CEP Phase-2 Session 2024-25
Class 11th
Subject:- Physics (LEP Study Material)

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Ch 1 Units and Measurements

1. A physical quantity can be written as Q = nu

Or $Q = n_1u_1 = n_2u_2$

2. Some more practical units:

3. Astronomical unit (AU): It is the average distance between the centres of sun and earth. 1 AU = 1.496×10^{11} m = 1.5×10^{11} m

4. Light year: It is the distance travelled by light in vacuum in one year. 1 ly = 9.462×10^{15} m

5. Parallactic second (parsec): 1 parsec is the distance at which an arc 1 AU long subtends an angle of 1 second (1″). 1 $parsec = 3.1 \times 10^{16}\ m$

6. 1 mean solar second is defined as $\frac{1}{86400}$th part of 1 mean solar day.

7. Dimensions have three important applications.

1. To convert one system of units into another.
2. To check the correctness of a given formula or equation
3. To derive new formulas

Ch 2 Motion in a straight line

1. Speed = $\frac{\text{Distance travelled}}{\text{time taken}}$

2. Average speed = $\frac{\text{Total distance travelled}}{\text{Total time taken}} = \frac{\Delta S}{\Delta t}$

3. Instantaneous speed: $V_{inst} = \underset{\Delta t \to 0}{Lt} \frac{\Delta S}{\Delta t} = \frac{dS}{dt}$

4. velocity, v = $\frac{\text{Displacement covered}}{\text{time taken}} = \frac{x_2 - x_1}{t_2 - t_1}$

5. Formula for uniform motion, S = vt or $x - x_o$ = vt or $x = x_o$ + vt

6. in the uniform motion of a body in one dimension
(i) Velocity is given by slope of position time graph and
(ii) Displacement covered is equal to area under the velocity time graph

7. Average velocity = $\frac{\text{Total displacement travelled}}{\text{Total time taken}} \Longrightarrow V_{av} = \frac{\Delta x}{\Delta t}$

Graphically average velocity of a body between two times t_1 and t_2 is equal to the slope of line AB joining two points A and B on the x – t curve corresponding to the times t_1 and t_2.

8. Instantaneous velocity, $V_{inst} = \underset{\Delta t \to 0}{Lt} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$

Graphically, instantaneous velocity of a body at any time t is equal to the slope of tangent at a point on the x – t curve corresponding to the time t.

9. acceleration, a = $\frac{\text{change in velocity}}{\text{time taken}} = \frac{v_2 - v_1}{t_2 - t_1}$

10. Average acceleration = $\frac{\text{Total change in velocity}}{\text{Total time taken}} \Longrightarrow a_{av} = \frac{\Delta v}{\Delta t}$

Graphically average acceleration is equal to the slope of line on the v – t curve

11. Instantaneous acceleration, $a_{inst} = \underset{\Delta t \to 0}{Lt} \frac{\Delta v}{\Delta t} = \frac{dv}{dt}$
Graphically, instantaneous acceleration is equal to the slope of tangent at a point.
12. Equations of motion:
(i) v = u + at (ii) S = ut + ½ at² or $x = x_o$ + ut + ½ at² (iii) $v^2 - u^2$ = 2aS (iv) distance covered in nth second, $D_n = u + \frac{a}{2}(2n - 1)$
13. In uniformly accelerated motion in one dimension
(a) The acceleration is equal to slope of vel – time graph
(b) The displacement is equal to area under the vel – time graph

Ch 3: Motion in a plane

Part 1: Vectors

1. Unit vector, $\hat{A} = \frac{\vec{A}}{A}$
2. Triangle law and parallelogram laws of vector addition:
$\vec{R} = \vec{A} + \vec{B}$
Magnitude of resultant $\vec{R}$ is
$R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$

Direction of $\vec{R}$: $\tan\phi = \frac{B\sin\theta}{A + B\cos\theta}$
3. Condition for zero resultant vector:
For three vectors: Resultant of three vectors will be a zero vector if three vectors are represented by the sides of a triangle taken in the same order.
Also in this case, $\frac{A}{OP} = \frac{B}{PQ} = \frac{C}{QO}$
4. Lami's theorem: $\frac{F_1}{\sin\alpha} = \frac{F_2}{\sin\beta} = \frac{F_3}{\sin\gamma}$
5. Relative velocity: Relative velocity of a body A wrt another body B is
$\overrightarrow{V_{AB}} = \overrightarrow{V_A} - \overrightarrow{V_B}$
6. Rectangular components: These are the components of a vector which are ⊥ to each other.
In plane, there are two and in space, there are three rectangular components.
7. Rectangular components of a vector in a plane:
$\vec{A} = \vec{A_x} + \vec{A_y}$ Or $\vec{A} = A_x\hat{\imath} + A_y\hat{\jmath}$
A_x = A cos θ, A_y = A sin θ
Squaring and adding these equations $A = \sqrt{A_x^2 + A_y^2}$
Dividing these equations, $\tan\theta = \frac{A_y}{A_x}$
8. Dot product or scalar product:
(i) $\vec{A}.\vec{B}$ = AB cos θ
Dot product of two vectors is a scalar quantity. ∴ dot product is also called scalar product.
(ii) In cartesian coordinates, $\vec{A}.\vec{B} = A_xB_x + A_yB_y + A_zB_z$
9. Cross product or vector product:
(i) $\vec{A} \times \vec{B}$ = AB sin θ $\hat{n}$
$\hat{n}$ gives the direction of $\vec{A} \times \vec{B}$.
(ii) Direction of $\vec{A} \times \vec{B}$: Direction of $\vec{A} \times \vec{B}$ or $\hat{n}$ can be found by using the right hand thumb rule.
(v) Cross product in Cartesian coordinates:

$$\vec{A} \times \vec{B} = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

PART 2 Projectile motion

1. Projectiles given horizontal projection:
(a) The path of projectile given horizontal projection is a parabolic path.
$y = \frac{1}{2}g\left(\frac{x}{u}\right)^2 = \frac{gx^2}{2u^2}$ or $x^2 = \left(\frac{2u^2}{g}\right)y$
(b) Time of flight (T): $T = \sqrt{\frac{2h}{g}}$
(c) Horizontal range (R): $R = uT = u\sqrt{\frac{2h}{g}}$
(d) Velocity at any time: $v_x = u$, $v_y = gt$
magnitude of velocity is $V = \sqrt{V_x^2 + V_y^2} = \sqrt{u + g^2t^2}$ Direction of velocity is $\tan\phi = \frac{V_y}{V_x} = \frac{gt}{u}$
2. Projectile given angular projection:
(a) Path of projectile given angular projection is a parabolic path. $y = x\tan\theta - \frac{gx^2}{2u^2\cos^2\theta}$
(b) Time of flight (T): It contains two times.
(i) Time of ascent (t_1): $t_1 = \frac{u\sin\theta}{g}$, (ii) Time of descent ($t_2$): $t_2 = \frac{u\sin\theta}{g}$
(iii) time of flight, $T = t_1 + t_2 = \frac{2u\sin\theta}{g}$
(c) Maximum height attained (H):
Taking vertical motion from O to A
$H = \frac{u^2\sin^2\theta}{2g}$
Height attained will be maximum when thrown vertically.
(d) Horizontal range (R): $R = \frac{u^2\sin 2\theta}{g}$
Horizontal range will be maximum when thrown at an angle of 45° with horizontal.
(e) Horizontal range is same whether the body is thrown at an angle θ or 90° – θ.
(e) Velocity at any instant:
$v_x = u\cos\theta$, $v_y = u\sin\theta - gt$
Magnitude of velocity is $V = \sqrt{V_x^2 + V_y^2}$
Direction of velocity is $\tan\phi = \frac{V_y}{V_x} = \frac{u\sin\theta - gt}{u\cos\theta}$

Ch 4 Laws of Motion:

Part 1 : Newton's Laws of Motion

1. Linear momentum, P = mv

SI unit of momentum is $kgms^{-1}$ and dim are $[P] = MLT^{-1}$
2. Newton's second law of motion: $\frac{d\vec{P}}{dt} \propto \vec{F}$

$\therefore F = \frac{d\vec{P}}{dt}$ or F = ma
In SI, absolute unit of force is newton (N). In CGS, absolute unit of force is dyne (dyne). $1\ N = 10^5$ dyne
3. Impulse: Impulse is also defined as the total change in linear momentum produced during time t. $\vec{I} = \overrightarrow{F_{av}} \times t = \vec{P_2} - \vec{P_1}$ 7. Newton's third law of motion: $\overrightarrow{F_{12}} = -\overrightarrow{F_{12}}$
4. Law of conservation of linear momentum: If $F_{ext} = 0$, then P = constant or $m_1\vec{v_1} + m_2\vec{v_2} = m_1\vec{u_1} + m_2\vec{u_2}$
5. Masses attached to a pulley (Pulley problem)
$T = \frac{2m_1m_2g}{m_1 + m_2}$, $a = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)$

Part 2: Friction

1. First law of limiting friction $F \propto R$ or $F = \mu R$ or $\mu = \frac{F}{R}$
2. Relation between μ and θ: $\mu = \tan\theta$
3. Relation between μ and ∝: $\mu = \tan\propto$
4. Relation between θ and ∝: $\theta = \propto$

Part 3: Rotational Motion

1. Angular Displacement: $\theta = \frac{arc}{radius}$
2. Angular velocity (ω): $\omega = \frac{Angle\ covered}{time\ taken} = \frac{d\theta}{dt}$
3. Relation between linear and angular velocity (v and ω): v = ωr
In vector form, $\vec{v} = \vec{\omega} \times \vec{r}$
4. Angular acceleration (α): $\alpha = \frac{change\ in\ angular\ velocity}{time\ taken}$
$\alpha = \frac{d\omega}{dt} = \frac{d}{dt}\left(\frac{d\theta}{dt}\right) = \frac{d^2\theta}{dt^2}$
5. Relation between linear and angular acc (a and α): a = αr
In vector form, $\vec{a} = \vec{\alpha} \times \vec{r}$
6. Uniform circular motion:
Relation between time period and frequency: $T = \frac{1}{\nu}$ or $\nu = \frac{1}{T}$

Relation between ω, T and v: $\omega = \frac{2\pi}{T} = 2\pi\nu$

7. Centripetal acceleration (a_c): Mag of $\overrightarrow{a_c}$: $a_c = \omega v = \omega^2 r = \frac{v^2}{r}$

Direction of centripetal acceleration: $\overrightarrow{a_c}$ act towards the centre.

