Set – II Std. – HSC	Subject – Physics	Model Answer

Section – A

Q. 1 Select and write correct answers for the following multiple choice type question: **16**

(i) (C) 0 1

(ii) (B) 3 1

(iii) (D) $\sqrt{3}$ 1

(iv) (A) energy is liberated 1

(v) (D) hot chamber 1

(vi) (A) 0 1

(vii) (B) 8.95×10^{-5} J 1

(viii) (A) the temperature will decrease 1

(ix) (A) 0^c 1

(x) (D) sound waves 1

Q. 2 Answer the following questions:

(i) 1

	Polar dielectric	Non -Polar dielectric
(i)	A dielectric molecule in which the centre of mass of positive charges does not coincide with the centre of mass of negative charges because of asymmetric shape of molecules is called polar dielectric.	A dielectric in which centre of mass of positive charges coincide with the centre of mass of negative charges is called non-polar dielectric.
(ii)	They have permanent dipole moments of the order of 10^{-30} cm. They act as tiny electric dipoles, as the charges are separated by small distance.	These have symmetrical shapes & have zero dipole moment in the normal state.
	Eg : HCl, Water, NH_3	Eg : H_2, N_2, O_2

(ii) **Given**: $T = 2.5 \times 10^{-2}$ N/m

Initial radius of bubble = 0

Final radius of bubble r = 1cm = 0.01 m

To Find Work done (W)

We know

$$W = TdA$$
$$= 2.5 \times 10^{-2} \times [8 \pi r^2 - 0]$$
$$= 2.5 \times 10^{-2} \times 8 \times 3.142 \times 0.01^2$$
$$= 0.251 \times 10^{-2} \times 2.5 \times 10^{-2}$$
$$W = 6.275 \times 10^{-5} \text{ J}$$

(iii) **Shunt:** 1

Moving Coil Galvanometer is converted into an ammeter by connecting a low resistance in parallel with galvanometer, which effectively reduces resistance of galvanometer. This low resistance connected in parallel is called Shunt.

(iv) **Given:** 1

$$V_p = 240 \text{ V}$$
$$V_s = 60 \text{ V}$$
$$N_s = 75$$

To Find: Np

We Know,

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$
$$\therefore N_p = N_s \times \frac{V_p}{V_s}$$

$$= 75 \times \frac{240}{60}$$

$$N_p = 300$$

$\therefore$ The secondary has 300 turns

(v) The hysteresis curve represents the relation between magnetic induction $\vec{B}$ of a ferromagnetic material with magnetizing force or magnetic intensity $\vec{H}$ 1

(vi) A low density liquid like water or kerosene helps in having a large level difference between the levels of liquid in the two arms of manometer. Thus, increasing the accuracy of value of pressure measured using manometer. 1

(vii) Electromagnetic Induction: 1
The phenomenon of producing an induced emf in a conductor or conducting coil due to changing magnetic flux is called electromagnetic induction.

(viii) 1

$$\text{Displacement, } x = A \sin(\omega t + \phi)$$

$$\text{Velocity, } v = \frac{dx}{dt} = A\omega \cos(\omega t + \phi)$$

$$\text{Acceleration, } a = \frac{dv}{dt} = -A\omega^2 \sin(\omega t + \phi)$$

Section – B

Attempt any EIGHT questions of following:

Q. 3 Frequency of conical pendulum depends on : 2

(a) Length of pendulum (L) : frequency increases with decrease in length of pendulum

$$\therefore \; n \propto \frac{1}{\sqrt{L}}$$

(b) Acceleration due to gravity (g) : frequency increases with increase in g

$$\text{i.e. } n \propto \sqrt{g}$$

(c) Angle of inclination (θ) : As θ increases cos θ decreases, hence, frequency of conical pendulum increases with increase in θ

$$n \propto \frac{1}{\sqrt{\cos\theta}}$$

(ii) Frequency of conical pendulum is independent of mass of bob

Q. 4 i) When a charged particles moves through a region in which both electric and magnetic fields are present, then the net force experienced by that charged particle is sum of electrostatic force and magnetic force and is called as Lorentz force. 2

ii) Equation of Lorentz force law:

a) Consider a charge q moving through electric field ($\vec{E}$) and magnetic field ($\vec{B}$) with velocity ($\vec{v}$).
b) Electric force and charge q, $\vec{F}_e = q\,\vec{E}$
c) Magnetic force on charge q,
$\vec{F}_m = q\left(\vec{v} \times \vec{B}\right)$
d) Net force on charge q,
$\vec{F} = \vec{F_e} + \vec{F}_m = q\,\vec{E} + q\,(\vec{v} + \vec{B})$
$= q\,[\vec{E} + (\vec{v} \times \vec{B})$
This is the required equation.

