

Class XI (Session 2024-25)

Marking Scheme

Subject - Physics

SECTION - A

1.	I)	10m	1
2.	ii)	ZERO	1
3.	ii)	60°	1
4.	iv)	ZERO	1
5.	iii)	10N	1
6.	ii)	9J	1
7.	ii)	decreases	1
8.	ii)	decreases	1
9.	iv)	$T \propto R^{3/2}$	1
10.		ZERO	1
11.		Bulk Modules	1
12.		Hooke's law	1
13.		8 : 1	1
14.		Joule / kg	1
15.		$\gamma = 3\alpha$	1
16.		(d)	1
17.		(d)	1
18.		(d)	1

SECTION - B

19.	By PRINCIPLE OF HOMOGENEITY	2
	$a = [L]$	(1+1)
	$b = [LT^{-1}]$	
20.	We know that : $n_1 u_1 = n_2 u_2$ $n_2 = n_1 \frac{u_1}{u_2} = n_1 \frac{[M_1^a L_1^b T_1^c]}{[M_2^a L_2^b T_2^c]}$ $= n_1 \left[\frac{M_1}{M_2} \right]^a \left[\frac{L_1}{L_2} \right]^b \left[\frac{T_1}{T_2} \right]^c$ SI System New system $n_1 = 4.2$ $n_2 = ?$ $M_1 = 1 \text{ kg}$ $M_2 = \alpha \text{ kg}$ $L_1 = 1 \text{ m}$ $L_2 = \beta \text{ m}$ $T_1 = 1 \text{ s}$ $T_2 = \gamma \text{ s}$ $1 \text{ cal} = 4.2 \text{ J} = 4.2 \text{ kg m}^2 \text{ s}^{-2} \therefore a = 1, b = 2, c =$ $\therefore n_2 = 4.2 \left[\frac{1 \text{ kg}}{\alpha \text{ kg}} \right]^1 \left[\frac{1 \text{ m}}{\beta \text{ m}} \right]^2 \left[\frac{1 \text{ s}}{\gamma \text{ s}} \right]^{-2}$ $\therefore n_2 = 4.2 \alpha^{-1} \beta^{-2} \gamma^2$ $\therefore 1 \text{ cal} = 4.2 \alpha^{-1} \beta^{-2} \gamma^2$ in new system	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$

$$\begin{aligned}
 21. \quad W &= \text{F.S.} & 1 \\
 &= (3\mathbf{i} + 4\mathbf{j} + 5\mathbf{k}) \cdot (5\mathbf{i} + 4\mathbf{j} + 3\mathbf{k}) \\
 &= 15 + 16 + 13 \\
 &= 46 \text{ Joule} & 1
 \end{aligned}$$

OR

Recation between K.E. and linear Momentum. 1

$$P = \sqrt{2mE}$$

KE of Lighter body will be greater because $KE \propto \frac{1}{\text{mass}}$ 1

22. Coefficient of restitution is defined as the ratio of the magnitude of velocity of separation and magnitude of velocity of approach. 1+1

For Elastic Collision $e = 1$

23. Maximum mass that can be lifted, $m = 3000 \text{ kg}$

Area of cross-section of the load-carrying piston, $A = 425 \text{ cm}^2 = 425 \times 10^{-4} \text{ m}^2$ $\frac{1}{2}$

The maximum force exerted by the load, $F = mg = 3000 \times 9.8 = 29400 \text{ N}$ $\frac{1}{2}$

The maximum pressure on the load-carrying piston, $P = F / A$ $\frac{1}{2}$

$P = 6.917 \times 10^5 \text{ Pa}$ $\frac{1}{2}$

24. At room temperature, $T = 27^\circ \text{C} = 300 \text{ K}$ $\frac{1}{2}$

Average thermal energy $= (3/2) kT$ $\frac{1}{2}$

Where,

k is the Boltzmann constant $= 1.38 \times 10^{-23} \text{ m}^2 \text{ kg s}^{-2} \text{ K}^{-1}$

Hence,

$$(3/2) kT = (3/2) \times 1.38 \times 10^{-23} \times 300 \quad \text{---} \quad \frac{1}{2}$$

On calculation, we get

$$= 6.21 \times 10^{-21} \text{ J} \quad \text{---} \quad \frac{1}{2}$$

25. $T = 80 \text{ N}$

$l = .50 \text{ metre}$

$m = 4 \times 10^{-3} \text{ kg}$

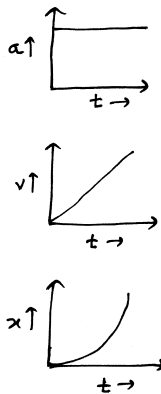
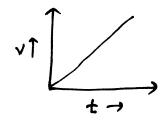
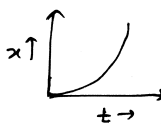
$$v = \sqrt{\frac{T}{\mu}} \quad \text{---} \quad 1$$

Where

$$u = \text{mass per unit length} = \frac{4 \times 10^{-3}}{.50} = 8 \times 10^{-3} \text{ kg/metre} \quad \text{---} \quad \frac{1}{2}$$

$$v = \sqrt{\frac{80}{8 \times 10^{-3}}} = 10 \text{ m/s} \quad \text{---} \quad \frac{1}{2}$$