8. Centripetal Force (F_c): $F_c = m\omega v = m\omega^2 r = \frac{mv^2}{r}$

9. Rounding a level circular turn: $v \leq \sqrt{\mu r g}$

10. Banking of roads: $v = \sqrt{rg\left(\frac{\mu + \tan\theta}{1 - \mu\tan\theta}\right)}$

Special case: If there is no friction, μ = 0, then

$v = \sqrt{rg\tan\theta}$, $\tan\theta = \frac{v^2}{rg}$ Also, $\tan\theta = \frac{h}{b}$

$\therefore \tan\theta = \frac{v^2}{rg} = \frac{h}{b}$ Or $h = \frac{v^2}{rg} \times b$

Unit 4: Work, Energy and Power

1. $W = FS\cos\theta = \overrightarrow{F}.\overrightarrow{S}$, $1J = 10^7$ erg
2. Power, $P = \frac{W}{t} = \frac{dW}{dt}$, Also, $P = \overrightarrow{F}.\overrightarrow{v} = FV\cos\theta$
3. Kinetic energy of body, $E_K = \frac{1}{2}mv^2$, $E = \frac{P^2}{2m}$
4. Work energy principle: $W_{net} = E_f - E_i = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$
5. Gravitational potential energy, U = mgh
6. Potential energy stored in a spring F = -Ky,

(i) Restoring force produced in a string, F = -Ky $U = W = \frac{1}{2}Ky^2$

7. coefficient of restitution, $e = \frac{\text{rel velocity of separation}}{\text{rel velocity of approach}} = \frac{v_2 - v_1}{u_1 - u_2}$ For elastic collision, e = 1, For perfectly inelastic collision, $v_1 = v_2$, ∴ e = 0, For other collisions, e lies between 0 and 1

8. Elastic collision of two bodies in one dimension

$v_1 = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)u_1 + \frac{2m_2u_2}{m_1 + m_2}$, $v_2 = \left(\frac{m_2 - m_1}{m_1 + m_2}\right)u_2 + \frac{2m_1u_1}{m_1 + m_2}$

Centre of mass and rotational motion

1. Center of mass of two particle system: $\overrightarrow{r_{CM}} = \frac{m_1\overrightarrow{r_1} + m_2\overrightarrow{r_2}}{m_1 + m_2}$
2. Torque, $\tau = F \times d$ or $\overrightarrow{\tau} = \overrightarrow{r} \times \overrightarrow{F}$ or $\tau = rF\sin\phi$
3. Ang Mom, $L = P \times d$ or $\overrightarrow{L} = \overrightarrow{r} \times \overrightarrow{P}$ or $\tau = rP\sin\phi$
4. Moment of inertia, $I = \sum_{i=1}^{N} m_i r_i^2$
5. Rotational KE, $E = \frac{1}{2}I\omega^2 = L^2/2I$
6. Torque, $\tau = I\alpha = I\frac{d\omega}{dt}$, $L = I\omega$, $\overrightarrow{\tau} = \frac{\overrightarrow{dL}}{dt}$

U – 6, Ch - 7 GRAVITATION

1. Kepler 2nd law, dA/dt = constant
2. Kepler 3rd law, $T^2 \propto R^3$
3. Newton law, $F = Gm_1m_2/r^2$,
4. g with height, $g_h = gR^2/(R+h)^2$ or $g_h = g(1 - 2h/R)$
5. g with depth, $g_d = g(1 - d/R)$

6. Satellite:

Orbital velocity, $v_o = R\sqrt{\frac{g}{R+h}}$

KE = GMm/2R, PE = -GMm/R, TE = - GMm/2R

7. Escape velocity, $v_e = \sqrt{\frac{2GM}{R}} = \sqrt{2gR}$

UNIT 7 PROPERTIES OF BULK MATTER

CHAPTER 8 MECHANICAL PROPERTIES OF SOLIDS

1. STRESS = $\frac{restoring force}{area} = \frac{F}{a}$
2. STRAIN = $\frac{change in dimension}{original length} = \frac{l}{L}$
3. YOUNG MODULUS = $\frac{normal stress}{longitudinal strain}$, $\frac{F/a}{l/L} = \frac{FL}{al} = \frac{FL}{\pi r^2 l}$
4. WORK DONE IN STRECHING A WIRE = $\frac{1F \times l}{2}$

$W = \frac{1}{2}$ stretching force × increase in length

5. BULK MODULUS, B = $\frac{normal stress}{volumetric strain} = \frac{F/a}{\Delta V/V} = -\frac{FV}{a\Delta V} = -\frac{PV}{\Delta V}$
6. COMPRESSIBILITY, K = 1/B
7. MODULUS OF RIGIDITY = η = $\frac{tangential stress}{shear strain} = \frac{F/a}{\theta} = \frac{F}{a\theta}$

CHAPTER 9 MECHANICAL PROPERTIES OF FLUIDS

1. Pressure $P = \frac{F}{A}$
2. Surface Tension $S = \frac{F}{l}$
3. Surface Energy, $W = S \times \Delta A$
4. Excess pressure inside a liquid drop or air bubble, $P = \frac{2S}{R}$
5. Excess pressure inside a soap bubble $P = \frac{4S}{R}$
6. Pascal's Law $\frac{F_1}{a_1} = \frac{F_2}{a_2}$
7. Equation of Continuity: $a_1v_1 = a_2v_2$
8. Bernoulli's Theorem: Pressure energy/mass + KE/mass + PE/mass = $P/\rho + \frac{1}{2}v^2 + gh$ = constant
9. Viscosity

$F = \eta Adv/dx$ or $\eta = Fdx/Adv$

10. Poiseuille formula, $V = \pi Pr^4/8\eta l$
11. Stokes law, $F = 6\pi\eta rv$ and terminal velocity, $v = 2r^2(\sigma - \rho)g/9\eta$

CHAPTER 10 THERMAL PROPERTIES OF MATTER

1. $\frac{T_C}{100} = \frac{T_F - 32}{180} = \frac{T_K - 273.15}{100}$
2. Linear expansion: $\Delta l = \alpha l\Delta T$, $\alpha = \frac{\Delta l}{l\Delta T}$, Areal expansion: $\Delta A = \beta A\Delta T$, $\beta = \frac{\Delta A}{A\Delta T}$, Volume expansion: $\Delta V = \gamma V\Delta T$, $\gamma = \frac{\Delta V}{V\Delta T}$
3. Energy required in heating a substance, Q = mcΔT, c = sp. Heat,
4. Calorimetry, $c = \frac{(m_2 + w)(T - T_2)}{m_1(T_1 - T)}$
5. Energy reqd in changing phase, Q = mL, L = latent heat
6. Heat conductivity, $\frac{\Delta Q}{\Delta t} = KA\frac{\Delta T}{\Delta x}$, K = thermal conductivity
7. Stefan's law: $E \propto T^4$ or $\mathbf{E = \sigma T^4}$, $\sigma = 5.67 \times 10^{-8}$ $Wm^{-2}K^{-4}$.
8. Wien's displacement law: $\lambda_m \propto \frac{1}{T}$ or $\lambda_m = \frac{b}{T}$ where b is Wien's constant. Its value is b = 0.29 cm k.

Ch 11 Thermodynamics

1. Slopes of isothermal and adiabatic curves:

Slope of isothermal curve, $\frac{dP}{dV} = -\frac{P}{V}$

Slope of adiabatic curve, $\frac{dP}{dV} = -\frac{\gamma P}{V}$

2. Work done in an isothermal process:

$W = 2.303\ RT log_{10}\frac{V_2}{V_1} = 2.303\ RT log_{10}\frac{P_1}{P_2}$

3. Work done in an adiabatic process:

$W = \frac{P_2V_2 - P_1V_1}{1-\gamma} = \frac{R(T_2 - T_1)}{1-\gamma}$

4. First law of thermodynamics:

dQ = dU + dW

It is based on law of conservation of energy.

5. Relation between C_P and C_V (Mayer's formula)

$(C_P - C_V) = R$

6. Efficiency of heat engine:

We can show that in an ideal engine like Carnot engine, $\frac{Q_2}{Q_1} = \frac{T_2}{T_1}$

$\eta = \frac{W}{Q_1} = 1 - \frac{Q_2}{Q_1} = 1 - \frac{T_2}{T_1}$

7. Coefficient of performance of refrigerator (β):

$\beta = \frac{Q_2}{W} = \frac{Q_2}{Q_1 - Q_2} = \frac{T_2}{T_1 - T_2}$

8. Relation between β and η:

$\beta = \frac{1-\eta}{\eta}$ or $\eta = \frac{1}{1+\beta}$

Ch 12 Kinetic Theory

1. Pressure exerted by a gas:

$P = \frac{1}{3}\frac{M}{V}C^2 = \frac{1}{3}\rho C^2$

E is kinetic energy per unit volume of the gas.

3. Average KE/molecule of a gas:

Av KE/molecule = $\frac{1}{2}mC^2 = \frac{3}{2}KT$

Also, $C^2 \propto T$ for a gas

Or $C \propto \sqrt{T}$

Thus, RMS speed

where $C = \sqrt{\frac{C_1^2+C_2^2+---+C_N^2}{N}}$ is the root mean square speed of the molecules of the gas.

2. Relation between pressure and kinetic energy of a gas:

$P = \frac{2}{3}E$

of a gas molecule is the function of temperature only.

4. Kinetic interpretation of temperature: From relation $\frac{1}{2}mC^2 = \frac{3}{2}KT$, we come to know that temperature is the measure of Av KE of translation/molecule of the gas.

If T = 0K, $\frac{1}{2}mC^2 = 0$, Thus, absolute zero is the temperature at which molecular motion ceases.

5. Various speed of a gas:

(i) Mean speed (C_{av}): $C_{av} = \frac{C_1+C_2+\_\_\_\_\_+C_N}{N} = C_{av} = \sqrt{\frac{8KT}{\pi m}} = \sqrt{\frac{8RT}{\pi M}}$

(ii) RMS speed, $C_{rms} = \sqrt{\frac{C_1^2+C_2^2+\_\_\_\_\_+C_N^2}{N}}\ \sqrt{\frac{8KT}{\pi m}} = \sqrt{\frac{8RT}{\pi M}}$

(iii) Most probable speed (C_{mp}): $C_{mp} = \sqrt{\frac{2KT}{m}} = \sqrt{\frac{2RT}{M}}$

6. Degrees of freedom: f = 3N - 1

Degrees of freedom of a system are the number of modes by which a system can absorb energy corresponding to translational, rotational and vibrational motion of molecules.

7. Law of equipartition of energy:

It states that the total energy of a system is divided equally amongst its various degrees of freedom and each degree of freedom gets the energy $\frac{1}{2}KT$.

