Code Number: **A**

Corp. Office: Aakash Educational Services Limited, 3rd Floor, Incuspaze Campus- 2, Plot No. 13, Sector- 18, Udyog Vihar, Gurugram, Haryana - 122015

Time: 3 hrs. **Mock Test Paper for Class-XII** **Max. Marks: 60**

Physics

Answers & Solutions

1 Any one contribution **02 M**

Chandra Shekhar limit (or) Structure and evolution of stars.

2 A physical quantity possesses a wide range of magnitudes. Hence, we need different units for different ranges. Ex: mg, gm, kg etc., for mass: mm, cm, m, km for length. (OR) **02 M**

Due to different measuring system of units. Ex : C.G.S, F.P.S, M.K.S

3 $\vec{P}+\vec{Q}=\left(2\hat{i}+4\hat{j}+14\hat{k}\right)+\left(4\hat{i}+4\hat{j}+10\hat{k}\right)$ **01 M**

$=6\hat{i}+8\hat{j}+24\hat{k}$ **01 M**

$|\vec{P}+\vec{Q}|=\sqrt{6^2+8^2+24^2}=\sqrt{676}=26\text{units}$

4 According to Law of conservation of linear momentum, **02 M**

$m_1v_1 + m_2v_2 = 0 \Rightarrow m_1v_1 = -m_2v_2$ hence the two pieces must travel in opposite directions (OR) Due to Law of conservation of Linear momentum.

5 Excess pressure $(P)=\frac{2T}{r}$ (OR) $(P)=\frac{2S}{r}$ **02 M**

T = S = surface tension ; r = radius of air bubble

6 Water Proofing Agents : The substances which increase the angle of contact of a liquid with the surface are called Water Proofing agents. **01 M**

They does not wet the surfaces.

Water Wetting agents: The substances which decreases the angle of contact of a liquid with the surface are called Water Wetting agents. **01 M**

They wet the surfaces.

7 No, A body does not radiate heat at 0 K. **01 M**

Yes, A body can radiate heat at 0°C. **01 M**

8 Latent heat of vaporization : The amount of heat required to convert a substance of unit mass **02 M**

from liquid state gaseous state at the constant temperature is called Latent Heat of vaporization.

9 $V_{rms} = \sqrt{\frac{3k_BT}{m}}$ **01 M**

$\Rightarrow V_{rms} \propto \sqrt{T}$ **01 M**

$\frac{V_{1rms}}{V_{2rms}} = \sqrt{\frac{T_1}{T_2}} = \sqrt{\frac{T}{3T}} = \frac{1}{\sqrt{3}} \Rightarrow V_{2rms} = \sqrt{3}\,V_{1rms}$

$\Delta V_{rms} = V_{2rms} - V_{1rms} = \sqrt{3} - 1 = 0.732$

10 At low pressures and high temperatures, a real gas behaves like an ideal gas. **02 M**

SECTION-B **6 × 4 = 24 M**

11 Let height of the building = Displacement of ball = h

For a first ball

$u = 0, a = g, S = h, t = t_1$ **02 M**

Substituting these values in $S = ut + \frac{1}{2}at^2$

$\Rightarrow h = 0 + \frac{1}{2}gt_1^2$ **02 M**

$\frac{1}{2}gt_1^2 = h$

$\therefore t_1 = \sqrt{\frac{2h}{g}}$ ..... (1)

For second ball $u_y = 0, a_y = g, S_y = h, t = t_2$

Substituting these values in $S_y = u_yt + \frac{1}{2}at^2$

$h = 0 + \frac{1}{2}gt_2^2$

$\frac{1}{2}gt_2^2 = h$

$\therefore t_2 = \sqrt{\frac{2h}{g}}$.....(2)

From equation (1) and (2) $t_1 = t_2$

Therefore, Two balls will reach the ground in same time

(OR)

Both the balls have same vertical component of velocity and the acceleration is also same. **04 M**

Hence, the two balls will reach the ground simultaneously.

