SUNCITY SCHOOL
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DIMENSIONAL ANALYSIS

1. Convert a power of 1 MW on a system whose fundamental units are 10 kg, 1dm & 1 minute.
2. A gas bubble from an explosion under water oscillates with a period T proportional to $p^a d^b E^c$ where p is the static pressure, d is the density of water and E is the total energy of the explosion. Find the value of a, b and c.
3. Assuming that the mass m of the largest store that can be moved by a flowing river depends upon the velocity v, density ρ and acceleration due to gravity g, show that m varies with sixth power of the velocity of flow.
4. Calculate the dimension of i) Force and ii) Impulse in terms of velocity v, density ρ & frequency v as the fundamental units.
5. Construct a new physical quantity having dimension of length in terms of universal constants G, c and h. What is it called?
6. The coefficient of viscosity η of a gas depends upon the mass m, the effective diameter d and the mean speed of the gas molecules. Use dimensional analysis to find the relation between them.
7. Check the dimensional consistency of the following equations:

   $h = r\rho g / 2S\cos\theta$

   where h is the height, r is the radius, ρ is the density, θ is the angle of contact, S is the surface tension and g is the acceleration due to gravity.
8. The velocity of a body which has fallen freely under gravity varies as $g^p h^q$ where g is the acceleration due to gravity and h is the height which the body has fallen from. Determine the values of p and q.
9. Find the value of x in the following equation:

   $(\text{velocity})^x = (\text{pressure difference})^{3/2} (\text{density})^{-3/2}$
10. Write the dimensions of a and b in the following relations:

    a) $E = \frac{b-x^2}{at}$ where E, x and t represents energy, distance and time respectively.

    b) $\left(P + \frac{a}{V^2}\right)(V - b) = RT$ where P, V & T represents pressure, volume & temp. respectively.
11. A calories is a unit of heat and it equals 4.2J where $1J = 1kgm^2s^{-2}$. Suppose we employ a system 0f units in which the unit of mass equals to α kg, the unit of length equals β m, the unit of time is γ s. Show that a calories has a magnitude of $4.2\ \alpha^{-1}\beta^{-2}\gamma^2$ in terms of the new units.
12. If the units of force, energy and velocity are 10N, 100J and 5m/s, find the units of mass, length and time.