Q. 5 Given : G = 99 Ω 2

$$I_g = \frac{20}{100} I = 0.2\,I$$

To find : shunt resistance (s)
We know,

$$S = \frac{Ig\,G}{I - Ig}$$

$$= \frac{0.2\,I \times 99}{(I - 0.2\,I)}$$

$$= \frac{0.2\ I \times 99}{0.8} = \frac{99}{4} = 24.75\ \Omega$$

$\therefore$ The value of shunt resistance is 24.75 Ω

Q. 6 Given : n_o = 90 rpm = 1.5 rpz — 2

Total revolutions N = 21

To find : Time taken by fan to stop (t)

We know

$$\theta = 2\pi N = 2\pi \times 21 = 42\pi \text{ rad}$$

and

$$\omega_0 = 2\pi n_0 = 2\pi \times 1.5 = 3\pi \text{ rad/s}$$

We also have

$$\alpha = \frac{\omega - \omega_0}{t} \text{ and } \alpha = \frac{\omega^2 - \omega_0^2}{2\theta}$$

$$\frac{\omega - \omega_0}{t} = \frac{\omega^2 - \omega_0^2}{2\theta}$$

$$\frac{0 - 3\pi}{t} = \frac{0^2 - (3\pi)^2}{2 \times 42\pi}$$

$$\therefore\ t = 28 \text{ s}$$

$\therefore$ Time taken by fan to stop is 28 s

Q.7 Given : l = 50 m — 2

$B = 6 \times 10^{-5}$ T

v = 400 m/s

To find : Induced emf (e)

We know, e = B l V

$$= 6 \times 10^{-5} \times 50 \times 400$$

$$= 1.2 \text{ V}$$

$\therefore$ induced emf between tips of wings is 1.2 V

Q. 8 **Characteristics of photon:** — 2

(i) According to Einsteins postulate, light behaves as a particle & its energy is absorbed and released in bundles of quanta named photons.

(ii) Photon has an associated momentum along with energy it carries

(iii) All photons of electromagnetic radiation of a particular frequency have same energy and momentum.

(iv) Photons are electrically neutral and are not deflected by electric or magnetic fields.

Q. 9 (i) NOT gate has one input and one output — 2

(ii) It produces a high output (1) if the input is low (0). When the input is high (1), its output is low (0).

(iii) Thus, it produces a negated version of input at its output.

That is why it is called an inverter.

Q. 10 Internal energy of a gas depends only on its temperature. — 2

Argon is a monoatomic gas.

Its internal energy is purely translational. Thus, it is given by $\frac{3}{2} K_B T$

Whereas, oxygen is a diatomic gas. Hence, its internal energy consists of translational as well as rotational kinetic energies. Thus, each mode contributes energy/equal to $\frac{1}{2} K_B T$

$\therefore$ The internal energy for oxygen molecule

$$= 3 \times \frac{1}{2} K_B T + 2 \times \frac{1}{2} K_B T$$

$$= \frac{5}{2} K_B T$$

Q. 11 Fundamental frequency of vibration $n = \frac{1}{2l}\sqrt{\frac{T}{m}}$ 2

Frequency of second harmonic $n_1 = \frac{1}{l}\sqrt{\frac{T}{m}}$

$$\therefore \quad \frac{n}{n_1} = \frac{\frac{1}{2l}\sqrt{\frac{T}{m}}}{\frac{1}{l}\sqrt{\frac{T}{m}}} = \frac{1}{2}$$

$$\therefore \quad \frac{n}{n_1} = \frac{1}{2}$$

Q. 12 Given : $n = 3$, $a_0 = 0.053$ nm 2

To find : radius of 3rd orbit, r_3

We know, $r_n = a_0 n^2 = 0.053 \times (3)^2$

$= 0.053 \times 9 = 0.477$ nm

$\therefore$ Radius of 3rd orbit is 0.477 nm.