(OR)

Any Relevant explanation

12 $|\vec{a}+\vec{b}| = |\vec{a}-\vec{b}|$ **01 M**

$\sqrt{a^2+b^2+2ab\cos\theta} = \sqrt{a^2+b^2-2ab\cos\theta}$ **01 M**

$a^2+b^2+2ab\cos\theta = a^2+b^2-2ab\cos\theta$ **01 M**

$4ab\cos\theta = 0$

$\cos\theta = 0,\ \theta = 90°$ **01 M**

13 Any four points **04 M**

Centre of Mass	Centre of Gravity
1) A point of the body at which total mass appears to be concentrated is called centre of mass.	1) A point of the body where the total gravitational torque is zero and total weight of the body acts.
2) Centre of gravity and centre of mass of a body coincide in case of symmetric and small bodies.	2) Centre of gravity and centre of mass of a body do not coincide in case of non- symmetric and large bodies.
3) It depends on the mass distribution	3) It depends on acceleration due to gravity (g)
4) It may or may not lies within the body.	4) It lies within the body only.
5) It explains the motion of the body.	5) It explains the stability of the body.

14 Definition : 1M

Example : 1M

Two properties : 2M

Definition: The magnitude of vector product is equal to product of magnitudes of the given two vectors and sine of angle between the two vectors. The direction is perpendicular to the plane of both the vectors.

(OR)

$\vec{A}\times\vec{B} = |\vec{A}||\vec{B}|\sin\theta.\hat{n}$ **01 M**

Example : 1) Angular momentum $L = \vec{r}\times\vec{P}$ 2) Torque $\tau = \vec{r}\times\vec{F}$ (or) Any Two relevant examples. **01M**

Properties : Any two relevant properties.

1. Cross product is not commutative $\vec{A}\times\vec{B} \neq \vec{B}\times\vec{A}$
2. Cross product obeys distributive law $\vec{A}\times(\vec{B}+\vec{C}) = (\vec{A}\times\vec{B})+(\vec{A}\times\vec{C})$
3. $\vec{i}\times\vec{i} = \vec{j}\times\vec{j} = \vec{k}\times\vec{k} = 0$ **02 M**
4. $\vec{i}\times\vec{j} = \vec{k}, \vec{j}\times\vec{k} = \vec{i}, \vec{k}\times\vec{i} = \vec{j}$

15 **Orbital Velocity:** The horizontal velocity required for a body to move around a planet in a circular orbit is called orbital velocity. **01 M**

Expression:

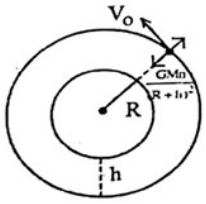


Fig : 1M

Let M = mass of the earth, R= radius of the earth

m = mass of the satellite, V_0 = orbital velocity of satellite,

h = height of the satellite above earth's surface.

R+h = orbital radius of the satellite.

The centripetal force required by the satellite to orbit around the earth is provided by the gravitational force between the earth and the satellite.

At equilibrium, the centripetal force is balanced by the gravitational force between the earth and satellite.

Gravitational force $\frac{GM.m}{(R+h)^2}$ .....(1)

Centripetal force $= \frac{mv_0^2}{R+h}$ .....(2)

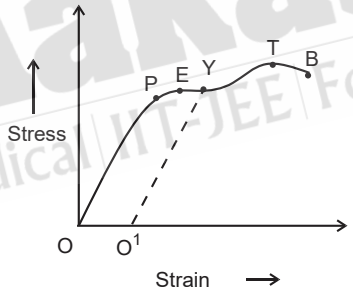
From equations (1),(2)

$$\therefore \frac{mv_0^2}{R+h} = \frac{GM.m}{(R+h)^2} \Rightarrow v_0^2 = \frac{GM}{(R+h)} \Rightarrow v_0 = \sqrt{\frac{GM}{R+h}}$$

when h << R (R + h $\cong$)

$v_0 = \sqrt{\frac{GM}{R}} = \sqrt{gR}$ (when h<<R & GM = gR^2) **02 M**

16



01 M

P – Proportionally limit

E – Elastic limit

Y = yield point

T = Tensila point

B – Banking point

Explanation : **03 M**

i) Proportionality Limit:

OP is a straight line showing that stress is proportional to strain. i.e, the wire obeys Hooke's law up to point P, so P is called proportionality limit

ii) Elastic Limit :

Between P and E when the load is removed the wire will regain its original length but

stress is not proportional to strain. It does not obey Hooke's law but has elastic nature, so E is called Elastic limit.

iii) Permanent Set:

From E to Y if the load applied on the wire is removed the wire does not regain its natural length completely. It will have a permanent increase in length. This is shown by dashed line, O O^1 is permanent set.

iv) Yield Point:

When the wire crosses the point Y the strain increases rapidly without any increase in the load. So yield point is defined as the point beyond which strain increases rapidly without any increase in load. Beyond the point Y the wire becomes thin. The stress for the same load becomes larger and larger increasing the strain further and further

v) Breaking Point:

Beyond the point T the thinning of the wire is no longer uniform and the wire shows necks. At 'B' the wire ultimately breaks.