8. Specific heats of mono, di and tri atomic gases:

$C_V = \frac{dU}{dT}$ and $C_P - C_V + R$

9. Mean free path (λ): $= \frac{\lambda_1+\lambda_2+\lambda_3+-----}{N} = \frac{C_{av}\times t}{N}$

$\lambda = \frac{1}{\sqrt{2}\pi d^2 n} = \frac{KT}{\sqrt{2}\pi d^2 P}$

Oscillations

1. In equation $y = A \sin(\omega t + \phi)$, where $(\omega t + \phi)$ is the phase of the particle at any instant t, ϕ is initial phase of particle at t = 0.
2. Velocity of a particle executing S.H.M. is $v = \omega\sqrt{(A^2 - y^2)}$, where A = amplitude, ω = angular frequency and y = displacement at any instant t.
3. Acceleration (a) of a particle executing S.H.M. is $a = \omega^2 y$.
4. Kinetic energy of a particle executing S.H.M. is given as, $K = 1/2\, m\omega^2 (A^2 - y^2)$.

(a) Kinetic energy is maximum at y = 0 i.e. at mean position and $K_{max} = 1/2\, m\omega^2 A^2$.

5. Potential energy of a particle executing S.H.M. is given by $U = 1/2\, m\omega^2 y^2$.
6. Total energy of a particle executing S.H.M. is $E = 1/2\, m\omega^2 A^2$.
7. The time period of a simple pendulum is $T = 2\pi\sqrt{L/g}$, where L = length of the pendulum and g = acceleration due to gravity.

Ch 14 Waves

FORMULAS

1. Wave number $\bar{n} = 1/\lambda$
2. Velocity of Wave $V = n\lambda$
3. Equation of a progressive wave $y = r \sin[2\pi(Vt \pm x)/\lambda]$
4. The relation between wave-velocity, frequency and wavelength is given by $V = \nu\lambda$
5. Speed of transverse wave in a stretched string is given by $V = \sqrt{T/\mu} = \sqrt{T/\pi r^2\rho}$
6. Speed of longitudinal waves in a medium is given by $V = \sqrt{E/\rho}$
7. For solid medium, $v = \sqrt{E/\rho}$ and for fluid medium, $v = \sqrt{B/\rho}$
8. Speed of sound in air is $v = \sqrt{\Upsilon P/\rho}$
9. A travelling wave or a progressive wave propagating along positive x-axis is represented by = a sin (kx-ωt) where $k = 2\pi/\lambda$ (propagation constant)
10. A travelling wave or a progressive wave propagation along negative x-axis is represented by y = a sin (kx + ωt)

Unit-1 Units and Measurements

1 Mark Questions (MCQs)

1. 1 metre is equal to: (a) 10^{10} Å (b) 10^8 Å (c) 10^6 Å (d) 10^5 Å
2. One fermi is equal to: (a) 10^{-19} m (b) 10^{-15} m (c) 10^{-8} m (d) 10^{-6} m
3. One light-year distance is equal to:(a)9.46×10^{10} km (b)9.46×10^{12} km (c)9.46×10^{12} m (d)9.46×10^{15} cm
4. One shake is equal to: (a) 10^{-2} sec (b) 10^{-4} sec (c) 10^{-6} sec (d) 10^{-8} sec
5. One barn is equal to: (a) 10^{-20} m^2 (b) 10^{-22} m^2 (c) 10^{-24} m^2 (d) 10^{-28} m^2
6. One micron is equal to: (a) 10,000 angstrom (b) 1000 angstrom (c) 100 angstrom (d) 10 angstrom
7. Parallactic second is the unit of: (a) distance (b) time (c) frequency (d) velocity
8. Which one of the following is not a unit of time? (a) Lunar month (b) Leap year (c) Parallactic second (d) Solar day
9. Which one of the following is not the name of a physical quantity? (a) Density (b) Impulse (c) Energy (d) Kilogram
10. Joule × sec is the unit of: (a) energy (b) momentum (c) angular momentum (d) power
11. One astronomical unit is the distance between: (a) Moon and the Earth (b) Mars and the Earth (c) Sun and the Earth (d) Sun and Pluto
12. KWh is a unit of: (a) power (b) energy (c) force (d) temperature
13. SI unit of quantity of matter is: (a) Kg (b) mole (c) g (d) both (a) and (c)
14. electron-volt is a unit of: (a) charge (b) potential (c) energy (d) coulomb repulsion
15. SI unit of luminous intensity is: (a) lumen (b) candela (c) lux (d) watt

Units & Dimensions Answer Key

1. A	2. B	3. B	4. D	5. D	6. A	7. A	8. C	9. D	10. C
11. C	12. B	13. B	14. C	15. B					

2 Marks Questions:

Q1. What do you understand by measurement of physical quantity?

Q2. What are fundamental units?

Q3. What are derived units?

Q4. Write characteristics of standard unit.

Q5. Define system of units. Name various systems of unit

NUMERICAL PROBLEMS

Problem 1. If nth division of main scale coincides with (n + 1)th division of vernier scale, find the least count of the vernier. Given one main scale division is equal to 'a' units. [IIT Mains 03] Ans: $\frac{a}{n+1}$ units.

Problem 2. If the velocity of light c, the constant of gravitation G and Planck's constant h be chosen as fundamental units, find the dimensions of mass, length and time in terms of c, G and h. [IlT 92]

Ans: $[M] = h^{1/2}c^{1/2}G^{-1/2}$, $[L] = h^{1/2}c^{-3/2}G^{1/2}$, $[T] = h^{1/2}c^{-5/2}G^{1/2}$.

Problem 3. 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 af the place and h is the height through which the body has fallen. Determine the values of p and q. Ans: $p = \frac{1}{2}, q = \frac{1}{2}$.

3 Marks Questions:

1. Name the fundamental units and supplementary units on SI and their symbols of representation.
2. What are the advantages of SI?
3. What is meant by significant figures? Give any four rules for counting significant figures.

5 Marks Questions:

1. Explain the uses of dimensional equations giving at least one example in each case.
2. Define astronomical unit, light year and parsec. Establish the relation between them.

Unit-2 Kinematics

MCQs

1. If the distance covered is zero, the displacement:
(a) Cannot be zero (b) Must be zero (c) May or may not be zero (d) depends on other factors
2. Which of the following is one dimensional motion: (a) Landing of an aircraft (b) Earth revolving around the sun
(c) Motion of a wheel of moving train (d) Train running on a straight track
3. The numerical value of the ratio of displacement to distance is:
(a) Always less than one (b) Always equal to one (c) Always more than one (d) Equal to or less than one
4. The area under velocity-time graph for a particle in a given interval of time represents:
(a) Speed (b) Displacement (c) Average Velocity (d) Acceleration
5. Pick out the only vector quantity from the following quantities: (a) Temperature (b) Pressure (c) lmpulse (d) Power
6. SI unit of acceleration is, (a) ms^{-1} (b) ms^{-3} (c) ms^{-2} (a) m^2s^{-2}
7. A particle moves a plane with uniform in acceleration having direction different from that of the instantaneous velocity. What is the nature of trajectory? (a) Circle (b) Ellipse (c) Straight line (d) Parabola
8. In case of an angular projectile motion, what is the angle between the velocity and acceleration at the highest point?
(a) 180° (b) 0° (c) 45^o (d) 90^0
9. An object is given angular projection. Its acceleration at the highest point is:
(a) Zero (b) Directed upwards (c) Directed downwards (d) Equally inclined with Horizontal and vertical direction
10. A stone is just released from the window of a train moving along a horizontal straight track. The stone will hit the ground following a: (a) Straight line path (b) Circular path (c) Parabolic path (d) Hyperbolic path
11. A particle covers equal distance around a circular path in equal intervals of time. Which of the following quantities connected with the motion of the particle remains constant with time? (a) Displacement (b) Velocity (c) Speed (d) Acceleration
12. Speedometer of a car can measure (a)Instantaneous speed(b)Instantaneous velocity(c)Angular acceleration(d) Linear velocity
13. When a tennis ball falls to the ground and bounces back then which of the following will change their directions in the process: (a) Velocity only(b)Displacement and velocity(c)Acceleration and velocity (d) Acceleration, displacement and velocity
14. If a body is projected vertically upwards from the top of a tower then the velocity-time graph for this body is a:
(a) Straight line (b) Parabola (c) Ellipse (d) Hyperbola
15. The acceleration of a moving body is found from the: (a) Area under velocity-time graph (b) Area under displacement-time graph (c) Slope of distance-time graph (d) Slope of velocity-time graph

NUMERICAL PROBLEMS

1. An airplane accelerates down a runway at 3.20 m/s^2 for 32.8 s until is finally lifts off the ground. Determine the distance traveled before takeoff.
2. A car starts from rest and accelerates uniformly over a time of 5.21 seconds for a distance of 110 m. Determine the acceleration of the car.
3. Upton Chuck is riding the Giant Drop at Great America. If Upton free falls for 2.60 seconds, what will be his final velocity and how far will he fall?

Two marks questions

1. What happens when a vector is multiplied by negative number.
2. Can a body have a constant speed but a varying velocity.
3. In what case the slope of distance-time graph have a negative value?
4. How can the distance travelled be calculated from v-t graph?
5. Does vector addition hold for any two vectors?

Three marks questions

1. Five vectors are represented by the sides of a closed polygon taken in same order. Make use of Triangle Law to prove that their resultant is zero.
2. How will you add (a) two vectors and (b) more than two vectors graphically? What do you understand by resultant of two vectors?
3. Derive the expression for distance covered by an object in the nth second of its motion.
4. Derive the relation $v^2-u^2=2as$ for uniformly accelerated motion along a straight line using velocity- time graph.

Five marks questions

1. State Triangle Law of vector addition. Find analytically the magnitude and direction of resultant vector.
2. Explain parallelogram law of vector addition in detail (including analytical treatment).
3. Derive equation of motion of Calculus method.

