1. Turpentine oil is flowing through a tube of length ℓ and radius r. The pressure difference between the two ends of the tube is p; the viscosity of the oil is given by :

$$\eta = \frac{p\left(r^2 - x^2\right)}{4v\ell}$$

where v is the velocity of oil at a distance x from the axis of the tube. From this relation, the dimension of viscosity η is :

(A) $[M^0L^0T^0]$ (B) $[MLT^{-1}]$ (C) $[ML^2T^{-2}]$ (D) $[ML^{-1}T^{-1}]$

2. The time dependence of a physical quantity P is given by $P = P_0\, e^{-\alpha t^2}\left(-\alpha t^2\right)$ [where α is a constant and t is time]. The constant α :

(A) is dimensionless (B) has dimension $[T^{-2}]$

(C) has dimension $[T^2]$ (D) has dimension of P

3. The number of particles crossing per unit area perpendicular to X - axis in unit time is ;

$$N = -D\frac{n_2 - n_1}{x_2 - x_1}$$

where n_1 and n_2 are number of particles per unit volume for the value of x_1 and x_2 respectively. The dimension of diffusion constant D is :

(A) $M^\circ LT^2$ (B) $M^\circ L^2T^{-4}$ (C) $M^\circ LT^{-3}$ (D) $M^\circ L^2T^{-1}$

4. The force acting on a body is represented as $F = A\cos Bx + C\sin Dt$ where x is displacement and t is time. The dimensions of $\frac{D}{B}$ are

(A) $M^0\ L^0\ T^0$ (B) $M^0\ L^{-1}\ T^0$ (C) $M^0\ L^0\ T^{-1}$ (D) $M^0\ LT^{-1}$

5. In a book, an answer for a particular question is expressed as $b = \frac{ma}{k}\left[\sqrt{1 + \frac{2k\ell}{ma}}\right]$, here m represents mass, a represents acceleration, ℓ represents length. The unit of b should be :

(A) m/s (B) m/s^2 (C) metre (D) /sec.

6. The velocity v of a point at time is given by :

$$v = at + \frac{b}{t + c}$$

The dimensions of a, b and c are respectively :

(A) $[L^2]$; [T] and $[LT^2]$ (B) $[LT^2]$; [LT] and [L]

(C) $[LT^{-2}]$; [L] and [T] (D) [L]; [LT] and $[T^2]$

7. If position of particle is given by the equation, $x = at^3 + bt^2 + \frac{c}{t}$, then what is the dimensional formulae of constants a , b & c respectively , if 'x' is position and 't' is the time

(A) $\left[LT^{-3}\right]$, $\left[LT^{-2}\right]$, $\left[LT^2\right]$ (B) $\left[LT^{-3}\right]$, $\left[LT^{-2}\right]$, [L]

(C) $\left[LT^{-3}\right]$, $\left[LT^{-2}\right]$, [L T] (D) $\left[LT^{-2}\right]$, $\left[LT^{-1}\right]$, [L T]

8. The frequency of vibration of a mass m suspended from a spring of spring constant K is given by the relation :

$$f = Cm^xK^y$$

where C is a dimensionless constant. The values of x and y are :

(A) $x = 1/2, y = 1/2$ (B) $x = -1/2, y = -1/2$

(C) $x = 1/2, y = -1/2$ (D) $x = -1/2, y = +1/2$

9. The equation of a plane progressive wave is given by ;

$$y = A \sin(\omega t - kx)$$

The dimensions of ω/k are that of :

(A) frequency (B) velocity (C) wavelength (D) inverse of velocity

10. If $x = \frac{a\sin\theta + b\cos\theta}{a+b}$, then :

(A) the dimensions of x and a are same (B) the dimensions of a and b are not same

(C) x is dimensionless (D) none of the above

11. Force F and density d are related as $F = \frac{\alpha}{\beta + \sqrt{d}}$ then find the dimensions of α and β.

12. In the following equations, the distance x is in metres, the time t in seconds and the velocity v in metres/second. What are the SI units of the constants C_1 and C_2?

(a) $v^2 = 2C_1x$ (b) $x = C_1 \cos C_2t$ (c) $v = C_1e^{-C_2t}$

Answers Key

1.	(D)	2.	(B)	3.	(D)	4.	(D)	5.	(c)	6.	(C)	7.	(C)
8.	(D)	9.	(B)	10.	(C)	11.	$M^{3/2}L^{-½}T^{-2}$, $M^{½}$, $L^{-3/2}$]						
12.	(a) m/s^2, (b) m, /sec, (c) m/s, /sec]												