CLASS XI : ASSIGNMENT : CH-1 : UNITS AND MEASUREMENT : PHYSICS

CONVERSION OF UNITS

1. $G = 6.67 \times 10^{-11}\ Nm^2/kg^2 =$ _____ $g^{-1}cm^3s^{-2}$.
2. 1 microsecond = millisecond.
3. Acceleration = 1 km/h^2 = _____ cm/s^2.
4. Acceleration = 10 m/s^2 = _____ km/h^2.
5. In the CGS system, the value of Stefan's constant (σ) is 5.67×10^{-5} erg s^{-1} cm^{-2} K^{-4}. Write down its value in SI units.

FIND DIMENSIONS

6. Write the dimensions of
   i. Pressure
   ii. Pressure gradient
   iii. Areal velocity
   iv. Impulse
   v. Gravitational constant
   vi. Surface tension.
   vii. Light year
   viii. Relative density
   ix. Coefficient of viscosity
   x. K in the equation $W = ½ Kx^2$.
   xi. h in the equation, E = hv, where E is energy and v is frequency.
7. For $10^{(at+3)}$, write the dimensions of a.
8. $\mu = A + B/\lambda + C/\lambda^2$, here λ is wavelength and μ, A, B, and C are constants. Find the dimensions of A, B, C, and D.
9. s is displacement and t is time,
   i. $s^2 = At^2$ ii. $s = At^3 + Bt^2 + Ct + D$
   Find the dimensions of A, B, C, and D.
10. The velocity v of the particle in terms of time t is defined as
    i. $v = at + b/(t + c)$. ii. $v = at + bt^2$
    Find the dimensions of a, b, and c.
11. The displacement of an oscillating particle is given by $y = A \sin (Bx + Ct + D)$. Write the dimensional formula for (ABCD).
12. The position of a particle at time t is given by the relation $x(t) = (v_0/\alpha)(1- c^{-\alpha t})$, where v_0 is a constant and $\alpha>0$. Find the dimensions of v_0 and α.
13. In a given relation $F = at + bt^2$, where F and t denotes force and time respectively. Find the dimensions of a and b.
14. If force F and density d are related as
    i. $F = \alpha/\sqrt{d}$ ii. $F = \alpha/(d + \beta^3)$ iii. $F = \alpha/(\beta + \sqrt{d})$,
    Then, find the dimensions of α and β.
15. Write the dimensions of a/b in the equation $P = (a - t^2)/bx$ where, P is pressure, x is distance and t is time.
16. The relation $P = \alpha/\beta\ e^{-\alpha z/k\theta}$ where P is pressure, Z is distance, K is Boltzmann constant and θ is temperature. Write the dimensional formula of β.
17. If E, m, L and G denote energy, mass, angular momentum, and gravitational constant respectively, then write the dimensions of the quantity (EL^2/m^5G^2)
18. The equation of a wave is given by $u = A \sin \omega(x/v - k)$, where ω is the angular velocity and v is the linear velocity. Find the dimensions of k.
19. The number of particles is given by $n = - D(n_2 - n_1)/(x_2 - x_1)$ crossing a unit area perpendicular to the X-axis in unit time, where n_1 and n_2 are the number of particles per unit volume at x_1 and x_2 respectively. Find the dimensions of D.(diffusion constant)
20. The force is given in terms of time, t, and displacement x by the equation $F = A \cos Bx + C \sin Dt$. Write the dimensional formula of AD/B.

ONE SYSTEM OF UNITS INTO ANOTHER SYSTEM

21. If minute is the unit of time, 10 m/s^2 is the unit of acceleration and 100kg is the unit of mass, then write the new unit of work in joule.

22. The magnitude of the force is 100 N. What will be its value if the units of mass and time are doubled and that of length is halved?
23. If the unit of force is 1000N and the unit of pressure is 40 Pascal, then write the unit of length.
24. If the fundamental units of length, mass, and time are halved then how will it change (affect) the unit of momentum?
25. If the fundamental units of length, mass, and time are doubled then how will it change the unit of force?
26. Write the magnitude of energy in joule.
    i. If the magnitude of mass is 1 kg that of time is 1 minute and that of acceleration due to gravity is $10 m/s^2$.
    ii. If the unit of force is 5N and that of length is 10m.

DIMENSIONS IN TERMS OF OTHER UNITS CHOSEN AS FUNDAMENTAL UNITS

27. If units of length, mass, and force are chosen as fundamental units. Write the dimensions of time.
28. Write the dimensions of mass:
    i. If velocity (V), time (T), and Force (F) were chosen as fundamental quantities.
    ii. If energy (E), velocity (V), and Force (F) were chosen as fundamental quantities.
    iii. If the velocity of light (c), gravitational constant(G), and Planck's constant(h) are chosen as fundamental units
    iv. If velocity (V), time (T), and angular momentum (L) are taken as fundamental units.
29. If force [F], acceleration [A], and time [T] were chosen as fundamental quantities, then write the dimensions of energy in terms of them.
30. Construct a new physical quantity having dimensions of length in terms of G, c, and h.

