass & time each be doubled. What increase in the unit of work takes place?

12. In the gas equation: $[p+a/v^2]\,[v-b]= RT$

where 'T' is absolute temp., P is the pressure & V is the volume. What are the dimensions of constants 'a' & 'b'?

13. Convert work of 1 joule into erg.

14. Convert kinetic energy of 5 joules into erg dimensionally.

15. Convert force of 15 dynes into newton dimensionally.

16. The density of water on the CGS system is $1g/cm^3$. Find its value in the SI system dimensionally.

17. Find the value of universal gravitational constant, $G= 6.67 \times 10^{-11}Nm^2\,(g)^{-2}$ in CGS.

18. Each side of a cube is 7.203m. So find its total surface area & volume of a cube with respect to significant figures.

19. The diameter of a circle is 2.486m. Calculate its area with due regard to significant figures. Find units of x & y.

20. When the planet Jupiter is at a distance of 824.7 million kilometers from the Earth, its angular diameter is measured to be 35.72" of arc. Calculate the diameter of Jupiter.

21. A SONAR (sound navigation and ranging) uses ultrasonic waves to detect and locate objects underwater. In a submarine equipped with a SONAR, the time delay between the generation of a probe wave and the reception of its echo after reflection from an enemy submarine is found to be 77.0 s. What is the distance of the enemy submarine? (Speed of sound in water = 1450 m s^{-1}).

22. Name two physical quantities whose dimensions are the same.

23. If $f = x^2$, then what is the relative error in f?

24. Name at least six physical quantities whose dimensions are ($ML^3 T^{-2}$).

25. Are all constants dimensionless?

26. The parallax of a heavenly body measured from two points diametrically opposite on earth's equator is 60 seconds. If the radius of the earth is 6.4×10^6 m, determine the distance of the heavenly body from the center of the earth. Convert this distance to A.U. Given 1 A.U. = 1.5×10^{11} m.

27. The parallactic angle subtended by a distant star is 0.76 on the earth's orbital diameter (1.5×10^{11} m). Calculate the distance of the star from the earth.

28. E, m, L and G denote energy, mass, angular momentum, and gravitational constant respectively. Determine the dimensions of EL^2/m^5G^2.

Long Answer Type Questions

29. We measure the period of oscillation of a sample pendulum. In successive measurements, the readings turn out to be 2.63s, 2.56s, 2.42s, 2.71s, 2.80s. Calculate the absolute error, relative error & % error.

30. While measuring the length of a cylinder with vernier calliper, the results were:

3.29cm, 3.28cm, 3.29cm, 3.31cm, 3.28cm, 3.27cm, 3.29cm, 3.30cm.

Find (a) Most accurate length of cylinder

(b) The absolute error in 1st & last observation

(c) Relative error & % error.

31. Determine the area of a platform whose length and breadth are measured as (1230.5)m & (750.3)m.

32. A body mass is (17.98 ± 0.6)kg has a volume of $(3.87 \pm 0.3)m^3$. What is its density?

33. Electric current (10 ± 1) A is flowing through a wire when a potential difference of (100 ± 5)v is applied across it. Find the resistance of the wire with error limits.

34. Two resistors of resistances $R_1 = (100 \pm 3)\Omega$ & $R_2 = (200 \pm 4)\Omega$ are connected (a) in series (b) in parallel. Find the equivalent resistance in both the connection.

[Hint: Use relation $\frac{1}{R'} = \frac{1}{R_1} + \frac{1}{R_2}$ and $\frac{\Delta R_1}{\Delta R_1^2} = \frac{\Delta R_1}{\Delta R_1^2} + \frac{\Delta R_2}{R_2^2}$

35. The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{\frac{L}{g}}$. The measured value of L=20.0 cm known to 1mm accuracy & time for 100 oscillations of the pendulum is found to be the 90s using a wristwatch of its resolution? What is the accuracy in the determination of 'g'?

36. A swimming pool is in form of a square of area (100 ± 0.2)m^2. Find the side of the pool with an error limit.

37. If a = (40 ± 0.2) cm, b= (60± 0.6) cm & c = (20± 0.2) cm. Then find the max. % error in the quantity $\frac{ab^2}{a+b+c}$.

38. Show that the frequency (n) of a vibrating string of length 'l' mass per unit length (m) having a tension in it is given by. $n=\frac{1}{2l}\sqrt{\frac{T}{m}}$.

39. An experiment measured quantities a, b, c and then x is calculated by using the relation x = $\frac{ab^2}{c^3}$. If the percentage errors in measurements of a, b and c are 1%, 2%, and 1.5% respectively, then calculate the maximum percentage error in the value of x obtained.

40. The density of the cylindrical rod was measured by using the formula, $P=\frac{4m}{\pi D^2 l}$

The percentage of errors in m, D, and l is ± 1%, ± 1.5%, and ± 0.5%. Calculate the percentage error in the calculated value of density.

41. The radius of the Earth is 6.37 x 106 m and its mass is 5.975 x 10^{24} kg. Find the Earth's average density to appropriate significant figures.

42. The radius of the curvature of a concave mirror measured by a spherometer is given by R = $\frac{l^2}{6h}+\frac{h}{2}$. The values of and h are 4 cm and 0.065 cm respectively. Compute the error in measurement of radius of curvature.