Q. 13 (i) A junction transistor is a semiconductor device having two junctions and three terminals 2

(ii) The current in a transistor is carried by both the electrons and holes. Hence, it is called Bipolar junction transistor.

(iii) There are two-types of transistors.

a. n-p-n transistor

b. p-n-p. transistor.

Q. 14 Main postulates of Huygens wave theory: 2

(i) Light energy from a source is propagated in the form of waves.

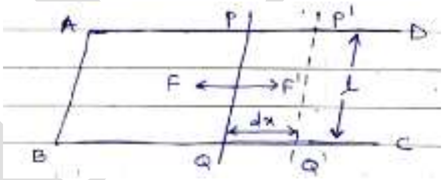
(ii) To explain the propagation of light waves through vacuum, Huygens suggested the existence of hypothetical medium called "ether."

Section - C

Attempt any EIGHT question of the following :

Q. 15 Relation between surface tension and surface energy:

(i) Let ABCD be a rectangular frame of wire, fitted with a movable arm PQ.



(ii) The frame held in horizontal position is dipped into soap solution & taken out so that a soap film APQB is formed. Due to surface tension of soap solution, a force 'F' will act on each arm of the frame. Under the action of this force, the movable arm PQ moves towards AB.

(iii) Magnitude of force due to surface tension is,

$$F = 2T\,l$$

(iv) Let the wire PQ be pulled outward through a small distance 'dx' to the position P′Q′ by applying an external force F′ isothermally, which is equal & opposite to F. Work done by this force $dW = F'dx = 2Tl\,dx$

(v) But, $2l\,dx = dA$ = increase in area of two surfaces of film

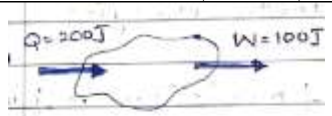
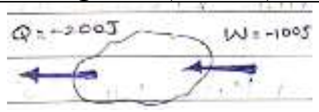
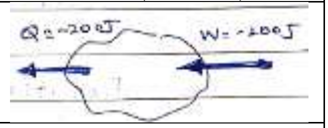
(vi) This work done in stretching the film is stored in area dA in the form of potential energy.

$\therefore$ surface Energy, $E = T\,d\,A$

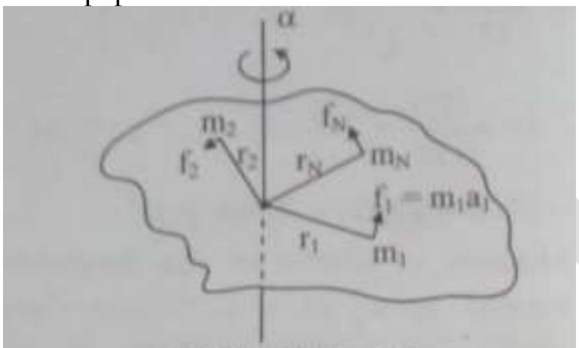
$$\frac{E}{dA} = T$$

(viii) Thus, surface tension is equal to the mechanical work done per unit surface area of the liquid which is also called as surface energy.

Q. 16

	Positive ($\Delta U > 0$)	Negative ($\Delta U < 0$)	Zero ($\Delta U = 0$)
(i)			
(ii)	$\Delta U = Q - W = +100$ J	$\Delta U = Q - W = -100$ J	$\Delta U = Q - W = 0$
(iii)	More heat added than the work done by the system. ($Q > W$)	More work is done by the system than the heat added to it ($Q < W$)	Heat added to the system and wok done are same ($Q = W$)

Q. 17 (i) Consider a rigid object rotating with a constant angular acceleration α about an axis perpendicular to plane of paper



A body of N particles

(ii) Let us consider the object consisting of n particles of masses m_1, m_2, ….,m_n at respective perpendicular distances: r_1, r_2,…. R_n from the axis of rotation.

(iii) As the object rotates, all these particles perform circular motion with same angular acceleration α, but with different linear accelerations, $\alpha_1 = r_1\alpha$, ……. , $\alpha_n = r_n \alpha$

(iv) Force experienced by the first particle is, $f_1 = m_1a$, $= m_1r_1a$

(v) As these forces are tangential, the irrespective perpendicular distances from the axis are r_1, r_2, …..,r_n.

