Class XI (Session 2024-25)
Marking Scheme
Subject - Physics

SECTION - A

1. I) 10m — 1

2. ii) ZERO — 1

3. ii) 60^o — 1

4. iv) ZERO — 1

5. iii) 10N — 1

6. ii) 9J — 1

7. ii) decreases — 1

8. ii) decreases — 1

9. iv) $T \alpha R^{3/2}$ — 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 : $n_1u_1 = n_2u_2$ — ½

$n_2 = n_1\frac{u_1}{u_2} = n_1\frac{[M_1^aL_1^bT_1^c]}{[M_2^aL_2^bT_2^c]}$

$= n_1[\frac{M_1}{M_2}]^a[\frac{L_1}{L_2}]^b[\frac{T_1}{T_2}]^c$ — ½

SI System New system

$n_1 = 4.2$ $n_2 = ?$ — ½

$M_1 = 1$ kg $M_2 = \alpha$ kg

$L_1 = 1$ m $L_2 = \beta$ m

$T_1 = 1$ s $T_2 = \gamma$ s

1 cal = 4.2 J = 4.2 kg m^2s^{-2} $\therefore a = 1, b = 2, c =$

$\therefore n_2 = 4.2[\frac{1\ kg}{\alpha\ kg}]^1[\frac{1\ m}{\beta\ m}]^2[\frac{1\ s}{\gamma\ s}]^{-2}$

$\therefore n_2 = 4.2\alpha^{-1}\beta^{-2}\gamma^2$ — ½

$\therefore$ 1 cal = $4.2\alpha^{-1}\beta^{-2}\gamma^2$ in new system

21.	W = F.S.		1
	= (3i + 4j + 5k) . (5i + 4j + 3k)		
	= 15 + 16 + 13		
	= 46 Joule		1

OR

Recation between K.E. and linear Momentum. 1

P= $\sqrt{2mE}$

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

Area of cross-section of the load-carrying piston, A = 425 cm^2 = 425 × 10-4m^2 ½

The maximum force exerted by the load,F = mg = 3000 x 9.8 = 29400 N ½

The maximum pressure on the load-carrying piston, P = F / A ½

P= 6.917 x 105 Pa ½

24. At room temperature, T = 270 C = 300 K ½

Average thermal energy = (3 / 2) kT ½

Where,

k is the Boltzmann constant = 1.38 × 10^{-23} m^2 kg s^{-2} K^{-1}

Hence,

(3 / 2) kT = (3 / 2) × 1.38 × 10^{-23} × 300 ½

On calculation, we get

= 6.21 x 10-21 J ½

25. T = 80N

l = .50 metre

m = 4 × 10^{-3}kg

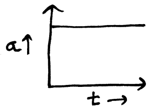
$$v = \sqrt{\frac{T}{\mu}}$$ 1

Where

u = mass per unit length = $\frac{4 \in 10^{-3}}{.50}$ = 8 × 10^{-3} kg/metre ½

$$\upsilon = \sqrt{\frac{80}{8 \in 10^{-3}}} = 10 \text{ m/s}$$ ½

SECTION - C

26. 

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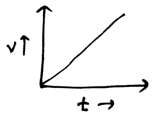

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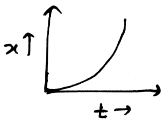

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27. Expression for centre of Mass 3

$$r = \frac{m_1 r_1 + m_2 r_2 + m_3 r_3}{m_1 + m_2 + m_3}$$

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

$$(E) = \frac{1}{2} mv^2$$ ½

As v = wr

So

$$E = \frac{1}{2} m (r^2 w^2)$$ ½

$$\Rightarrow E = \frac{1}{2} Iw^2$$ 1

$[\therefore I = mr^2]$

which is required relationship between kinetic energy of rotation and moment of inertia.

29. Kepler's Laws of Planetary MotionThey 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_0) : Velocity of a satellite moving in orbit is called orbital velocity (V_0). 1

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".