17 **Conduction :** It is a mode of transfer of heat from one part of the body to the another, from particle to particle in the direction of fall of temperature without any actual movement of the particles. **Def : 03 M**

Ex. Heat transfer all solids **Ex : 01 M**

Convection : It is a mode of transfer of heat from one part of the medium to the another part by the actual movement of the particles of the medium.

Ex : Sea breeze, trade wind etc.,

Radiation : It is the fastest mode of transfer of heat without any medium.

Ex : Heat from Sun to earth.

18 **Methods of decreasing Friction :**

i) Polishing : **01 M**

By polishing the surfaces in contact to some extent friction can be reduced.

ii) Using lubricants : **01 M**

A thin layer of an oil or fluid is used between the surfaces in contact to reduce friction.

iii) Using ball bearing : **01 M**

The free wheels of vehicles and shafts of motors etc., are provided with ball bearings to reduce friction by replacing sliding with rolling friction.

iv) Streamlining: **01 M**

Automobiles and aeroplanes are specially designed with curved surfaces, to streamline the air layers during the motion and hence reduce friction.

19 **Work : -** Work is done by a force on the body over a certain displacement **01 M**

(OR)

Work is said to be done when a body undergoes displacement parallel to the line of action of force

$W = \bar{F}.\bar{S} = \bar{F}.\bar{S}\cos\theta$

Kinetic Energy: The Kinetic energy of an object is a measure of the work an object can do by the virtue of its motion (OR) **01 M**

The Energy possessed by a body by virtue of its motion is called Kinetic Energy .

$$K.E = \frac{1}{2}mv^2$$

Work Energy Theorem :

The change in Kinetic energy of a particle is equal to the work done on it by the net force. **04 M**

$v^2 - u^2 = 2as$

Multiplying with $\frac{m}{2}$ on both slides,

$\frac{1}{2}mv^2 - \frac{1}{2}mu^2 = mas = Fs$

$K_f - K_i = W$

Problem : -

Formula : 01 M

Substitution and Result – 01 M

Power = Work done / Time (or)

$$\text{Power } P = \frac{1}{2}\frac{mnv^2}{t}$$ **01 M**

$$= \frac{1}{2} \times \frac{0.005 \times 360 \times 600 \times 600}{60}$$ **01 M**

5400 W = 5.4 kW

20 **Derivation :** A bob of mass 'm' oscillating in a plane about the vertical line through the support.

There are only two forces acting on the bob.

(i) Tension T due to the string (ii) Vertical force due to gravity mg.

The force 'mg' can be resolved into two components

(i) mg Cos θ

(ii) mg Sin θ

Torque acting on the bob $\vec{\tau} = \vec{r} X \vec{F}$

$= rF\,Sin\theta$

$= -LmgSin\theta$

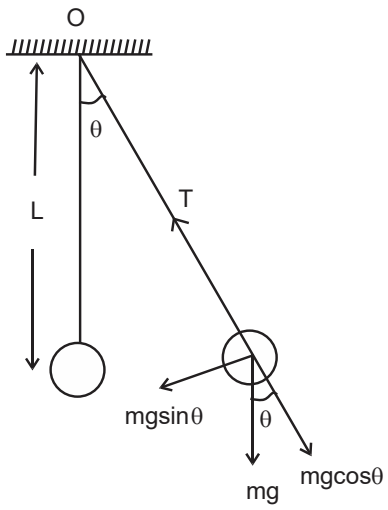


Fig 1 M

By Newton's law of rotational motion

$$\vec{\tau} = I\alpha$$

$$I\alpha = -(mgSin\theta)L$$

$$\alpha = \frac{-mgL}{I}Sin\theta$$

$$As\,\theta is\ small \sin\theta \approx \theta$$

$$\alpha = \frac{-mgL}{I}\theta \Rightarrow \alpha \propto -\theta$$

Hence the motion of simple Pendulum is simple Harmonic.