(vi) Thus, the torque experienced by the first particle is of magnitude $\tau_1 = f_1r_1 = m_1r_1^2\alpha$

Similarly, $\tau_2 = m_2r_2^2\alpha$,….., $\tau_n = m_nr_n^2\alpha$

(vii) If the rotation is restricted to a single plane, directions of all these torque are the same, and along the axis.

(viii) Total magnitude of the given torque is given by

$$\boldsymbol{\tau = \tau_1 + \tau_2 + \tau_3 \ldots\ldots\ldots + \tau_n}$$

$\tau = m_1r_1^2a + m_2r_2^2a + m_3r_3^2a + \ldots\ldots\ldots\ldots + m_nr_n^2\, a$

$\tau = (m_1r_1^2 + m_2r_2^2 + m_3r_3^2 + \ldots\ldots\ldots + m_nr_n^2)a$

$\tau = (\sum_{i=1}^{n} m_ir_i^2)a$

$\tau = I\, a$……….where moment of inertia

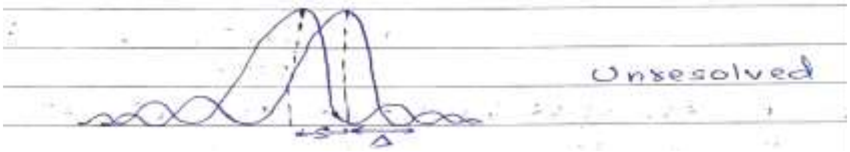
$(I) = \sum_{i=1}^{n} m_ir_1^2$

Both Torque and angular acceleration are directed parallel to the axis of rotation of the body.

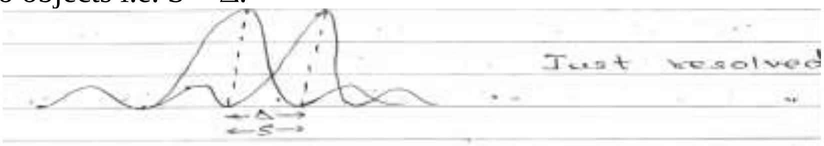
$\vec{\tau} = \overrightarrow{I\alpha}$

Q. 18 (i) According to Rayleigh, the ability of an optical instrument to distinguish between two closely spaced objects depends upon the diffraction patterns of two objects, produced at the screen.

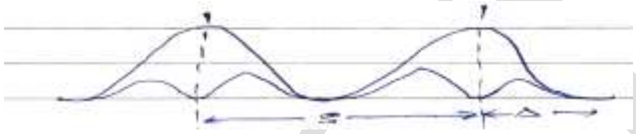
(ii) The two objects are said to be unresolved, if the separation between central maximum of the two objects is less than the distance between central maximum and first minimum of any of the two objects i.e. $S < \Delta$



(iii) Two objects are said to be just resolved when the separation between central maxima of two objects is just equal to the distance between central maximum and the first minimum of any two objects i.e. $S = \Delta$.



(iv) The two objects are said to be well resolved, if separation between central maximum of two objects is greater than distance between central maximum and first minimum of any of the two objects. i.e. $S > \Delta$.



Q. 19

i. Consider one mole of an ideal gas that is enclosed in a cylinder by light, frictionless airtight piston.

ii. Let P, V and T be the pressure, volume and temperature respectively of the gas.

iii. If the gas is heated so that its temperature rises by dT, but the volume remains constant, then the amount of heat supplied to the gas (dQ1) is used to increase the internal energy of the gas (dE). Since volume of the gas is constant, no work is done in moving the piston.

$\therefore dQ_1 = dE - C_v\, dT$ ....(1)

where Cv is the molar specific heat of the gas at constant volume.

iv. On the other hand, if the gas is heated to the same temperature, at constant pressure, volume of the gas increases by an amount say dV. The amount of heat supplied to the gas is used to increase the internal energy of the gas as well as to move the piston backwards to allow expansion of gas. The work done to move the piston dW = PdV.