(i) $v=u+at$ (vel-time relation) (ii) $S=ut+\frac{1}{2}at^2$ (Disp – time relation) (iii) $v^2-u^2=2as$ (vel – disp relation)

4. Define dot product of vectors. Give its properties.
5. Define cross product of two vectors. Give its properties.

Answer Key

MCQs

1. (b) 2. (d) 3. (d) 4. (b) 5. (c) 6. (c) 7. (d) 8. (d) 9. (c) 10.(c) 11.(c) 12.(a) 13.(b) 14.(a)15.(d)

Unit-3 Laws of Motion:

Multiple Choice Questions:

1. A man getting down a running bus falls forward because (a) Due to inertia of rest, road is left behind and man reaches forward. (b) Due to inertia of motion upper part of body continues to be in motion in forward direction while feet come to rest as soon as they touch the road. (c) He leans forward as a matter of habit. (d) Of the combined effect of all the three factors stated (a), (b) and (c).
2. When a bus suddenly takes a turn, the passengers are thrown outwards because of
(a) Inertia of direction (b) Inertia of motion (c) Inertia of rest (d) Acceleration of motion
3. Two bodies of equal mass, one in motion and another is at rest, then:
(a) both possess no inertia (b) both possess different inertia (c) both have same inertia (d) can't say anything
4. A particle is moving with a constant speed along straight line path. A force is not required to (a) Increase its speed (b) Decrease the momentum (c) Change the direction (d) Keep it moving with uniform velocity
5. Newton's first law defines(a) momentum & acceleration (b) inertia & force (c) force & velocity (d) Momentum and energy
6. A 1000kg spaceship travels in the vacuum of space at constant speed of 500m/s. Ignoring any gravitational forces, what is net force on the spaceship? (a) 500000 N (b) 2 N (c) 0.5 N (d) 0 N
7. What causes the motion of a body which is initially in the state of rest? (a) Force (b) Displacement (c) Speed (d) Velocity
8. Impulsive force varies during collision. (a) Rapidly (b) Slowly (c) Remains Constant (d) None of these
9. The area enclosed by the force versus time curve numerically equals to
(a) Change in momentum (b) Magnitude of impulse (c) Both a and b (d) None of these.
10. If the duration of time is small, then impact of force will be (a) Large (b) Small (c) Remains unaffected (d) None of these.
11. S.I units of Impulse are (a) Nm^{-1} (b) Ns (c) Nm (d) Ns-1
12. Impulse = change in ….. (a) Momentum (b) Force (c) Time (d) None of these
13. A child on a cart with wheels throws a sand bag forward. As a result
(a) He moves to the left (b) He moves backward (c) He moves forward (d) He moves to the right
14. Which is incorrect statement about Action and Reaction Forces
(a) They act on different objects (b) They are equal (c) They are opposite (d) They act on the same object
15. Rocket propulsion is associated with
(a) Conservation of angular momentum (b) Conservation of mass (c) Conservation of mechanical energy (d) Newton's third law of motion

TWO MARK QUESTIONS

Q1. Why are the wheels of vehicles are provided with mudguards?
Q2. How does friction help us in walking?
Q3. What do you mean by the inertial frame of reference?
Q4. Action and reaction are equal and opposite to each other, yet they don't cancel each other. Why?
Q5.The total momentum of the universe is constant. Why?

THREE MARKS QUESTIONS

1. State Newton's second law of motion. Show that the second Law gives the measure of force.
2. Define the terms momentum and impulse. Obtain the relation between impulse and momentum.
3. State the law of conservation of linear momentum. Explain, why the gun recoils after firing.

FIVE MARKS QUESTION

Q1: A heavy ball of mass m is suspended from a thread of length r and is being rotated in a vertical circle. Find velocity of mass m at lowest and highest points and condition for looping the loop?

Q2: What will be the maximum velocity with which a vehicle can negotiate a turn of radius r safely if friction is considered between tyres and road?

Q 3: Explain old view as well as modern view about cause of friction? Also explain any three methods of reducing friction?

Numerical Problems

Q:1 A man of mass 70 kg stands on a weighing scale in a lift which is moving

(a) upward with a uniform speed of 10 ms^{-1},

(b) downward with a uniform acceleration of 5 ms^{-2},

(c) upward with a uniform acceleration of 5 ms^{-2}.

What would be the readings on the scale in each case?

(d) What would be the reading if the lift mechanism failed and it hurtled down freely under gravity?

Q:2 Two masses 8 kg and 12 kg are connected at the two ends of a light inextensible string that goes over a frictionless pulley. Find the acceleration of the masses, and the tension in the string when the masses are released.

ANSWERS OF MULTIPLE CHOICE QUESTIONS

1. b 2. a 3. c, 4. d 5. b 6. d, 7. a, 8.a, 9. b, 10. a 11. b 12. a 13. b 14. 15. d

Unit 4: Work, Energy and Power

1 Mark (Multiple choice questions):

Q1 What is the SI unit of Work? (a) Joule (b) erg (c) g-cm (d) Watt

Q.2 1 joule = _____ erg. (a) 10^9 (b) 10^5 (c) 10^7 (d) 10^{10}

Q.3 Which of the followings is an example of work done against force?

(a) Getting up with the stairs(b)Get down with the stairs(c)Walking on the flat ground(d) Dropping any object down from the top

Q.4 What happens to its potential energy when an object is taken to high altitude?

(a) Its potential energy increases (b) Its potential energy decreases

(c) Its potential energy remain same (d) None of the above

Q.5 What is the unit of energyin SI system? (a) Joule (b) erg (c) Watt (d) Newton

Q.6 What is the unit of energy in cgs system? (a) dyne (b) erg (c) newton-meter/second (d) dyne-cm/second

Q.7 What is energy? (a)energy is the rate of change of work done(b)It is the ability to do work(c)Both (a) & (b)(d) none of these

Q.8 The rate of change of work is _____ . (a) Power (b) Force (c) Momentum (d) Energy

Q.9 What is the unit of power? (a) Watt (b) Newton (c) Joule (d) Newton-meter

Q.10 Potential energy = mass × _____ × height. (a) Displacement (b) Velocity (c) Density (d) Gravitational acceleration

Q.11 Horse Power (HP) = _____ Watt. (a) 446 (b) 766 (c) 746 (d) 674

Q.12 If a person walks on horizontal road with a suitcase on his hand, then the work done is zero. (a)zero (b)90 (c)180 (d) None

Q.13 What is the formula of work done? (a) Work done = force × displacement (b) Work done = force × velocity (c) Work done = pressure × displacement (d) Work done = mass × acceleration

Q.14 An object of mass 200 g moving with velocity 50 cm/s. What is its kinetic energy?

(a) 2.1×10^5 erg (b) 2.0×10^5 erg (c) 2.8×10^5 erg (d) 2.5×10^5 erg

Q.15 Which of the following is true? (a) Power = work done × time (b) Power = work done/time

(c) Power = work done × velocity (d) Power = work done/ velocity

2 Marks Questions:

Q1. State the conditions under which a force does no work.

Q2. Why no energy is being consumed in planetary motion?

Q3. Give one example of positive work, negative work and zero work each.

Q4. What is conservative force.

Q5. Justify that a hydroelectric power plant in operation illustrates an example of law of conservation of energy.

Answer Key (Multiple choice)

1. (a) 2. (b) 3. (a) 4. (a) 5. (a) 6 (b)7.(b) 8 (a)9 (a) 10 (d)11 (c) 12 (a)3 (a)14 (d)15 (b)

Unit-5 System of particles and rotational motion

Multiple Choice Questions

Q1. The centre of mass of a system shall be

(a) At the centre of the system (b) outside the system (c) inside the system (d) inside or outside the system

Q2. Unit of centre of mass in SI is (a) m (b) kg m^2 (c) kg m (d) kg

Q3. A shell at rest explodes .The centre of mass of the fragments (a) moves along a parabolic path (b) moves along an elliptical path (c) moves along a straight line (d) remains at rest

Q4. The separation between carbon and oxygen molecules in CO is 0.12nm.What is the distance of the centre of mass from the carbon atom? (a) 0.03 nm (b) 0.05 nm (c) 0.07 nm (d) 0.06 nm

Q5.Consider a system of two identical particles .one of the particles is at rest and other has an acceleration $\vec{a}$ .The centre of mass has an acceleration (a) zero (b) $\frac{1}{2}\vec{a}$ (c) $\vec{a}$ (d) $2\vec{a}$

Q6. Two balls are thrown simultaneously in air. The acceleration of the centre of mass of the two balls, while in air (a) Depends on the direction of the motion of the balls. (b) Depends on the masses of the two balls.

(c) Depends on the speeds of the two balls. (d) Is equal to g.

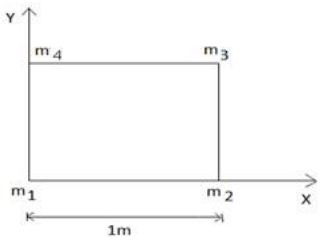
Q7. The magnitude of the vector product of two vectors $\vec{A}$ and $\vec{B}$ may be
(a) Greater than AB (b) equal to AB (c) less than AB (d) equal to zero.
Q8. If $\vec{A}.\vec{B}$ =I$\vec{A} \times \vec{B}$I, then the angle between $\vec{A}$ and $\vec{B}$ is (a) Zero (b) $\frac{\pi}{2}$ (c) π (d) $\frac{\pi}{4}$
Q9.The magnitude of the vector product of two vectors $\vec{A}$ and $\vec{B}$ equals the scalar product .The square of the sum of these vectors is $(a)\frac{1}{\sqrt{2}}$(A+B) (b) $A^2+B^2+\frac{1}{\sqrt{2}}$ AB (c) $A^2+B^2+\sqrt{2}$ AB (d) $A^2+B^2+\frac{1}{2}$ AB
Q10.When a steady torque is acting on a body, the body (a) Continues in its state of rest or uniform motion along a straight line. (b) Gets linear acceleration.(c) Gets angular acceleration (d) Rotates at a constant speed.
Q11. If there is no external force acting on a non-rigid body, which of the following quantities must remain constant?
(a) Angular momentum (b) linear momentum (c) kinetic energy (d) moment of inertia
Q12. The moment of momentum is called (a) Couple (b) torque (c) impulse (d) angular momentum.
Q13. Angular momentum of a body is defined as the product of (a) Mass and angular velocity (b) centripetal force and radius (c) linear velocity and angular velocity (d) moment of inertia and angular velocity.
Q14.The unit of angular momentum is (a) N m (b) kg $m^{-1} s^{-1}$ (c) kg $m^2 s^{-1}$ (d) $kg^2 m^2 s^{-1}$
Q15.Relation between torque and angular momentum is similar to the relation between
(a) Acceleration and velocity (b) mass and moment of inertia (c) force and momentum (d) energy and displacement

Two Marks Questions

Q1. Define the cross product of two vectors?
Q2. Show that $\vec{A} \times \vec{A} = 0$
Q3. What is the condition for two vectors to be parallel to each other?
Q4. If$\vec{A} \times \vec{B} = 0$, what can be said about the vectors $\vec{A}$ and $\vec{B}$?
Q5. The angle between vectors $\vec{A}$ and $\vec{B}$ is 60^0. What is the ratio of $\vec{A}.\vec{B}$ and I $\vec{A} \times \vec{B}$ I ?

Three Marks Questions

Q1. The moment of inertia of a solid sphere about a tangent is $\frac{7}{5}MR^2$. Find the moment of inertia about a diameter?
Q2. Four particles of mass 1kg, 2kg, 3kg and 4kg are placed at the four vertices A, B, C and D of square of side 1m. Find the position of centre of mass of the particle.



Q3. In the HCl molecule, the separation between the nuclei of the two atoms is about $1.27A^0$. Find the approximate location of the CM of the molecule, given that a chlorine atom is about 35.5 times as massive as a hydrogen atom and nearly all the mass of an atom is concentrated in its nucleus.