DERIVE RELATIONS

31. The speed (v) of ripples depends upon their wavelength(λ), density(ρ), and surface tension(σ). Using the method of dimensions, show that $v \alpha \sqrt{(\sigma/\rho\lambda)}$.
32. The critical velocity (v_c) of the flow of liquid through a pipe depends upon the radius(r) of the pipe, density (ρ) and viscosity (η) of the liquid. Using the dimensional considerations, obtain an expression for critical velocity.
33. The period of revolution (T) of a planet moving around the sun in a circular orbit depends upon the radius(r) of the orbit, mass (M) of the sun, and gravitational constant(G). Using the dimensional considerations, obtain Kepler's third law of planetary motion.
34. Given that the amplitude A of the scattered light is : (i) directly proportional to the amplitude (A_o) of incident light(ii) directly proportional to the volume(V) of the scattering particle, (iii) inversely proportional to the distance(r) from the scattered particle(iv) depend upon the wavelength (λ) of the scattered particle then find how A and λ are related?
35. The volume of water passing any point of uniform tube during t seconds is related to the cross-sectional area A and velocity u of water. Derive the relation.
36. If the time period (T) of vibration of a liquid drop depends on surface tension(S), radius(r) of a drop, and density (ρ) of the liquid, then write the expression of T.
37. 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, then write the expression of V.

SIGNIFICANT FIGURES

38. Round off
    i. 103.5 kg to three significant digits.
    ii. 13546 to four significant figures.
    iii. 24.25×10^3 to three significant figures.
39. Write the number of significant figures in
    i. $6.023 \times 10^{23}\ mol^{-1}$.
    ii. 0.010200
    iii. $0.007\ m^2$
    iv. $11.118 \times 10^6 V$

40. Find the value(taking into account the significant figures)
    i. 9.99 m + 0.0099 m
    ii. 3.124 x 4.576
    iii. 10.845 x 3.23
41. What is the difference between 4.0 and 4.000?
42. The side of the cube is 2.5 m. write the volume of the cube in significant figures.
43. The mass of the box is 2.3 kg. two marbles of masses 2.15 g and 12.48 g are added to it. Write the total mass of the box in significant figures.
44. A student measuring the diameter of a pencil of the circular cross-section with the help of an vernier scale records the following four readings 5.50 mm, 5.55 mm, 5.45 mm, 5.65 mm. The average of these four readings is 5.5375 mm and the standard deviation of the data is 0.07395 mm. What is the average diameter of the pencil?

ERRORS

45. We measure the period of oscillation of a simple pendulum. In successive measurements, the readings turn out to be 2.63s. 2.56s, 2.42s, 2.71s and 2.80s. Calculate the absolute errors and the percentage error.
46. The percentage error in a measurement of 6mm is 0.1%. Find the error in mm.
47. For a cubical block, error in measurement of sides is $\pm$ 1% and error in measurement of mass is $\pm$ 2%. Find the maximum possible error in density.
48. The least count of a stop watch is 0.2 second. The time of 20 oscillations of a pendulum is measured to be 25 seconds. Find the percentage error in time period.
49. To estimate g (from $g = 4\pi L/T^2$), error in measurement of L is $\pm$ 2% and error in measurement of T is $\pm$ 3%. Find the percentage error in g.
50. If the error in measurement of the radius of a sphere is 2%. Find the error in the measurement of the volume of the sphere.
51. In an experiment four quantities a, b, c, and d are measured with percentage errors 1%, 2%, 3%, and 4% respectively. The quantity P is calculated as follows $P = a^3b^2/cd$. Find the percentage error in P.
52. The resistance R = V/I where V = 100 $\pm$ 5 Volts and I = 10 $\pm$ 0.2 amperes. What is the total percentage error in R?
53. The mass and density of the solid sphere are measured to be (12.4 $\pm$ 0.1)kg and (4.6 $\pm$ 0.2)kg/m^3. Calculate the volume of the sphere with error limits.
54. The relative density of a metal may be found by hanging a block of the metal from a spring balance and nothing that in the air, the balance reads (5.00 $\pm$ 0.05)N while in water, it reads (4.00 $\pm$ 0.05) N. What will be the relative density?

VERNIER CALLIPERS AND SCREW GAUGE

55. In a vernier calipers, one MSD is x cm and n divisions of the vernier scale coincide with (n-1) divisions of the main scale. Find the least count in cm.
56. A screw gauge has the least count of 0.01 mm and there are 50 divisions in its circular scale. Find the pitch of the screw gauge.
57. The smallest division on the main scale of the vernier calipers is 1mm, and 10 vernier divisions coincide with 9 main scale divisions. While measuring the diameter of a sphere, the zero mark of the vernier scale lies between 20 and 21 mm and the fifth division of the vernier scale coincides with a main scale division. What is the diameter of the sphere?
58. A student measured the diameter of a small steel ball using a screw gauge with least count of 0.001 cm. The main scale reading is 5 mm and the zero of the circular scale division coincides with 25 divisions above the reference level. If the screw gauge has a zero error of – 0.004 cm. what is the correct diameter of the ball?