$\therefore dQ_2 = dE + dW = C_p dT$ ....(2)

Where, C_p is the molar specific heat of the gas at constant pressure.

v. From equations (1) and (2),

$C_p dT = C_v\, dT + dW$

$(C_p - C_v)\, dT = PdV$ …..(3)

vi. For one mole of gas,

$PV = RT$

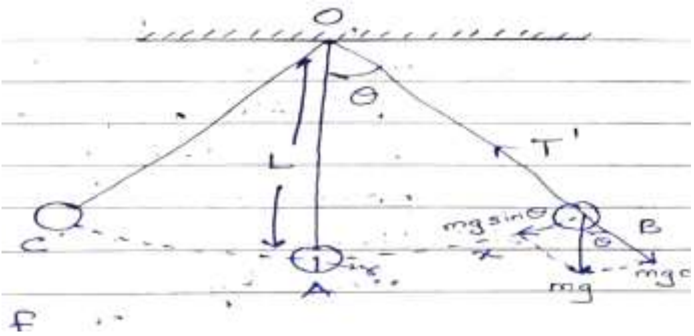
$P\, dV = R\, dT$, since pressure is constant. Substituting equation (3), we get

$(C_p - C_v)\quad dT = R\, dT$

$C_p - C_v = R$

This is known as Mayer's relation between C_p and C_v.

Q. 20 (i) Let ‘m’ be the mass of bob and T′ be the tension in the string. The pendulum remains in equilibrium in position OA, with the centre of gravity of bob, vertically below the point of suspension O.



(ii) If now the pendulum is displaced through a small angle θ , called angular amplitude and released, it begins to oscillate on either side of mean position in a single vertical plane.

(iii) In displaced position, two forces acting on the bob.

(a) T′ due to tension in the string, directed along the string, towards the support.

(b) Weight mg, directed vertically downward.

(iv) At extreme positions, there should not be any net force along the string.

(v) The component of mg can only balance the force due to tension. Thus, it is resolved into two components.

(i) mg cos θ balancing T′.

(ii) mg sin θ tending to return to its equilibrium position.

(vi) ∴ Restoring force, $F = -mg \sin\theta$

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

$$F \approx -mg\,\theta$$

Also, for small angle θ ; $\theta = \frac{x}{L}$

$$F = -mg\frac{x}{L} \qquad \ldots(1)$$

Thus, $F \propto -x$

(vii) Thus, for small displacement, the restoring force is directly proportional to displacement and is oppositely directed. Hence, the bob of a simple pendulum performs linear S.H.M. for small amplitudes.

(viii) The period T of oscillation of a pendulum is given by

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{\sqrt{\text{acceleration per unit displacement}}}$$

$$F = -mg\frac{x}{L}$$

$$\cancel{m}a = -\cancel{m}g\frac{x}{L}$$

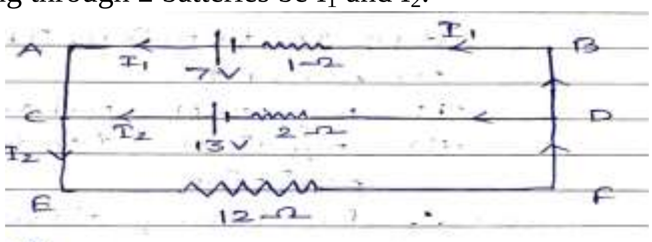
$$a = -g\frac{x}{L}$$

$$\frac{a}{x} = \frac{-g}{L} = \frac{g}{L} \quad \text{(in magnitude)}$$

Thus, $$\boxed{T = 2\pi\sqrt{\frac{L}{g}}}$$

This, gives the expression for time period of a simple pendulum.

Q. 21 Let the currents passing through 2 batteries be I_1 and I_2.



Applying Kirchoff's 2nd law to the loop AEFBA,

$$-12(I_1 + I_2) - I_1 + 7 = 0$$

$$12\,(I_1 + I_2) + I_1 = 7 \quad \ldots(1)$$

Applying Kirchoff's 2nd law in loop CEFDC,

$$-12\,(I_1 + I_2) - 2I_2 + 13 = 0$$

$$12\,(I_1 + I_2) + 2I_2 = 13 \quad \ldots(2)$$

Solving (1) and (2),

$$I_1 = 2\,I_2 - 6$$

Substituting in (2),

$$12\,(2I_2 - 6 + I_2) + 2I_2 = 13$$

$$I_2 = \frac{85}{38} = 2.237\text{A}$$

$$I_1 = 2\,I_2 - 6 = 2 \times \frac{85}{38} - 6$$

$$I_1 = -1.526\text{ A}$$

As $I = I_1 + I_2 = -1.526 + 2.237$

$$I = 0.711\text{ A}$$

Potential difference across 12 Ω resistance,

$$V = IR = 0.711 \times 12 = \mathbf{8.532\ V}$$

Q. 22 1) It states that the direction of induced emf or current in the coil in conductor is such as oppose the change in the magnetic flux that produces it.

