CBSE

UNITS AND MEASUREMENTS WS 4

Class 11 - Physics

Section A

1. What are the dimensions of $\frac{A}{B}$ in the relation $F = A\sqrt{x} + Bt^2$, where F is the force, x is distance and t is time? **[1]**

   a) $[LT^{-2}]$ b) $[ML^2T^{-2}]$

   c) $[L^{-\frac{1}{2}}T^2]$ d) $[L^{-\frac{1}{2}}T^{-1}]$

2. Which of the following is a dimensional constant? **[1]**

   a) refractive index b) relative density

   c) gravitational constant d) poisson ratio

3. According to Newton, the viscous force acting between liquid layers of area A and velocity gradient $\frac{\Delta v}{\Delta x}$ is given by $F = -\eta A\frac{\Delta v}{\Delta x}$, where η is constant called coefficient of viscosity. The dimensional formula of η is **[1]**

   a) $[ML^{-2}T^{-2}]$ b) $[M^0L^0T^0]$

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

4. Which of the following pairs does not have same dimensions? **[1]**

   a) Angular momentum and Planck's constant b) Moment of inertia and moment of force

   c) Impulse and momentum d) Work and torque

5. If energy (E), velocity (V) and time (T) are chosen as the fundamental quantities, the dimensional formula of surface tension will be **[1]**

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

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

6. The unit of a in van der Waal's gas equation is: **[1]**

   a) atm L^2 per mol b) atm L^{-1} mol^{-2}

   c) atm L^2 mol^{-2} d) atm L^{-2} mol^2

7. In the formula $x = 3yz^2$, x and z have dimensions of capacitance and magnetic induction, respectively. The dimensions of y in MKS system are **[1]**

   a) $[M^{-2}\ L^{-2}\ T^4\ A^4]$ b) $[M^{-3}\ L^{-3}\ T^4\ A^5]$

   c) $[M^{-3}\ L^{-2}\ T^8\ A^4]$ d) $[M^{-1}\ L^{-4}\ T^2\ A^4]$

8. The magnetic moment has the dimensions of **[1]**

   a) $[L^2T^{-1}A]$ b) $[LT^{-1}A]$

c) [LA]

d) $[L^2A]$

9. The dimensional formula of angular momentum is **[1]**

a) $[ML^{-2}T^{-1}]$

b) $[ML^2T^{-2}]$

c) $[MLT^{-1}]$

d) $[ML^2T^{-1}]$

10. The dimensional formula of permeability of free space μ_0 is **[1]**

a) $[MLT^{-2}A^{-2}]$

b) $[M^0L^2T^{-1}A^2]$

c) $[M^0L^1T]$

d) $[M^0L^0T^0]$

11. The dimensions of Planck's constant equal to that of **[1]**

a) power

b) angular momentum

c) momentum

d) energy

12. The force F is given in terms of time t and displacement x by the equation F = A cos Bx + C sin Dt. The dimensional formula of $\frac{D}{B}$ is: **[1]**

a) $[M^0L^0T^0]$

b) $[M^0LT^{-1}]$

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

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

13. If momentum (P), area (A) and time (T) are taken to be fundamental quantities, then energy has the dimensional formula. **[1]**

a) $(P^2\ A^1\ T^1)$

b) $(P^1\ A^{-1/2}\ T^1)$

c) $(P^1\ A^{-1}\ T^1)$

d) $(P^1\ A^{1/2}\ T^{-1})$

14. **Assertion (A):** In the relation $f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$, where symbols have standard meaning, m represent linear mass density. **[1]**

Reason (R): The frequency has the dimensions of inverse of time.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

15. A book with many printing errors contains four different formulas for the displacement y of a particle undergoing a certain periodic motion. Choose the correct formula **[1]**

a) $y = a \sin \frac{2\pi t}{T}$

b) y = a sin vt

c) y = (a/T) sin t/a

d) $y = a \sin 2\pi t$

16. Name the physical quantity whose dimensional formula is ML^2T^{-2} . **[1]**

17. Deduce the dimensional formulae for the physical quantity Planck's constant. **[1]**

18. Deduce the dimensional formula for the physical quantity Young's modulus. **[1]**

19. Name the physical quantity whose dimensional formula as follow: MT^{-2} **[1]**

20. Deduce the dimensional formulae of the physical quantity of Mechanical equivalent of heat. **[1]**

21. Deduce the dimensional formula for the physical quantity **Coefficient of viscosity.** **[1]**

22. Name the physical quantity whose dimensional formula as follow: ML^2T^{-3} **[1]**

23. Deduce the dimensional formulae of the physical quantity of Latent heat. **[1]**

24. Deduce the dimensional formula for the physical quantity Surface tension. **[1]**

25. Justify L + L = L and L - L = L. **[1]**

26. Find the dimensional formulae of **[1]**

    1. Kinetic energy
    2. Pressure.

27. Name the physical quantity whose dimensional formula as follow: $ML^{-1}T^{-2}$ **[1]**

28. Are all constants dimensionless? **[1]**

29. Deduce the dimensional formulae of the physical quantity of Coefficient of thermal conductivity. **[1]**

30. In the following dimensionally correct equation for force, F = $\frac{X}{\text{Density}} + Y$, the dimensional formula for X is _____ and that for Y is _____. **[1]**