Centrifugal force $= \frac{mV^2}{r} = \frac{mV_0^2}{R+h}$........(1)

Centripetal force is the force acting towards the centre of the circle it is provided by gravitational force between the planet and satellite. 1

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

$(1) = (2) \frac{mV_0^2}{(R+h)} = \frac{GM}{(R+h)^2}$

$\therefore V_0^2 = \frac{GM}{R+h}$ or $V_0 = \sqrt{\frac{GM}{R+h}}$

When $h << R$ then orbital velocity.

$V_0 = \sqrt{gR}$ is called orbital velocity. Its value is 7.92 km/sec.

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

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

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

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

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

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

$W = \int dW$

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

as $PV = RT$ (n = mole)

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

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

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

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

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

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

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

31. (I) Let H be the maximum height reached by the projectile in time t_1 For vertical motion, 2½

The initial velocity = u sin θ

The final velocity = 0

Acceleration = – g

∴ using, $v^2 = uw^2 + 2as$

$0 = u^2 \sin^2\theta - 2gH$

$2gH = u^2 \sin^2\theta$

$$H = \frac{u^2 \sin^2 \sigma}{2g}$$

(ii) Let t_1 be the time taken by the projectile to reach the maximum height H. For vertical motion, 2½

initial velocity = u sin θ

Final velocity at the maximum height = 0

Acceleration a = –g

Using the equation $v = u + at_1$

$0 = u \sin\theta - gt_1$

$gt_1 = u \sin\theta$

$$t_1 = \frac{u \sin \theta}{g}$$

Let t_2 be the time of descent.

But $t_1 = t_2$

i.e. time of ascent = time of descent.

∴ Time of flight $T = t_1 + t_2 = 2t_1$

$$\therefore \; T = \frac{2u \sin \sigma}{g}$$

OR

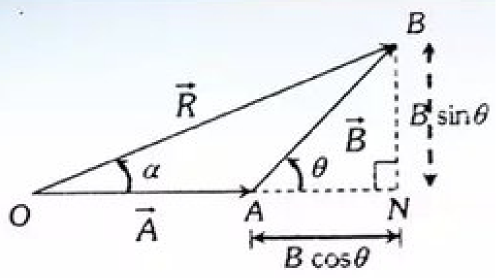
The triangle law for vector addition states that if two vectors are represented by two sides of a triangle taken in order, then their vector sum is represented by the third side of the triangle taken in the opposite direction. 1

4

(1) Magnitude of resultant vector

In ΔABN, $\cos\theta = \frac{AN}{B}$ ∴ $AN = B\cos\theta$

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



In ΔOBN, 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. 1

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.

1

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:

$$A_1L_1 = A_2L_2$$ 1

Work done is given by:

$$W = F \times d = p \times volume$$
$$\Rightarrow W_{net} = p_1 - p_2$$
$$\Rightarrow K.E = \frac{1}{2}mv^2 = \frac{1}{2}V\rho v^2 = \frac{1}{2}\rho v^2 (\because V = 1)$$ 1
$$\Rightarrow K.E_{gained} = \frac{1}{2}\rho({v_2}^2 - {v_1}^2)$$
$$P_1 + \frac{1}{2}\rho {v_1}^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho {v_2}^2 + \rho g h_2$$
$$\therefore P + \frac{1}{2}\rho v^2 + \rho g h = const.$$ 1

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,

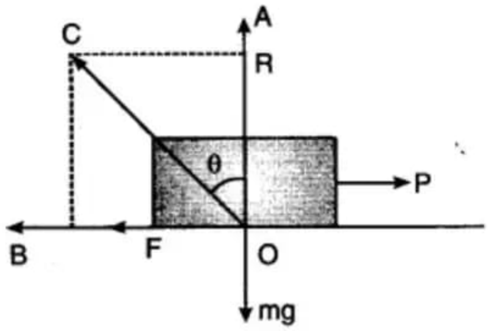
Proof / Derivation 1+4

33. Limiting friction is described as the friction created when two static surfaces come into contact with each other 1

LAWS :

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

OR



2

Relation :

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