2) considering Faraday's law, Lenz's law can be written as $e = \frac{-d\emptyset}{dt}$

3) The negative sign indicates that the induced emf opposes the change in the magnetic flux.

Let us consider a (-ve) sign in Faraday's law as given by, $e = \frac{-d\emptyset}{dt}$ ……………(i)

Let $\overline{A} \rightarrow$ area vector of the loop, which is perpendicular to the plane of the loop.

$\overline{B} \rightarrow$ magnetic induction (parallel to $\overline{A}$) increasing with time

then $\overline{B}.\overline{A} = BA$ ($\because \theta = 0^0$)

then, magnetic flux, $\emptyset = \overline{B}.\overline{A} = BA$ ………….(ii)

Put (ii) in (i),

$e = \frac{-d}{dt}(BA) = -A\frac{dB}{dt}$ …………….(iii)

Here, R.H.S. of eq. (iii) is a negative quantity.

Since, (A) and $\left(\frac{dB}{dt}\right)$ are both (+ve). As B is increasing with time.

As the induced current in the loop is in anticlockwise direction (-ve)

∴ The induced emf is also negative.

Hence, LHS of eq. (iii) is induced a (-ve) quantity

So that it become equal to its RHS.

Thus, the (-ve) sign in the equation $\left(e = \frac{-d\emptyset}{dt}\right)$ incorporates Lenz's low into Faraday's law.

Q. 23 **Given :** $\lambda_0 = 2.76 \times 10^{-5}$ cm = 276 nm

$\lambda_{uv} = 1.80 \times 10^{-5}$ cm = 180 nm

$\nu = 4 \times 10^{15}$ Hz

To find : Maximum kinetic energy

We know,

$$\phi_0 = \frac{hc}{\lambda_0} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{276} = \frac{1250}{276}\ \text{eV-nm}$$

$$= \mathbf{4.53\ eV}$$

(i) For UV radiations

$$K.E_{max} = h\nu - \phi_0 = \frac{hc}{\lambda} - \phi_0 = \frac{1250}{180} - 4.53 = \mathbf{2.41\ eV}$$

(ii) For radiation of given frequency,

$$\text{K.E}_{max}\text{ (eV)} = \frac{6.63 \times 10^{-34} \times 4 \times 10^{15}}{1.6 \times 10^{-19}} - 4.53 = 16.57 - 4.53 = \mathbf{12.04\ eV}$$

(i) The maximum kinetic energy for UV radiations is **2.41 eV.**

(ii) The maximum kinetic energy is **12.04 eV**

Q. 24 **Given :** $L = 2H$, $i_0 = 0.25$ A, $f = 60$ Hz

To find : e_{rms}

We know, $$i_{rms} = \frac{i_0}{\sqrt{2}} = \frac{0.25}{\sqrt{2}} = \mathbf{0.176\ A}$$

Also, $$X_L = 2\pi fL = 2 \times 3.142 \times 60 \times 2 = 754.08\ \Omega$$

and, $$e_{rms} = i_{rms} \times X_L = 0.176 \times 754.08 = \mathbf{133.4\ V}$$

The effective potential difference across the inductor is 133.4 V.

Q. 25 (i) Consider two simple harmonic progressive waves of equal amplitudes (a) and wavelength (λ) propagating on a long uniform string in opposite directions.

