

Daily Practice Problems

Q1) The air bubble formed by explosion inside water perform oscillations with time period T which depends on pressure (p), density (ρ) and on energy due to explosion (E). Establish relation between T , p , E and ρ .

Q2) The velocity v of a particle depends upon the time ' t ' according to the equation

$$v = \sqrt{ab} + bt + \frac{c}{d+t}$$

Determine the units of a , b , c and d . What physical quantities they represent. All have SI units

Q3) An artificial satellite is revolving around a planet of mass M and radius R , in a circular orbit of radius r . Determine its time period T .

$$T = \frac{k}{R} \sqrt{\frac{r^3}{g}},$$

where k is a dimensionless constant and g is acceleration due to gravity.

Q4) The speed of sound v in a gas might plausibly depend on the pressure p , the density ρ , and the volume V of the gas. Use dimensional analysis to determine the exponents x , y , and z in the formula

$$v = C p^x \rho^y V^z,$$

where C is a dimensionless constant. Incidentally, the mks units of pressure are kilograms per meter per second squared.

Q5) What variable could not influence the velocity if it is proposed that the velocity depends on a diameter?

- a. length
- b. gravity
- c. rotational speed
- d. viscosity

Ans. D

Q6) If v stands for velocity of sound, E is elasticity and d the density, then find x in the equation $v = (d/E)^x$

- a. 1
- b. $\frac{1}{2}$
- c. 2
- d. $-\frac{1}{2}$

Ans. D

Q7) Force of viscosity F acting on a spherical body moving through a fluid depends upon its velocity (v), radius (r) and co-efficient of viscosity ' η ' of the fluid. Using method of dimensions obtain an expression for ' F '.

Q8) A spherical ball of mass m and radius r is allowed to fall in a medium of viscosity η . The time in which the velocity of the body increases from zero to 0.63 times the terminal velocity is called time constant (τ). Dimensionally τ can be represented by

- a. $\frac{mr^2}{6\pi\eta}$
- b. $\sqrt{\frac{6\pi m\eta}{g^2}}$
- c. $\frac{m}{6\pi\eta r}$
- d. none of these.

Ans. C

Q9) a length scale ' l ' depends on the permittivity ϵ of a dielectric material, Boltzmann's constant k_B , the absolute temperature T , the number per unit volume n of certain charged particles, and the charge q carried by each of the particles which of the following expression(s) for l is (are) dimensionally correct?

- a. $l = \sqrt{\frac{nq^2}{\epsilon k_B T}}$
- b. $l = \sqrt{\frac{\epsilon k_B T}{nq^2}}$

$$c. l = \sqrt{\frac{q^2}{\epsilon n^{2/3} k_B T}}$$

$$d. l = \sqrt{\frac{q^2}{\epsilon n^{1/3} k_B T}}$$

Ans. b, d

Q10 Plank's constant h , speed of light c and gravitational constant G are used to form a unit of length L and a unit of mass M . Then, the correct options is/are

a. $M \propto \sqrt{c}$

b. $M \propto \sqrt{G}$

c. $L \propto \sqrt{h}$

d. $L \propto \sqrt{G}$

Ans. a, c, d

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