SECTION - C

26.  1
-  1
-  1
27. Expression for centre of Mass 3
- $$r = \frac{m_1 r_1 + m_2 r_2 + m_3 r_3}{m_1 + m_2 + m_3}$$
28. Moment of inertia is the sum of the product of the mass of every particle with its square of the distance from the axis of rotation. We know, kinetic energy 1
- $$(E) = \frac{1}{2} m v^2 \quad \text{1/2}$$
- As $v = \omega r$
- So
- $$E = \frac{1}{2} m (r^2 \omega^2) \quad \text{1/2}$$
- $$\Rightarrow E = \frac{1}{2} I \omega^2 \quad \text{1}$$
- [∵ $I = m r^2$]
- which is required relationship between kinetic energy of rotation and moment of inertia.
29. Kepler's Laws of Planetary Motion They describe how 1+1+1
- 1) planets move in elliptical orbits with the Sun as a focus,
 - 2) a planet covers the same area of space in the same amount of time no matter where it is in its orbit, and
 - 3) a planet's orbital period is proportional to the size of its orbit.

OR

Orbital velocity (V_o) : Velocity of a satellite moving in orbit is called orbital velocity (V_o).

Let a satellite of mass is revolving round the earth in a circular orbit at a height 'h' above the ground.

Radius of the orbit = $R+h$ where R is radius of earth.

In orbit motion is "The centrifugal and centripetal forces acting on the satellite".

$$\text{Centrifugal force} = \frac{mV^2}{r} = \frac{mV_o^2}{R+h} \dots\dots\dots(1)$$

Centripetal force is the force acting towards the centre of the circle it is provided by gravitational force between the planet and satellite.

$$\therefore F = \frac{GM}{(R+h)^2} \dots\dots\dots(2)$$

$$(1) = (2) \quad \frac{mV_o^2}{(R+h)} = \frac{GM}{(R+h)^2}$$

$$\therefore V_o^2 = \frac{GM}{R+h} \quad \text{or} \quad V_o = \sqrt{\frac{GM}{R+h}}$$

When $h < R$ then orbital velocity.

$V_o = \sqrt{gR}$ is called orbital velocity. Its value is 7.92 km/sec.

1

1

1

30. An adiabatic process is defined as. The thermodynamic process in which there is no exchange of heat from the system to its surrounding neither during expansion nor during compression.

1+2

ANSWER

Adiabatic process: $PV^\gamma = K$

So, $P = KV^{-\gamma}$

Work done $W = \int PdV$

Or $W = \int KV^{-\gamma} dV$

$$\text{Or } W = K \times \frac{V^{-\gamma+1}}{1-\gamma} \Big|_{V_1}^{V_2}$$

$$\text{Or } W = \frac{K}{1-\gamma} \times [V_2^{-\gamma+1} - V_1^{-\gamma+1}]$$

$$\text{Or } W = \frac{1}{1-\gamma} \times [KV_2^{-\gamma+1} - KV_1^{-\gamma+1}]$$

$$\text{Or } W = \frac{1}{1-\gamma} \times [P_2V_2^\gamma V_2^{-\gamma+1} - P_1V_1^\gamma V_1^{-\gamma+1}]$$

$$\text{Or } W = \frac{P_2V_2 - P_1V_1}{1-\gamma}$$

OR

Isothermal process is a thermodynamic process in which the temperature of a system remains constant. The transfer of heat into or out of the system happens so slowly that thermal equilibrium is maintained.

1+2

Suppose 1 mole of gas is enclosed in isothermal container. Let P_1, V_1, T be

initial pressure, volumes and temperature. Let expand to volume V_2 &

pressure reduces to P_2 & temperature remain constant. Then, work done is given by

$$W = \int PdV$$

$$W = \int_{V_1}^{V_2} P dV$$

$$\text{as } PV = RT \quad (n = \text{mole})$$

$$P = \frac{RT}{V}$$

$$W = \int_{V_1}^{V_2} \frac{RT}{V} dV$$

$$W = RT \int_{V_1}^{V_2} \frac{dV}{V}$$

$$= RT [\ln V]_{V_1}^{V_2}$$

$$= RT [\ln V_2 - \ln V_1]$$

$$W = RT \ln \frac{V_2}{V_1}$$

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

31. (I) Let H be the maximum height reached by the projectile in time t_1 . For vertical motion, $2\frac{1}{2}$
 The initial velocity $= u \sin \theta$
 The final velocity $= 0$
 Acceleration $= -g$
 $\therefore$ using, $v^2 = u^2 + 2as$
 $0 = u^2 \sin^2 \theta - 2gH$
 $2gH = u^2 \sin^2 \theta$
 $H = \frac{u^2 \sin^2 \theta}{2g}$
- (ii) Let t_1 be the time taken by the projectile to reach the maximum height H . For vertical motion, $2\frac{1}{2}$
 initial velocity $= u \sin \theta$
 Final velocity at the maximum height $= 0$
 Acceleration $a = -g$
 Using the equation $v = u + at$
 $0 = u \sin \theta - gt_1$
 $gt_1 = u \sin \theta$
 $t_1 = \frac{u \sin \theta}{g}$
 Let t_2 be the time of descent.
 But $t_1 = t_2$
 i.e. time of ascent = time of descent.
 $\therefore$ Time of flight $T = t_1 + t_2 = 2t_1$
 $\therefore T = \frac{2u \sin \theta}{g}$