Five Marks Questions

Q1. (a) A child stands at the centre of a turntable with his two arms outstretched. The turntable is set rotating with an angular speed of 40 rev/min. How much is the angular speed of the child if he folds his hands back and thereby reduces his moment of inertia to 2/5 times the initial value? Assume that the turntable rotates without friction.
(b) Show that the child's new kinetic energy of rotation is more than the initial kinetic energy of rotation. How do you account for this increase in kinetic energy?
Q2. From a uniform disk of radius *R*, a circular hole of radius *R*/2 is cut out. The centre of the hole is at *R*/2 from the centre of the original disc. Locate the centre of gravity of the resulting flat body.
Q3. A solid sphere rolls down two different inclined planes of the same heights but different angles of inclination. (a) Will it reach the bottom with the same speed in each case? (b) Will it take longer to roll down one plane than the other? (c) If so, which one and why?

Answer Key:

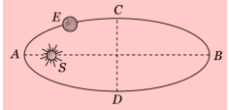
Multiple Choice Questions (One-mark questions)

Q1 (d) Q2 (a) Q3 (d) Q4 (c) .07nm Q5 (b) Q6 (d) Q7 (c) Q8 (d) Q9 (b) Q10 (d) Q11 (a) Q12 (d) Q13 (d) Q14 (c) Q15 (c)

U – 6 GRAVITATION

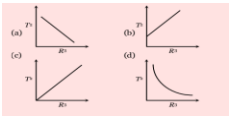
MULTIPLE CHOICE QUESTIONS

1. What is rotational period of a geostationary artificial satellite? a) 6 hrs b) 12 hrs c) 48 hrs d) 24 hrs.
2. When the planet comes near the sn, it moves a) fast b) slow c) constant at every point d) none of above
3. If the radius of the earth were to shrink by 1%, its mass remaining same, the acceleration due to gravity on the earth surface would a) decrease by 2% b) remains unchanged c) increase by 2% d) will increase by 9.8%
4. A satellite is revolving around the earth in a circular orbit with a velocity of 7.07 km/s. What minimum increase in its velocity is needed to make it escape gravitational pull of earth?
a) 4.23 km/s in the direction of its velocity b) 11.3 km/s I a direction perpendicular to its velocity
c) 2.93 km/s in the direction of its velocity d) 4.23 km/s in a direction perpendicular to its velocity



5. The value of acceleration due to gravity_____(a) is same on equator and poles (b) is least on poles
(c) is least on equator (d) increases from pole to equator
6. The weight of an object at the centre of the Earth of radius R is _____
(a) zero (b) infinite (c) R times the weight at the surface of the Earth (d) 1/R times the weight at surface of the Earth

7. The time period of a satellite of earth is 5 hr. If the separation between the earth and the satellite is increased to 4 times the previous value, the new time period will become (a)10 hr (b)80 hr (c) 40 hr (d) 20 hr
8. The earth E moves in an elliptical orbit with the sun S at one of the foci as shown in figure. Its speed of motion will be maximum at the point (a) C (b) A (c) B (d) D
9. Which of the following graphs represents the motion of a planet moving about the sun?



10. If orbital velocity of planet is given by $v = G^a M^b R^c$, then
a) a = 1/3, b= 1/3, c= 1/3 b) a = 1/2, b= 1/2, c= -1/2 c) a = 1/2, b= -1/2, c= ½ d) a = 1, b= - 1, c= -1/2
11. The distance of two planets from the sun are 10^{13} and 10^{12} meters respectively. The ratio of time periods of these two planets is a) $1/\sqrt{10}$ b) 100 c) $10/\sqrt{10}$ d) $\sqrt{10}$
12. For a satellite escape velocity is 11 km/s. If the satellite is launched at an angle of 600 with the vertical, then escape velocity will be a) 11 km/s b) $11\sqrt{3}$ km/s c) $11\sqrt{2}$ km/s d) 33 km/s
13. What will be the formula of the mass in terms of g, R and G. a) g^2 (R/G) b)G (R^2 /g) c)G (R/g) d)g(R^2 /G)
14. The escape velocity from the surface of the earth is ve. The escape velocity from the surface of a planet whose mass and radius are three times those of the earth, will be a) v_e b) 3 v_e c) 9 v_e d) 1/3 v_e
15. Assuming earth to be a sphere of uniform density. What is the value of 'g' in a mine 100 km below the earth's surface?
a) 9.65 m/s^2 b) 7.65 m/s^2 c) 5.06 m/s^2 d) 3.10 m/s^2

ANSWER KEY MULTIPLE CHOICE QUESTIONS

1. d) 2. a) 3. (c) 4.(c) 2.93 5.(c) 6. (a) 7. (c) 8. (b) 9.(c) 10.b) 11. (c) 12. a) 13. d) 14. a) 15. a)

2 MARKS QUESTIONS

1. Distinguish between gravity and gravitation.
2. Gravitational force between two bodies is 1 Newton. If the distance between them is doubled, what will be the force?
3. Explain why a body weighs more at poles and less at equator.
4. Explain why one can jump higher on the surface of moon than on the earth.
5. Calculate the force of attraction between two balls each of mass 1kg, when their centres are 10 cm apart. G= $6.67*10^{-11}$ Nm^2kg^{-2}

03 Marks Questions

1. Explain why the weight of a body becomes zero at the center of Earth..
2. Show that Kepler's Second law is the law of conservation of angular momentum.
3. How do Kepler's laws lead to Newton's universal law of gravitation?

05 Marks Questions

1. What is Orbital Velocity? Derive an expression for orbital velocity. How orbital velocity is related to escape velocity?
2. Define gravitational potential energy and derive the expression for gravitational potential energy.
3. What is meant by Time period of satellite? Derive an expression of it.

UNIT 7 PROPERTIES OF BULK MATTER

Ch 8 Mechanical properties of solids

MULTIPLE CHOICE QUESTIONS

1. Elastic limit is equal to (a) Stress (b) Strain (c) Young's modulus (d) Modulus of rigidity
2. Dimensional formula of stress is same as that of (a) Impulse (b) Pressure (c) Force (d) Strain
3. If the length of a wire is reduced to half, then it can hold the (a) one fourth load (b) same load (c) a half load(d) double load
4. The Young's modulus of a perfectly rigid body is (a) some finite non-zero constant (2) zero (c) unity (d) infinity
5. According to Hooke's law of elasticity, if stress is increased, then the ratio of stress to strain
(a) increases (b) becomes zero (c)remains constant (d) decreases
6. The restoring force per unit area is known as (a) stress (b) plasticity (c) elasticity (d) strain
7. In magnitude hydraulic stress is equal to (a) hydraulic strain (b) hydraulic force (c) hydraulic pressure(d) restoring force
8. Substances which can be stretched to cause large strains are called (a) elastomers (b) plastic (c) ductile(d) brittle
9. The reason for the change in shape of a regular body is (a) shearing strain (b) longitudinal strain (c) metallic strain (d) volume stress
10. Longitudinal stress depends on (a) length (b) volume (c) area (d) mass
11. Which of the following affects the elasticity of a substance? (a) Impurity in substance (b) Change in temperature (c) Hammering and annealing (d) All of the above
12. If the load is increased beyond the (a) yield point (b) fracture point (c) elastic point (d) plastic point
13. Which of the following elastic moduli is used to describe the elastic behaviour of object? (a) Shear modulus (b) Young's modulus (c) Bulk modulus (d) All of these
14. Which of the following is the correct relation? Y = Young's modulus & G = modulus of rigidity?
(a) Y>G (b) Y <G (c) Y = G (d) None of these
15 The ratio of shearing stress to the corresponding shearing strain is called
(a) bulk modulus(b) Young's modulus (c) modulus of rigidity (d) None of these

ANSWER KEY AND HINTS

1. (a) 2. (c) 3. (b) 4. (d)5.(c)6.(a) 7.(c) 8.(a)9. (d)10.(c)11.(d) 12. (a)13.(d)14.(a) 15. (c)

TWO MARKS QUESTIONS

1. Define elasticity?

2. On what factors does the value of the coefficient of elasticity depend? Why it is of it three types?
3. Elasticity is said to be the internal property of matter. Explain.
4. State Hooke's law.

THREE MARKS QUESTIONS

1. Which is more elastic rubber or steel? Explain
2. Read the following two statements below carefully and state, with reasons, if it is true or false.
(a) The Young's modulus of rubber is greater than that of steel;
(b) The stretching of a coil is determined by its shear modulus.
3. Two wires of different materials are suspended from a rigid support. They have the same length and diameter and carry the same load at their free ends. (a) Will the stress and strain in each wire be the same? (b) Will the extension in both wires be same?

FIVE MARKS QUESTIONS

1. Explain why
(a) The angle of contact of mercury with glass is obtuse, while that of water with glass is acute.
(b) Water on a clean glass surface tends to spread out while mercury on the same surface tends to form drops. (Put differently, water wets glass while mercury does not.)
(c) Surface tension of a liquid is independent of the area of the surface.
(d) Water with detergent dissolved in it should have small angles of contact.
(e) A drop of liquid under no external forces is always spherical in shape.
2. Hooke's law states that stress α strain. a) What is the necessary condition for the above law to be valid? b) Explain with the help of a graph, the relation between stress and strain for a given solid material under increasing tensile stress.

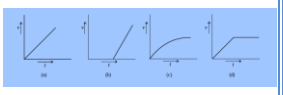
Numerical Problems

1. A wire increases by $10^{-3}$of its length, when a stress of 10^8 N/m^2 is applied to it. What is the Young's modulus of the material of the wire? Solution- $Y = 10^{11}\ \mathrm{Nm}^{-2}$
2. A steel wire of length 4.7 m and cross-sectional area 3.0×10^{-5}m^2 stretches by the same amount as a copper wire of length 3.5 m and cross-sectional area of 4.0×10^{-5} m^2 under a given load. What is the ratio of the Young's modulus of steel to that of copper? Solution-1.8
3. How much should the pressure on a litre of water to be changed to compress it by 0.1 %? (Bulk modulus of water $=2.2\times10^9$ Pa) Solution- $2.2 \times 10^6\ N$

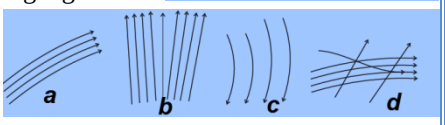
CHAPTER 9 MECHANICAL PROPERTIES OF FLUIDS

Multiple choice questions:-

1. When area of cross section of a pipe increases, the velocity of flow of the liquid (a) Increases (b) Decreases (c) Becomes zero (d) Remain the same
2. A tall cylinder is filled with viscous oil. A round pebble is dropped from the top with zero initial velocity. Which of the following graph represents the velocity (v) of the pebble as a function of time (t)?



3. Along a streamline
(a) The velocity of a fluid particle remains constant. (b) The velocity of all fluid particles crossing a given position is constant. (c) The velocity of all fluid particles at a given instant is constant. (d) The speed of a fluid particle remains constant.
4. Which of the following diagrams does not represent a streamline flow?