(ii) The equation of wave travelling along x-axis in positive direction is given by

$$y_1 = a \sin\left[2\pi\left(nt - \frac{x}{\lambda}\right)\right]$$

The equation of wave travelling along x-axis in negative direction is given by

$$y_2 = a \sin\left[2\pi\left(nt + \frac{x}{\lambda}\right)\right]$$

(iii) When these waves interfere, the resultant displacement of particles of string is given by principle of superposition of waves as,

$$y = y_1 + y_2$$

$$\therefore \quad y = a \sin\left[2\pi\left(nt - \frac{x}{\lambda}\right)\right] + a \sin\left[2\pi\left(nt + \frac{x}{\lambda}\right)\right]$$

By using trigonometric formula,

$$\sin C + \sin D = 2 \sin\left(\frac{C + D}{2}\right) \cos\left(\frac{C - D}{2}\right)$$

$$\therefore \quad y = 2a \sin(2\pi nt) \cos\frac{2\pi x}{\lambda}$$

$$y = 2a \cos\frac{2\pi x}{\lambda} \sin(2\pi nt) \qquad \ldots(1)$$

Substituting, $2a \cos\frac{2\pi x}{\lambda} = A$ in Equation (1)

$$y = A \sin(2\pi nt)$$

$$y = A \sin \omega t$$

This is the equation of a stationary wave which gives resultant displacement due to two simple harmonic progressive waves.

Q. 26 **Given:** $f = 50$ Hz, $i_{rms} = 5$A, $t = \frac{1}{600}$ s

To find: (i) Peak value of current (i_o), (ii) Instantaneous current (i)

We know,

$$i_o = \sqrt{2}\ i_{rms} = \sqrt{2} \times 5 = \mathbf{7.07\ A}$$

$$i = i_o \sin(\omega t) = 7.07 \sin\left(2\pi \times 50 \times \frac{1}{600}\right)$$

$$= 7.07 \sin\frac{\pi}{6} = 7.07 \times 0.5 = \mathbf{3.535\ A}$$

(i) Peak value of current, $i_o = 7.07$ A

(ii) Instantaneous value of current, I = **3.535 A**

SECTION - D

Q. 27 (i) Let there be n moles of an ideal gas enclosed in a cubical box of volume v ($= L^3$) with sides of box parallel to co-ordinate axes. The walls of box are kept at a constant temperature T.

(ii) The gas molecule are in continuous random motion, colliding with each other and hitting the walls of the box and bouncing back.

(iii) As per one of assumptions, we neglect intermolecular collisions and consider only elastic collisions with walls.

(iv) A typical molecule having with velocity $\vec{v}$, about to collide elastically with the shaded wall of cube parallel to yz-plane.

(v) During elastic collision, the component v_x of the velocity will get reversed, keeping v_y and v_z components unaltered.

(vi) Hence, the change in momentum of the particle is only in the x-component of momentum Δp_x is given by

Δp_x = final momentum – initial momentum = $(-mv_x) - (mv_x) = -2\,mv_x$ …(1)

(vii) Thus, the momentum transferred to the wall during collision is $+2\,mv_x$. The re-bounced molecule then goes to the opposite wall and travels back towards the shaded wall again.

(viii) This means that the molecule travels a distance of 2L in between two collisions.

(ix) As L is the length of cubical box, the time for travel is $\Delta t = \frac{2L}{v_x}$

(x) Average force exerted by molecule 1 is given by,

$$F_{avg} = \frac{2mv_{x1}}{\frac{2L}{v_{x1}}} = \frac{mv_{x1}^2}{L} \quad \ldots(2)$$

(xi) Thus, total average force on the wall is

$$F_{avg} = \frac{m}{L}\left(v_{x1}^2 + v_{x2}^2 + v_{x3}^2 + \ldots\ldots\right)$$

$\therefore$ The average pressure,

$$P = \frac{\text{Average Force}}{\text{Area of wall}} = \frac{m\,(v_{x1}^2 + v_{x2}^2 + \ldots\ldots)}{L \times L^2}$$

$$P = \frac{m\,N\,v_x^2}{v}$$

By symmetry, $v_x^2 = v_y^2 = v_z^2 = \frac{v^2}{3}$

$\therefore$ Average Pressure, $\boxed{P = \frac{1}{3}\frac{N}{v}\,mv^2}$

Q. 28 i)

a) Dielectrics are non-conducting substances which cannot transmit electric charge through them.