Equation for time period (T) :

$\alpha = -\omega^2\theta \Rightarrow \omega^2 = \frac{mgL}{I}$ but $I = mL^2$ **04 M**

$$\omega^2 = \frac{mgL}{mL^2} \Rightarrow \omega^2 = \frac{g}{L} \Rightarrow \omega = \sqrt{\frac{g}{L}}$$

$$T = \frac{2\pi}{\omega} \Rightarrow T = 2\pi\sqrt{\frac{L}{g}}$$

Definition : The pendulum whose time period is equal to 2 seconds is called Seconds Pendulum. **02 M**

Note : Award full marks for any other relevant method. **01 M**

21 **Reversible Process:-** A thermodynamic process is reversible if the process can be turned back such that both the system and the surroundings return to their original states, with no other change anywhere else in the universe **01 M**

(Or any other relevant answer)

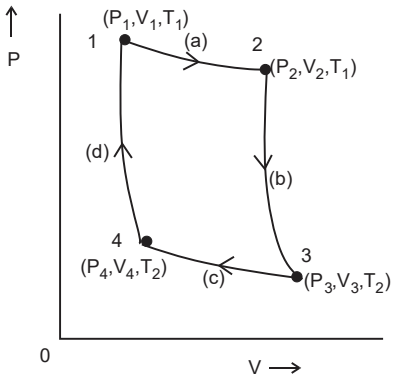
Eg : Fusion of ice and vaporization of water

Irreversible Process:- A Process that cannot be retraced back in opposite direction is called irreversible process. **01 M**

(Or any other relevant answer)

Eg : Work done against friction

Carnot engine Description:- A reversible heat engine operating between two temperatures is called a Carnot engine. This works in cyclic process through the following sequence of steps: **01 M**



01 M

a) (step $1 \rightarrow 2$) Isothermal Expansion

$$(P_1, V_1, T_1) \rightarrow (P_2, V_2, T_1)$$

$$W_{1\rightarrow 2} = Q_1 = \mu R T_1 \ln\left(\frac{V_2}{V_1}\right) \ldots\ldots (1)$$

04 M

(b) (step $2 \rightarrow 3$) Adiabatic Expansion

$$(P_2, V_2, T_1) \rightarrow (P_3, V_3, T_2)$$

$$W_{2\rightarrow 3} = \frac{\mu R(T_1 - T_2)}{\gamma - 1} \ldots\ldots\ldots (2)$$

(c) (step $3 \rightarrow 4$) Isothermal Compression

$$(P_3, V_3, T_2) \rightarrow (P_4, V_4, T_2)$$

$$W_{3\rightarrow 4} = Q_2 = \mu R T_2 \ln\left(\frac{V_3}{V_4}\right) \ldots\ldots\ldots (3)$$

(d) (step $4 \rightarrow 1$) Adiabatic Compression

$$(P_4, V_4, T_2) \rightarrow (P_1, V_1, T_1)$$

$$W_{4\rightarrow 1} = \frac{\mu R(T_1 - T_2)}{\gamma - 1} \ldots\ldots\ldots\ldots (4)$$

Total Work done $(W) = W_{1\rightarrow 2} + W_{2\rightarrow 3} - W_{3\rightarrow} 4 - W_{4\rightarrow 1}$

$$= \mu R T_1 \ln\left(\frac{V_2}{V_1}\right) - \mu R T_2 \ln\left(\frac{V_3}{V_4}\right) \ldots\ldots\ldots\ldots (5)$$

The efficiency of Carnot engine is given as.

$$\int = \frac{W}{Q_1} = \frac{\mu R T_1 \ln\left[\frac{V_2}{V_1}\right] - \mu R T_2 \ln\left[\frac{V_3}{V_4}\right]}{\mu R T_1 \ln\left[\frac{V_2}{V_1}\right]}$$

$$= 1 - \left[\frac{T_2}{T_1}\right] \frac{\ln\left[\frac{V_3}{V_4}\right]}{\ln\left[\frac{V_2}{V_1}\right]} \text{ ----(6)}$$

Since the process (2 – 3) is adiabatic process,

$$T_1 V_2^{r-1} = T_2 V_e^{r-1}$$

$$\Rightarrow \frac{T_2}{T_1} = \left[\frac{V_2}{V_3}\right]^{r-1} \text{ ------(7)}$$

Since the process (4 – 1) is adiabatic process,

$$T_2 V_4^{r-1} = T_1 V_1^{r-1}$$

$$\Rightarrow \frac{T_2}{T_1} = \left[\frac{V_1}{V_4}\right]^{r-1} \quad \text{---- (8)}$$

From equation (7) and (8) $\frac{V_2}{V_3} = \frac{V_1}{V_4}$

$$\Rightarrow \frac{V_2}{V_1} = \frac{V_3}{V_4} \quad \text{----- (9)}$$

From equation (6) and (9)

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