31. State dimensional formulae for stress, strain and Young's modulus. **[1]**

32. If slap times speed equals power, what will be the dimensional equation for slap? **[1]**

33. Deduce the dimensional formulae of the physical quantity of Universal gas constant. **[1]**

34. Check by the method of dimension whether the given equation is correct: $E = mc^2$ **[1]**

35. Using the relation $E = h\nu$, obtain the dimensions of Planck's constant. **[1]**

36. In the equation: y = a sin (ωt - kx), t and x stand for time and distance respectively. Obtain the dimensional formula for ω and k. **[1]**

37. Write the dimensional formula of (i) stress (ii) coefficient of viscosity. **[1]**

38. Deduce the dimensional formula of the physical quantity of Heat. **[1]**

39. Deduce the dimensional formulae of the physical quantity of Boltzmann's constant. **[1]**

40. Write the dimensional formulae of the following physical quantities: **[1]**

    i. work
    ii. angular velocity
    iii. pressure
    iv. Planck's constant

41. Name the physical quantity whose dimensional formula as follow: $ML^{-1}T^{-1}$ **[1]**

Section B

42. Differentiate between dimensional and non-dimensional variables. **[2]**

43. The displacement of a progressive wave is represented by y = A sin(ωt - kx), where x is distance and t is time. Write the dimensional formula of **[2]**

    i. ω and
    ii. k.

44. If the value of universal gravitational constant in SI is 6.6×10^{-11} Nm^2kg^{-2}, then find its value in CGS system. **[2]**

45. How is a dimensional formula different from a differential equation? **[2]**

46. Name any three physical quantities having the same dimensions and also give their dimensions. **[2]**

47. Find the dimension formula of force and write the SI unit of force? **[2]**

48. In the relation p = $(a/b)e^{-(az/\theta)}$, p is the pressure, z is the distance, and θ is the temperature. What is the dimensional formula of b? **[2]**

49. Distinguish between dimensional and non-dimensional constants. **[2]**

50. Find the dimensional formulae of **[2]**

i. charge

ii. potential

iii. resistance

iv. capacitance.

51. State the principle of homogeneity of dimensions. Test the dimensional homogeneity of the following equation : **[2]**

$h = h_0 + v_0t + \frac{1}{2}gt^2$

Section C

52. **State True or False:** **[3]**

(a) Magnetic flux and electric flux have the same dimensional formula. **[1]**

(b) Pressure and stress have different dimensional formula. **[1]**

(c) Work and energy have same dimensional formula. **[1]**

53. The critical angular velocity ω_c of a cylinder inside another cylinder containing a liquid at which its turbulence occurs depends on viscosity η, density ρ and the distance d between the walls of the cylinder. Find an expression for ω_c. **[3]**

54. Obtain dimensions of: **[3]**

i. impulse

ii. power

iii. surface energy

iv. coefficient of viscosity

v. bulk modulus

vi. force constant

55. Deduce dimensional formulae for: **[3]**

i. angle

ii. angular velocity

iii. angular acceleration

iv. torque

v. angular momentum and

vi. moment of inertia.

56. By using dimensional analysis, derive an expression for the height (h) to which a liquid of density (ρ) and surface tension (S) will rise in a capillary tube of radius (r). Given acceleration due to gravity is g and $h \propto \frac{1}{r}$. **[3]**

57. Obtain an expression for the centripetal force F acting on a particle of mass m moving with velocity in a circle of radius r. Take dimensionless constant K = 1. **[3]**

58. The period of vibration of a tuning fork depends on the length l of its prong, density d and Young's modulus Y of its material. Deduce an expression for the period of vibration on the basis of dimensions. **[3]**

59. The velocity v of water waves depends on the wavelength λ, density of water ρ and the acceleration due to gravity g. Deduce by the method of dimensions the relationship between these quantities. **[3]**

Section D

Question No. 60 to 64 are based on the given text. Read the text carefully and answer the questions: **[5]**

All quantities in mechanics are represented in terms of base units of length, mass and time. Additional base unit of temperature (kelvin) is used in heat and thermodynamics. In magnetism and electricity, the additional unit of electric current is ampere.

60. The dimensions of universal gravitational constant are:

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

c) $[M^{-1}L^{3}T^{-2}]$ d) $[M^{2}L^{2}T^{-2}]$

61. The coefficient of thermal conductivity has the dimensions

a) $[MLT^{-3}K^{-1}]$ b) $[ML^{-1}T^{-3}K^{-1}]$

c) $[ML^{-1}T^{3}K^{3}]$ d) $[MLT^{-3}K]$

62. Dimensions of resistance are

a) $[M^{2}LT^{-3}A^{-1}]$ b) $[ML^{2}T^{-3}A^{-1}]$

c) $[MLT^{-3}A^{-1}]$ d) $[ML^{2}T^{-3}A]$

63. Given, force = $\frac{\alpha}{\text{Density}+\beta^{3}}$

a) $[M^{2}L^{4}T^{-2}]$, $[M^{1/3}L^{-1}]$ b) $[M^{2}L^{-2}T^{-2}]$, $[ML^{-2}]$

c) $[M^{2}L^{-2}T^{-2}]$, $[M^{1/3}L^{-1}]$ d) $[ML^{2}T^{-2}]$, $[ML^{-1/3}]$

64. Which of the following has unit but no dimension?

a) Relative velocity b) Angle

c) Strain d) Relative density

65. Derive dimensionally the relation: $S = ut + \frac{1}{2}at^{2}$ **[5]**

66. Define dimensional formula. Give uses of dimensional analysis. Write down the limitations of dimensional analysis. **[5]**