5. An ideal fluid flows through a pipe of circular cross-section made of two sections with diameters 2.5 cm and 3.75 cm. The ratio of the velocities in the two pipes is (a) 9:4 (b) 5:2 (c) 3:2 (d) 7:3
6. When water droplets merge to form a bigger drop (a) energy is liberated (b) energy is absorbed (c) energy is neither liberated nor absorbed (d) process is independent of energy
7. A sudden decrease in atmospheric pressure indicates (a) dry weather (b) stormy weather (c) wet weather (d) fine weather
8. Due to capillary action, a liquid will rise in a tube if angle of contact is (a) acute (b) 90^0 (c) obtuse (d) Zero
9. Unit of coefficient of viscosity is (a) m kg^{-1} s^{-1} (b) m s kg^{-1} (c) kg m^{-1} s^{-1} (d) kg m^{-1} s^{-2}
10. Soaps and detergents help in cleaning because they (a) increases the angle of contact (b) reduce the surface tension between water and oil (c) increase the surface tension between water and oil (d)absorb the dust
11. When a steel ball is dropped in oil (a) the ball stops (b) the speed of ball will keep on increasing (c) the ball attains constant velocity after sometime (d) None of these.
12. Stream line flow is more likely for liquids with (a) high density and low viscosity (b) low density and high viscosity (c) high density and high viscosity (d) low density and low viscosity
13. Hydraulic lift and Hydraulic brake is based on (a) Archimedes' principle (b) Bernoulli's equation (c) Pascal Law (d) Reynold's law
14. For pure water and clean glass, the angle of contact is (a) 8^0 (b) 138^0 (c) 0^0 (d) 90^0
15. A man standing close to the platform at a railway station experiences a pulling force towards a fast moving train because of (a) gravitational force between train and man (b) illusion of the man (c) the centripetal force (d) pressure difference due to fast moving air in between

Answer Key

1. (b) 2. (c) 3. (b) 4. (d) 5. (a) 6. (a) 7. (b) 8. (a) 9. (b) 10. (b)11 (c) 12 (b) 13 (c) 14 (b) 15 (d)

Two Marks Questions

1. Define surface tension?
2. Water rises in a capillary tube but mercury falls in the same tube. Why?
3. Define viscosity?
4. What is the significance of Reynolds's Number?
5. The accumulation of snow on an aero plane wing may reduce the lift. Explain?

LONG QUESTIONS

1. Explain the working of the following along with their underlying principle
1) Hydraulic lift 2) Hydraulic brakes
2. State stokes law. Derive its expression.
3. State and prove bernoulli's theorem .
4. Obtain the expression for excess of pressure inside liquid drop and soap bubble.
5. Define surface tension, capillary and capillarity. Derive expression for the rise of liquid in a capillary tube.

NUMERICAL PROBLEMS

1. A force of 40 N is applied on a nail, whose tip has an area of cross-section of 0.001 cm^2. Find the pressure on the tip.
2. Torricelli's barometer used mercury. Pascal duplicated it using French wine of density 984 Kgm^{-3}. Determine the height of the wine column for normal atmospheric pressure.

CHAPTER 10 THERMAL PROPERTIES OF MATTER

Multiple choice Questions:-

Q1. On the absolute scale of temperature given by Kelvin steam point has a value of (a) 373 K (b) 273 K (c) -273 K (d) 0 K
Q2. If a thermometer reads freezing point of water as 20°C and boiling point as 150°C. How much it will reads if the actual temperature is 60°C? (a) 98 °C (b) 40 °C (c) 110 °C (d) 60 °C
Q3. If the coefficient of cubical expansion is x times of the coefficient of superficial expansion then value of x is
(a) 3 (b) 1.5 (c) 2.5 (d) 2
Q 4. When a metallic sphere is heated the largest increase in its (a) Volume (b) diameter (c) Area (d) Same in all
Q5. An ice block contain a glass ball, when the ice melts within the water containing vessel, the level of water
(a) Rises (b) remains unchanged (c) Falls (d) First rises then falls
Q6. A thin circular disc has a concentric hole in it. The disc is heated. The diameter of the cavity will
(a) Increase (b) remain same (c) Decreases (d) none of these
Q7. If a bimetallic strip is heated it will (a) Bend toward the metal with lower value of α. (b) Bend toward the metal with higher value of α. (c) Twist itself into a helix. (d) Have no bending.
Q8. In cold countries water pipes some time bursts because; (a) Pipe contract (b) Water expand on freezing
(c) When water freezes pressure increases (d) When water freezes it takes heat from pipes
Q9. At what temperature does the Celsius and Fahrenheit scale give the same reading (a) 40° F (b) 0°C (c) - 40° C (d) 40 °C
Q10. A water fall is 84m high assuming that half of the kinetic energy of the falling water is converted into heat. The rise in temperature will be (a) 0.098 °C (b) 9.8° C (c) 0.98 °C (d) 0.0098 °C
Q11. Transmission of heat by molecular collision is (a) Conduction (b) Radiation (c)Convection (d) Scattering
Q12. Coefficient of thermal conductivity depends upon (a) Nature of material (b) Difference in temperature (c) Heat produced (d) Atmospheric pressure
Q13. The absorptive power of perfectively black body is (a) Zero (b) less than 1 (c) One (d) Infinity
Q14. Heat travel through vacuum by (a) Conduction (b) radiation (c) Convection (d) Both 1 and 3
Q15. Woollen cloths keeps the body warm, because wool (a) Is a bad conductor (b) Increases the temperature of body (c) Decreases the temperature of body (d) All of these

Answer key / Hints:-

Q1 (a) Q2 (a) Q3 (b) Q4 (a) Q5 (c) Q6 (a) Q7 (a) Q8 (b) Q9 (c) Q10 (a) Q11 (a) Q12 (a) Q13 (c) Q14 (b) Q15 (a)

Two Marks Questions

1. Define Heat and Temperature.
2. Name different temperature scales. Write expression showing relationship between different temperature scales.
3. What do you mean by thermal expansion. Name different types of it.
4. Define linear expansion, superficial expansion and cubical expansion.
5. Write the relation between alpha (α), beta (β) and gamma(ϒ).

THREE MARKS QUESTIONS

1. Define heat or thermal capacity and specific heat capacity. What is SI unit of thermal capacity and specific heat capacity? Why water is preferred to any other liquid in hot water bottles?
2. When two bodies having temperature T_1 and T_2 are brought in contact, then the temperature of this system may not be $(T_1+T_2)/2$. Explain why.
3. A blacksmith fixes iron ring on the rim of the wooden wheel of a bullock cart. The diameter of the rim and iron ring is 5.243 m and 5.231 m respectively at 27 °C. To what temperature should the ring be heated so as to fit the rim of the wheel? (α for iron= $1.20x10^{-5o}C^{-1}$)

FIVE MARKS QUESTIONS

1. State Newton's law of cooling. Draw a graph showing the variation of $\log_e(\theta-\theta_o)$ with time t, where θ is the temperature of the body and $\theta_o$is the temperature of surroundings. Obtain the necessary relation to verify it experimentally.
2. State Stefan's law and Wein's displacement law. How can you derive Newton's law of cooling from Stefan's law?

Numerical Problems

1. A rod has radius of 100mm and a length of 10 cm. A 100 N force compressed along its length. Calculate the stress developed in rod. ($3184.71\ N/m^2$).
2. A steel rod 2.0m long has a cross sectional area 0f $0.30cm^2$. The rod is now hung by one end from a support of structure and a 550 Kg milling machine is hung from s rod's lower end. Determine stress, the strain and elongation of the rod.($Y= 20\times10^{10}$ Pa) Solution:Stress = 1.8×10^8 Pa, Strain = 9.0×10^{-4}, Elongation = 1.8 mm
3. A 45 Kg boy whose leg bones are $5cm^2$ in area and 50 cm long falls through a height of 2m without breaking of his leg bones. If the bones can stand stress of $0.9x10^8Nm^{-2}$. Calculate the young modulus for the material of the bone.Use $g=10ms^{-2}$. Solution: $2.25\times10^{-9}\ Nm^{-2}$

Ch 11 Thermodynamics

ONE MARK QUESTIONS

1. First law of thermodynamics is the law of conservation of: (a) mass (b) linear momentum (c) energy (d) angular momentum.
2. Internal energy of an isolated system: (a) increases (b) decreases (c) remains the same (d) none of these.
3. The change in internal energy of a system in a cyclic process is: (a) positive (b) negative (c) zero (d) may be positive or negative.
4. Mathematical form of first law of thermodynamics is:

(a) dQ = dU – PdV (b) dQ = dU + PdV (c) dU + dQ = PdV (d) dQ + PdV =dU

5. Work done in isothermal process is :

(a) $\mu RT \log (V_1 / V_2)$ (b) $\mu RT \log (V_2 / V1)$ (c) $\mu RT \log (P_1V_1 / P_2\ V_2)$ (d) $\mu R(T_2 – T_1)\ \log (V_2 / V_1)$

6. Work done in adiabatic process is: (a) $RT_1 / (\gamma-1)$ (b) $RT_2 / (\gamma-1)$ (c) $R(T_1 - T_2) / (\gamma-1)$ (d) $R(\gamma-1)(T_2 – T_1)$
7. In an isothermal process, temperature remains constant. In this process, (a) change in internal energy of the system is positive (b) change in internal energy of the system is negative (c) change in internal energy of the system is zero (d) change in internal energy = work done by the system.
8. Efficiency of Carnot's engine depends on: (a) nature of the working substance (b) temperature of source (c) temperature of sink (d) the temperature of source and sink.
9. The efficiency of heat engine working between the temperature T_1 and T_2 ($T_1 > T_2$) is:

(a) $1- (T_1/T_2)$ (b) $1- (T_2/ T_1)$ (c) $1+ (T_2/ T_1)$ (d) T_2 / T_1

10. Sudden bursting of the tube of a bicycle tyre is : (a) An Adiabatic process (b) An Isochoric process (c) An Isothermal process (d) Isobaric process
11. In which of the following thermodynamic process of gas, the work done is maximum:

(a) isothermal (b) adiabatic (c) isobaric (d) isochoric

12. Two Carnot engines A and B have their sources at 1000K and 1100K and their sinks at 400K and 500K respectively. If η_A and η_B be their efficiencies, Then which of the following is correct: (a) $\eta_A < \eta_B$ (b) $\eta_A = \eta_B$ (c) $\eta_A > \eta_B$ (d) data is not sufficient
13. Which of the following statement is correct: (a) Work done is state dependent but not path dependent (b) Internal energy of gas depends only on the state of gas (c) Area under P- V graph equals heat supplied in any process (d) In an isothermal process, change in internal energy is maximum.
14. We consider a thermodynamic system. If ΔU represent the increase in its internal energy and W is the work done by the system, then which of the following statements is correct: (a) $\Delta U = -W$ in an adiabatic process (b) $\Delta U = W$ in an isothermal process (c) $\Delta U = -W$ in an isothermal process (d) $\Delta U = W$ in an adiabatic process.
15. When you make ice cubes, the entropy of water: (a) increases (b) decreases (c) does not change (d) may either increases or decreases depending on the process used.