Examples: Glass, wax, water, wood, mica, rubber, stone, plastic, etc.

b) Dielectric substances do not contain any free electrons in them, so they have no charge carriers. Dielectrics can be polarised through small localised displacement of charges.

c) Dielectrics are insulates which can be used to store electrical energy.

d) Dielectrics can be classified as polar dielectrics and non-polar dielectrics.

(ii) Solution:

Given: $n = 10^8$ electrons, V= 10V

To Find: Capacitance of conductors

Formulae: i. Q = ne ii. $C = \frac{Q}{V}$

Calculation: From formula (i),

$Q = 10^8 \times 1.6 \times 10^{-19}$ …..($\because$ $e = 1.6 \times 10^{-19}$ C)

$= 1.6 \times 10^{-11}$ C

From Formula (ii)

$C = \frac{1.6 \times 10^{-11}}{10} = 1.6 \times 10^{-12}$ F

Q. 29 i) For toroid, magnetic field is inversely proportional radius of Amperian loop. Hence, magnetic field of toroid is not constant over a cross-section whereas magnetic field of solenoid being independent of dimensions of Amperian loop, is constant over its cross-section.

ii) Given: l = 25 cm = 0.25 m,

inner radius r = 1 cm = 10^{-3} m,

N = 250 turns, I = 3A

To find: Magnetic Field

Formula: $B = \mu_0 ni$

Calculation: Using formula,

$B = 4\pi \times 10^{-7} \times \frac{250}{0.25} \times 3$

$B = 4\pi \times 10^{-7} \times 103 \times 3$

$B = 3.77 \times 10^{-3}$ T

Q. 30 **Given :** $e = 1.6 \times 10^{-19}$ c

To find : Gyromagnetic ratio

We know, Gyromagnetic ratio $= \frac{e}{2m_e} = \frac{1.6 \times 10^{-19}}{2 \times 9.1 \times 10^{-31}} = 8.8 \times 10^{10}$ c kg^{-1}

Gyromagnetic ratio of electron is 8.8×10^{10} c kg^{-1}

(ii) Given : n = 300

d = 14 cm, r = 7 cm = 7×10^{-2} m

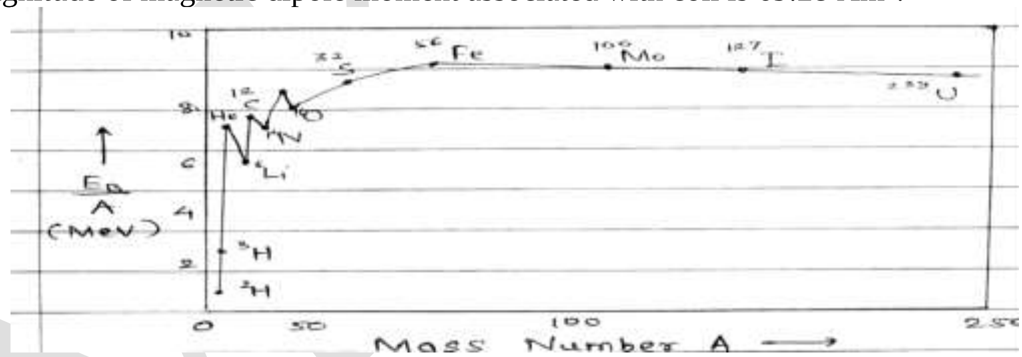
I = 15A

To find : $m_{orb} = nIA = 300 \times 15 \times \pi \times (7 \times 10^{-2})^2$

$= 69.28\ Am^2$

The magnitude of magnetic dipole moment associated with coil is 69.28 Am^2.

Q. 31



Inferences from B.E. curve :

(i) The B.E. of hydrogen nucleus having a single proton is zero.

(ii) Deuterium nucleus has the minimum value of B.E. per nucleon (E_B/A) and is therefore least stable nucleus.

(iii) The value of (E_B /A) increases with increase in atomic number and reaches a plateau for A between 50 to 80. Thus, the nuclei of these elements are the most stable.

(iv) The peak occurs around A = 56 corresponding to iron, which is thus one of the most stable nuclei.

(v) The value of E_B /A decreases gradually for values of A greater than 80, making the nuclei of those elements slightly less stable.

(vi) The value of B.E. per nucleon goes on decreasing till A ~ 238 which is the mass number of the heaviest naturally occurring element which is Uranium.