OR

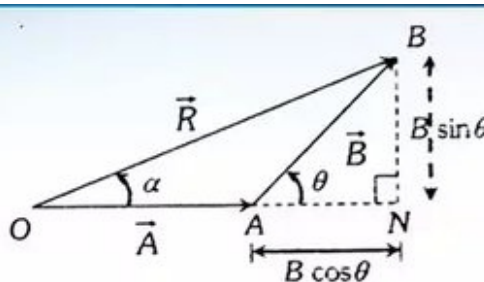
The triangle law for vector addition states that if two vectors are represented by two sides of a triangle taken in order, then their vector sum is represented by the third side of the triangle taken in the opposite direction.

(1) **Magnitude of resultant vector**

In $\triangle ABN$, $\cos \theta = \frac{AN}{B} \therefore AN = B \cos \theta$

$\sin \theta = \frac{BN}{B} \therefore BN = B \sin \theta$

In $\triangle OBN$, we have $OB^2 = ON^2 + BN^2$



$$R^2 = (A + B \cos \theta)^2 + (B \sin \theta)^2$$

$$R^2 = A^2 + B^2 (\cos^2 \theta + \sin^2 \theta) + 2AB \cos \theta$$

$$R = \sqrt{A^2 + B^2 + 2AB \cos \theta}$$

32.

Bernoulli's principle states that an increase in the speed of a fluid occurs simultaneously with a decrease in static pressure or a decrease in the fluid's potential energy.

To prove Bernoulli's theorem, consider a fluid of negligible viscosity moving with laminar flow, as shown in Figure.

Let the velocity, pressure and area of the fluid column be p_1 , v_1 and A_1 at Q and p_2 , v_2 and A_2 at R. Let the volume bounded by Q and R move to S and T where $QS = L_1$, and $RT = L_2$.



If the fluid is incompressible:

The work done by the pressure difference per unit volume = gain in kinetic energy per unit volume + gain in potential energy per unit volume. Now:

$$A_1 L_1 = A_2 L_2$$

Work done is given by:

$$W = F \times d = p \times \text{volume}$$

$$\Rightarrow W_{\text{net}} = p_1 - p_2$$

$$\Rightarrow K.E = \frac{1}{2}mv^2 = \frac{1}{2}V\rho v^2 = \frac{1}{2}\rho v^2 (\because V = 1)$$

$$\Rightarrow K.E_{\text{gained}} = \frac{1}{2}\rho(v_2^2 - v_1^2)$$

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho gh_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho gh_2$$

$$\therefore P + \frac{1}{2}\rho v^2 + \rho gh = \text{const.}$$

OR

Newton's law of cooling states that the rate at which an object cools is proportional to the difference in temperature between the object and the object's surroundings,

Proof/Derivation

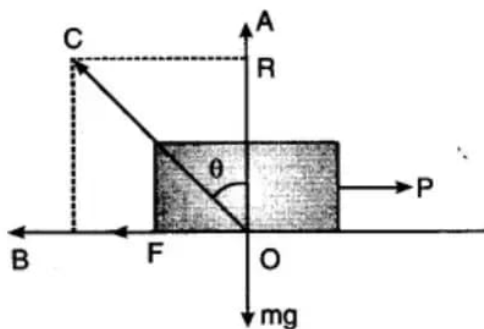
1+4

33. Limiting friction is described as the friction created when two static surfaces come into contact with each other

LAWS :

- 1) The direction of limiting friction force is always opposite the direction of motion.
- 2) It always acts tangential to the two surfaces.
- 3) It is dependent on the material and the nature of the surfaces in contact.
- 4) It is independent of the shape and area.

OR



2

Relation :

In $\triangle AOC$ $\tan \theta = \frac{AC}{OA} = \frac{OB}{OA} = \frac{F}{R} = \mu$

2

Hence $\mu = \tan \theta$

1

Coefficient of static friction: $\mu = \tan(\theta)$, where μ is the coefficient of friction and θ is the angle

34. i) (d) 5 1
 ii) (a) He 1
 iii) The number of independent ways in which a molecule of gas can move is called the degree of freedom. 2

OR

The law of equipartition of energy states that “For a system which is in thermal equilibrium, its total energy is divided equally among the degree of freedom.” 2

35. I) (d) Restoring Force 1
 ii) (a) Periodic Motion 1
 iii) Simple harmonic motion is defined as a periodic motion of a point along a straight line, such that its acceleration is always towards a fixed point in that line and is proportional to its distance from that point. 2

OR

Seconds pendulum: a pendulum requiring exactly one second for each swing in either direction or two seconds for a complete vibration and having a length between centres of suspension and oscillation of 99.353 centimetre 2