➢ **ANSWERS / HINTS**

1. (c) 2. (c) 3. (c) 4. (b) 5. (b) 6. (c) 7. (c) 8. (d) 9. (b) 10. (a) 11. (c) 12. (c) 13. (b) 14. (a) 15. (b)

2 Marks Questions:

Q1. Define the term "Thermodynamics."
Q2. What do you understand by a thermodynamic system?
Q3. What do you understand by thermodynamic variables?
Q4. What do you mean by thermodynamic equilibrium?
Q5. When two bodies are said to be in thermal equilibrium?

3 Marks Questions:

1. State and explain zeroth law of thermodynamics.
2. Define: i) Isothermal equilibrium ii) Thermodynamical state iii) Thermodynamical variables
3. State First law of thermodynamics and hence drive a relation between moral specific heats of a gas.
4. Derive an expression for work done during adiabatic process.
5. Calculate the difference between the two principle specific heats of 1g of helium at S.T.P. Given atomic weight of helium = 4 and J = 4.186 $Jcal^{-1}$and R = 8.31 $Jmol^{-1}K^{-1}$.

5 Marks Questions:

1. Describe the operation of a Carnot's engine. Calculate efficiency of a
2. Define isothermal and an adiabatic process. Drive an expression for work done during an adiabatic process.
3. Explain the principle, construction and working of heat engine. Work out its efficiency.

Numerical Problems

1. An electric heater supplies heat to a system at a rate of 100W. If system performs work at a rate of 75 joules per second. At what rate is the internal energy increasing? Solution: 25 W
2. What amount of heat must be supplied to 2.0 x 10^{-2} kg of nitrogen (at room temperature) to raise its temperature by 45 °C at constant pressure? (Molecular mass of N_2 = 28; R = 8.3 J mol^{-1} K^{-1}.) Solution: 933.4 J
3. A Carnot engine develops 100 H.P. and operates between 27^0C and 227^0C. Find 1) thermal efficiency; 2) heat supplied3) heat rejected? Solution: 0.4, 4.44 × 10^4 cal/s, 2.66 × 10^4 cal | s

Ch 12 Kinetic Theory

Multiple choice questions:

1. A pressure cooker reduces cooking time for food, because (A) heat is more evenly distributed in the cooking space (B) cooking involves chemical changes helped by a rise in temperature (C) boiling point of water involved in cooking is increased(D) the higher pressure inside the cooker crushes the food material
2. Cooking gas containers are kept in a lorry moving with uniform speed. The temperature of the gas molecules inside will: (A) Increase (B) decrease (C) remain same (D) decrease for some, while increases for others.
3. An ant is walking on the horizontal surface. The number of degrees of freedom of ant will be(A) 1 (B) 2 (C) 3 (D) 6
4. The number of degrees of freedom for a diatomic gas molecule is (A) 2 (B) 3 (C) 5 (D) 6
5. The degree of freedom of a triatomic gas is (A) 1 (B) 2 (C) 6 (D) 8
6. For Boyle's law to hold good, the gas should be (A) prefect and of constant mass and temperature (B) real and of constant mass and temperature (C) prefect and at constant temperature but variable mass (D) real and at constant temperature but variable mass.
7. A gas behaves as an ideal gas at (A) low pressure and high temperature (B) low pressure and low temperature (C) high pressure and low temperature (D) high pressure and high temperature
8. The temperature of a gas is held constant, while it's volume is decreased. The pressure exerted by the gas on the walls of the container increases, because it's molecules (A) are in contact with the walls for a shorter time (B) strike the walls with higher velocities (C) strike the walls with large force (D) strike the walls more frequently
9. The absolute zero is the temperature, at which A) all substances exist in solid state B) water freezes C) molecular motion ceases D) none of these
10) $v_{r.m.s}$, V_{av} and V_{mp} are root mean square, average and most probable speeds of molecules of a gas obeying Maxwellian velocity distribution. Which of the following statements is correct?
A) $v_{r.m.s} < V_{av} < V_{mp}$ B) $v_{r.m.s} > V_{av} > V_{mp}$ C) $v_{mp} < V_{rms} < V_{av}$ D) $v_{mp} > V_{rms} > V_{av}$
11) Pressure of an ideal gas is increased by keeping temperature constant. Which is the effect on kinetic energy of molecules? A) Increases B) decreases C) No change D) Can't be determined
12) On the basis of Kinetic theory of gases, the mean K.E. of1 mole per degree of freedom is: A) RT/2 B) 3RT/2 C) kT/2 D) 3kT/2
13) A real gas behaves like an ideal gas, if it's A) pressure and temperature are both high B) pressure and temperature are both low C) pressure is high and temperature. is low D) pressure is low and temperature is high
14) The ideal gas is one, which obeys A) Boyle's law B) Charle's C) Boyle's law and charle's law D) none of these
15) The pressure of a given mass of a gas at constant temperature is P and it's volume is V. The PV versus V graph is A) a hyperbola B) straight line parallel to the V-axis C) straight line parallel to the PV- axis D) straight line having slope one

Answers.

1) C 2) C 3) B 4) C 5) C 6) A 7) A 8) D 9) C 10) B 11) C 12) A 13) D 14) C 15) B

2 Marks Questions:

1. State Postulates of kinetic theory of gases. 2 . What is an ideal gas? 3 . State Boyle's Law.
4 . Define Charle's Law.
5. Why the molecular motion of molecules ceases at zero Kelvin?

3 Marks Questions:

1. What is universal gas constant? Obtain its dimensional formula and the numerical value.
2. What is an ideal gas? Derive the Ideal gas equation.
3. State the postulates of Kinetic Theory of gases.
4. What is the Kinetic interpretation of temperature?
5. Define degrees of freedom. Calculate the degrees of freedom of a monoatomic and diatomic gas molecule.

5 MARKS QUESTIONS:

1. The absolute temperature of a given quantity of an ideal gas is doubled and its volume is decreased by one half, how is the pressure affected?
2. Using the ideal gas equation, determine the value of R. Given that one gram molecule of a gas at S.T.P occupies 22.4 litres.

3. From the postulates of Kinetic Theory of Gases, derive an expression for thepressure exerted by a gas.
4. From the expression for pressure exerted by a gas,
a. Obtain expression for r.m.s speed of the gas molecules.
b. Deduce perfect gas equation. **Numericals:**

1. The volume of an air bubble becomes thrice when it rises from the bottom of a water container to the top. What will be the depth of container if atmospheric pressure is 76 cm of Hg? Solution: 20.67 m
2. The volume of a partially filled air balloon is 50 cm^3 at the surface of earth. The temperature and pressure of balloon are 27^0C and 76 cm of mercury at the same place. Calculate the increase in volume of balloon if it rises to a height where pressure is 10.9 cm of Hg and temperature (-30^0C). Solution: **232.3 cm^3**
3. Calculate the pressure exerted by a vessel of volume 1000 cm^3 containing 0.2 moles of Arand 0.3 moles of Ne at a temperature of 350K. Solution: 1.454×10^6 Pa

U-10 Oscillations and waves

1. The displacement of a particle in S.H.M.in one time period (a) r (b) zero (c) 2r (d) 4r
2. The time period of a simple pendulum will be double, if we (a) Increase the length 4 times (b) Increase the length 2 times (c) decrease the length 4 times (d) decrease the length 2 times
3. A particle executes S.H.M. given by Y=0.02 sin100t
The amplitude and frequency are (a) 0.02,100 (b) 0.02, 50/π (c) 0.01,50 (d) 1/0.02, 50/π
4. A child, swinging on a swing in sitting position, stands up. Then the time period of the swing will,
(a) Increase (b) decrease (c) remain same (d) increase, if the child is long and decrease, if the child is short.
5. Restoring force acting on particle executing S.H.M.is directly proportional to (a) velocity (b) amplitude (c) displacement (d) none of these
6. The distance moved by a particle in simple harmonic motion oscillating with amplitude A in one time period is (a) A (b) 2A (c) 4A (d) zeros
7. The time period of a particle in simple harmonic motion is equal to time between consecutive, appearances of the particle at a particular point in its motion. This point is (a) the mean position (b) an extreme position (c) between the mean position and the positive extreme (d) between the mean position and the negative extreme
8. The displacement of particle varies with time according to the relation y = a sinω̇t + b cosω̇t (a) the motion is oscillatory but not S.H.M (b)the motion is S.H.M with amplitude a + b (c) the motion is S.H.M with amplitude $a^2 + b^2$ (d) the motion is S.H.M. with amplitude $\sqrt{a^2 + b^2}$
9. The equation of motion of a simple harmonic oscillator is (a) $\frac{d^2y}{dt^2} = \omega^2/y$ (b) $\frac{d^2y}{dt^2} = \omega$ (c) $\frac{d^2y}{dt^2} = \omega^2 y$ (d) $\frac{d^2y}{dt^2} = -\omega^2 y$
10. In a simple harmonic motion (a) potential energy is conserved (b) kinetic energy is conserved (c) total energy is conserved (d) none of these.
11. The time period of a simple pendulum depends on (a) length of the pendulum (b) acceleration due to gravity (c) both length and acceleration due to gravity (d) mass of the bob of the simple pendulum
12. For a system to execute S.H.M. it must possess (a) inertia only (b) elasticity only (c) inertia and elasticity both (d) none of these
13. The potential energy of a body executing S.H.M. will be maximum at (a) equilibrium position (b) extreme position (c) both at equilibrium and extreme position (d) mid-way between equilibrium and extreme positions.
14. The rotation of earth about its axis is (a) oscillatory motion (b) simple harmonic motion (c) periodic motion (d) non periodic motion.
15. What is the effect on the time period of a simple pendulum if the length is quadrupled?
(a) Halved (b) Doubled (c) No effect (d) It would be zero **Answer Key**

Ans.1. (b) Ans.2 (a) Ans.3. (b) Ans.4. (b) Ans.5. (c) Ans.6. (c) Ans.7. (a) Ans.8. (d) Ans.9. (d) Ans.10. (c) Ans.11. (c) Ans.12. (c) Ans.13. (b) Ans.14. (c) Ans.15. (b)

2 Marks Questions

1. What is periodic motion? 2. What is oscillatory motion?
3. Every oscillatory motion is periodic, but every periodic motion is not oscillatory. Explain.
4. Is there any difference between oscillation and vibration? 5. What is the relation between time period and frequency?

