Worksheet - 1

Topic: Units & Dimensions

1. The velocity of a particle is given by

$$V = a\,t^2 + b\,t + c$$

If V is measured in ms^{-1} and t is measured in sec, what are the units of a,b and c ?

2. If the unit of length mass and time each be doubled. How many times the unit of work is increased?

3. If the unit of length and force each be doubled, how many times does the unit of power increase?

4. The de-Broglie wavelength associated with a particle of mass m and energy E is $\frac{h}{\sqrt{2mE}}$. What is the dimensional formula of plank's constant h.

5. The equation of state of some gases can be expressed as

$(p + \frac{a}{V^2})(V - b) = R\,T$ Here P is the pressure, V the volume, T the absolute temperature, and a,b, R are constants .What are the dimensions of a and b?

6. The number of particles is given by $n = -D\frac{n_2 - n_1}{x_2 - x_1}$ crossing a unit area perpendicular to X –axis in unit time, where n_1 and n_2 are number of particles per unit volume for the value of x meant to x_1 and x_2 . Find dimensions of D called as diffusion constant?

7. If force, length and time are taken as fundamental units, then what will be the dimension of mass?

8. In a system of units, the units of mass, length and time are 1 quintal,1 kilometer and 1 hour respectively. What will be 1 Newton force in this system?

9. What is the dimension of a/b in the equation $p = \frac{a - t^2}{bx}$ where P is pressure, X is distance and t is time

10. The velocity v of a particle at a time t is given by $v = at + \frac{b}{t+c}$, Find the dimensions of a,b and c.

11. The velocity v of transverse waves on a string may depend upon (i) length (ii) tension of string (iii) mass per unit length (m) of the string. Derive the formula dimensionally.

12. A jet of water of cross sectional area A and velocity v impinges normally on a stationary flat plate. The mass per unit volume of water is ρ . By dimensional analysis, determine an expression for the force F exerted by the jet against the plate.

13. A simple pendulum, having a bob attached to a string, that oscillates under the action of the force of gravity. Suppose that the period of oscillation of the simple pendulum depends on its length (l), mass of the bob (m) and acceleration due to gravity (g). Derive the expression for its time period using method of dimensions.

ANSWERS

1. $a=LT^{-3}, b=LT^{-2}, c=LT^{-1}$ **2.** two times **3.** four times **4.** ML^2T^{-1}

5. $a=ML^5T^{-2}, b=L^3$ **6.** L^2T^{-1} **7.** $FL^{-1}T^2$ **8.** 129.6new units

9 .MT^{-2} **10.** $a=LT^{-2}, b=L, c=T$ **11.** $v=\frac{k}{L}\sqrt{\frac{T}{m}}$

12. $F = k\rho Av^2$ **13.** $t = 2\pi\sqrt{\frac{l}{g}}$