Three marks questions:

1. Explain periodic motion and oscillatory motion with illustrations.
2. Distinguish clearly harmonic and non-harmonic oscillations.
3. What do you understand by SHM? Explain.
4. Explain the relationship between uniform circular motion and SHM.
5. Derive an expression for a total energy of a particle executing SHM. **Five marks questions**

1. Explain time period, frequency, angular frequency, displacement and periodic function in periodic motion.
2. Explain displacement, velocity and acceleration in SHMs. Find relation for them.
3. Explain the relation in phase between displacement, velocity and acceleration in SHM, graphically as well as theoretically.
4. What is the simple pendulum? Find an expression for the time period and frequency of the simple pendulum.
5. Derive an expression for time period in case of two springs connected in (i) series and (ii) parallel executing SHM

Numericals:

1. Human heart beats 80 times in 60s. What is the frequency and time period of the heart beat?
2. A particle executing S.H.M. is represented by a periodic function F(t) = 5 cos(10t +0.2)

Calculate the amplitude, angular frequency, frequency, time period and initial phase. Given, displacement represented by F(t) is measured in metres and time in s.

3. A body executes S.H.M. according to the equation, y=(2.0m) cos[(π rad s^{-1})t + $\frac{\pi}{4}$]

Find (i) displacement (ii) velocity and (iii) acceleration of the body at t= 2.0 s.

Ch 14 Waves MULTIPLE CHOICE QUESTIONS

1. The phenomenon of sound propagation in air is (a) Isothermal process (b) Adiabatic process (c) Isobaric process (d) Isochoric process
2. A transverse wave can be polarised but longitudinal wave cannot be polarized. Which of the followings cannot be polarized? (a) Light (b) Ultraviolet light (c) Radio waves (d) Sound waves
3. Standing waves are produced in 10 m long stretched string. If the string vibrates in 5 segments and wave velocity is 20 ms^{-1}, the frequency is (a) 2 Hz (b) 4 Hz (c) 5 Hz (d) 10 Hz
4. The speed of sound in air is affected by the change in (a) Amplitude (b) Wavelength (c) Frequency (d) Temperature

Answer Key:1(b) 2(d) 3(c) 4(d)

TWO MARKS QUESTIONS

1. Define wave motion. 2. Define transverse wave motion. 3. Define longitudinal wave motion.4. Define frequency. 5. Define wavelength.

NUMERICAL PROBLEMS

1. What is the wavelength of sound in a medium, in which the speed of sound is 9.6 km s^{-1}? The frequency of sound is 3 kHz.
2. A tuning fork vibrates with a frequency of 256. If the speed of sound in air is 345.6 ms^{-1}, find the wavelength and the distance which the sound travels in air during the time the fork marks 50 vibrations.
3. A steel wire 90 cm long has a mass of 9.0 mg. If the wire is under a tension of 400 N, what is the speed of transverse waves in the wire?
4. If the displacement of two waves at a point is given by:- Y_1 = a sinωt, Y_2 = a sin($\omega t + \frac{\pi}{2}$), calculate the resultant amplitude?
5. If the splash is heard 4.23 seconds after a stone is dropped into a well, 78.4 meters deep, find the velocity of sound in air?

SAMPLE PAPER FOR FINAL EXAMINATION MARCH 2025

Time 3 hr **SUBJECT: PHYSICS CLASS: XI** **MM: 70**

Q1 (i) **Which of the following is not a derived physical quantity? (a)** Speed **(b)** Volume **(c)** Force **(d)** Mass

(ii) The no. of significant figures in 20340 is (a) 3 **(b)** 4 **(c)** 5 **(d)** none of these

(iii) Name the physical quantity which has unit but no dimension.

(a) strain **(b)** frequency **(c)** angular displacement **(d)** radius

(iv) Area under velocity-time graph tells us the (a) Time **(b)** Acceleration **(c)** Displacement **(d)** Velocity

(v) The range of a projectile is maximum when thrown at an angle with horizontal equal to

(a) 90° **(b)** 45° **(c)** 30° **(d)** 60°

(vi) Rolling friction is

(a) less than sliding friction **(b)** more than sliding friction **(c)** equal to sliding friction **(d)** None of these

(vii) Acceleration of a body moving with constant speed in a circle is (a) zero **(b)** rω **(c)** $\frac{\omega^2}{r}$ **(d)** rω^2

(viii) Which one of the following is a non-conservative force?

(a) Gravitational Force **(b)** Electrostatic Force **(c)** Magnetic Force **(d)** Force of Friction

(ix) A body has uniform circular motion. Which of the quantity of the body will remain same?

(a) Velocity **(b)** Momentum **(c)** Kinetic energy **(d)** Both (a) and (b)

(x) if no external torque acts on the system then the total angular momentum of the system

(a) must be constant **(b)** must be zero**(c)** must be variable **(d)** may be variable

(xi) The unit of moment of inertia is **(a)** Kg^2 m **(b)** kg m^2 s^{-1} **(c)** kg m^2 **(d)** kg^2 m^{-1} s

(xii) If mass of body is M on earth then mass of same body at moon is (a) M/6 **(b)** zero **(c)** M **(d)** none

(xiii) Value of escape speed on the surface of a planet does not depend on

(a) Mass of planet **(b)** mass of the body to be projected **(c)** Radius of the planet **(d)** acceleration due to gravity on the surface of planet

(xiv) If a liquid does not wet glass, angle of contact is (a) Zero **(b)** acute **(c)** obtuse **(d)** right angle

(xv) According to Stokes' law, viscous force F on a body of radius r moving with a terminal velocity v in a fluid of viscosity n is given by (a) 2πnrv **(b)** 6πnrv **(c)** 5πnrv **(d)** 9πnr

(xvi) Green house effect is due to (a) Visible light **(b)** UV rays **(c)** Radio waves **(d)** Infrared rays

(xvii) In which of following processes the work done is zero?(a) Isothermal**(b)**Isobaric**(c)** Isochoric**(d)**Adiabatic

(xviii) Zeroth law led us to the concept of (a) Internal energy **(b)** entropy **(c)** temperature **(d)** all of these

(xix) The perfect gas equation can be written as (a) PV = nRT **(b)** PV = nR **(c)** PV^2 = RT **(d)** P = nRTV

(xx) Temperature is the measure of

(a) Total kinetic energy of all the molecules of the system.**(b)** Total KE + PE of all the molecules of the system.
(c) Average KE of the molecules of the system. **(d)** Amount of internal energy of a system.

(xxi) No force is found to be acting on a particle vibrating in S.H.M, when it is

(a) at its extreme position **(b)** at its mean position **(c)** at any other point **(d)** none of the points

(xxii) Relation between angular frequency ω and spring constant k of a spring executing SHM is

(a) $\omega = \sqrt{\frac{k}{m}}$ **(b)** $\omega = \frac{k}{m}$ **(c)** $\omega = mk^2$ **(d)** $k = \frac{\omega}{m}$

(xxiii) Velocity of sound waves ($v = \sqrt{\frac{B}{\rho}}$) is maximum among the following in

(a) Vacuum **(b)** gases **(c)** liquids **(d)** solids

xxiv) Without centripetal force, a body cannot move in a circular path. **(T/F)**

(xxv) Force of friction depends on the area of contact. **(T/F)**

(xxvi) Centre of mass always lies inside the material of the body. **(T/F)**

(xxvii) Gravitational potential is a scalar quantity. **(T/F)**

(xxviii) Steel is less elastic than rubber. **(T/F)**

2 MARKS QUESTIONS

Q2. Write the Dimensional Formulas of following quantities.
(a) linear momentum **(b)** strain **(c)** torque **(d)** surface tension (½+½+½+½) **OR**

Q2. Convert 1 Newton into dyne using dimensional analysis. (2)

Q3. Making proper diagram, give the statement of triangle Law of vector addition. Also write (without derivation) the magnitude and direction of the resultant of two vectors. (1/2 each)**OR**

Q3. Brakes are applied to a car travelling at 30 metre per second its velocity is reduced to 20 metre per second in 5 seconds. Calculate the retardation produced by brakes. Also calculate the distance covered in 5 second. (2)

Q4. State and prove work energy principle. (1+1)**OR**

Q4. A particle is displaced through (3î -2ĵ+2k̂) m under the influence of a force (-î +ĵ-5k̂) N. Calculate the work done.(2)

Q5. What is equation of continuity? On which conservation law it is based? (1+1)

Q6. What are reversible and irreversible processes? Give at least one example of each. (1+1)

Q7. Give the statement of law of equipartition of energy. Using this law, find the internal energy of a monatomic gas molecule of an ideal gas. (1+1)

Q8. Write two differences between transverse and longitudinal waves. (2)

3 MARKS QUESTIONS

Q9. Friction is necessary evil. Justify? Write at least 3 points each in the favour and against frictional force.(3)**OR**

Q9. A large block of ice is being pulled across a frozen lake. The block of ice has a mass of 300 kg. The coefficient of friction between two ice surfaces is small: $\mu_k = 0.05$. What is the force of friction that is acting on the block of ice? (3)

Q10. Justify giving proper reasoning whether the work done in the following cases is positive or negative: **(a)** Work done by a man in lifting a bucket out of a well by means of a rope tied to the bucket. **(b)** Work done by gravitational force in the above case. **(c)** Work done by friction on a body sliding down an inclined plane. (3)

Q11. State and explain principle of conservation of angular momentum and apply this principle to explain why an ice skater can increase her angular velocity by folding her arms and bringing the stretched leg close to the other leg(3)

Q12. Derive the expression for escape velocity and find its value on the surface of earth? (2+1)**OR**

Q12. An artificial satellite is getting around the earth at a distance of 1,600 km. Calculate the period of revolution and orbital velocity. Given radius of the earth = 6,400 Km and g = 9.8 ms^{-2} ($1\frac{1}{2} + 1\frac{1}{2}$)

Q13. Derive the relation $\mathbf{C_P - C_V = R}$ using first law of thermodynamics where C_P and C_V are molar specific heats of a gas at constant pressure and constant volume respectively. (3)**OR**

Q13. An electric heater supplies heat to a system at a rate of 100W. If the system performs work at the rate of 75 J per second, at what rate is the internal energy increasing? (3)

Q14. Show that motion of the bob of a simple pendulum when taken to certain position and then released will be SHM. Also find the expression of its time period. (2+1)

5 MARKS QUESTIONS

Q15. State parallelogram law of vector addition. Give its analytical treatment i.e. find the magnitude and direction of resultant of two vectors. (2+3) **OR**

Q15. Prove that the motion of a projectile given angular projection is a parabolic path. Also find expression of time period of particle in parabolic path. (3+2)

Q16. Derive an expression for rise of liquid in a capillary tube. Also discuss the case if the tube is of insufficient height (3+2)**OR**

Q16. State and prove Bernoulli principle. Also discuss the spinning of a ball in air. (3+2)