COMMON PRE-BOARD EXAMINATION

Class-XII-(2025-26) - KEY

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SET: 2

Time allowed: 3 Hrs. Maximum Marks: 70

General Instructions:

Read the following instructions very carefully and follow them:

1. There are 33 questions in all. All questions are compulsory.
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
3. All the sections are compulsory.
4. **Section A** contains sixteen questions, twelve MCQ and four Assertion Reasoning based of **1 mark** each, **Section B** contains five questions of **two marks** each, **Section C** contains seven questions of **three marks** each, **Section D** contains two **case study based** questions of **four marks** each and **Section E** contains three long answer questions of **five marks** each.
5. There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You must attempt only one of the choices in such questions.
6. Use of calculators is not allowed.
7. You may use the following values of physical constants wherever necessary.

(i) $c = 3 \times 10^8$ m/s

(ii) $m_e = 9.1 \times 10^{-31}\, kg$

(iii) $e = 1.6 \times 10^{-19}\, C$

(iv) $\mu_0 = 4\pi \times 10^{-7}\, TmA^{-1}$

(v) $h = 6.63 \times 10^{-34}\, Js$

(vi) $\varepsilon_0 = 8.854 \times 10^{-12}\, C^2\, N^{-1} m^{-2}$

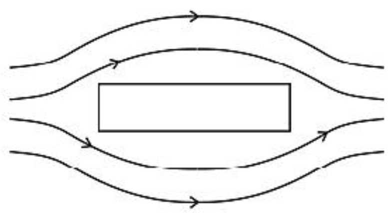
SECTION A

1 A proton and an α -particle enter with the same velocity $\vec{v}$ in a uniform magnetic field $\vec{B}$ such that $\vec{v} \perp \vec{B}$. The ratio of the radii $(r_p : r_\alpha)$ of their paths is: **1**

(A)1/4 (B) 1/2 (C) 2 (D) 4

Ans: (B) 1/2

2 The magnetic field lines near a substance are as shown in the figure. The substance is: **1**



(A) Aluminium (B) Iron (C) Sodium (D) Copper

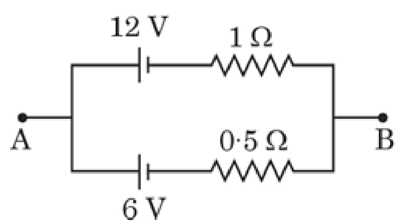
Ans: (D) Copper

3 If charge of the electron is basic elementary charge, then the minimum possible coulomb force between two charges separated by 0.5 m in vacuum is **1**

(A) $4ke^2$ (B) $ke^2/2$ (C) $ke^2/4$ (D) $2ke^2$

Ans: (A) $4ke^2$

4 Consider the circuit shown in the figure. The maximum potential difference between points A and B is: **1**



(A) 12 V (B) 9 V (C) 8 V (D) 6V

Ans: (C) 8 V

5 A transformer supplies a current of 4 A to a device connected across the secondary coil. The current in the primary coil is 40 A. If the primary coil has 800 turns, then the number of turns in the secondary coil is- **1**

(A) 40 (B) 80 (C) 400 (D) 8000

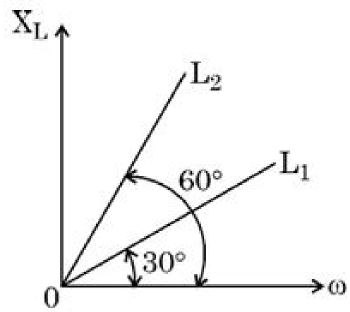
Ans: (D) 8000

6 The de Broglie wavelength of the electron in the ground state of a hydrogen atom is λ. Calculate the change in the de Broglie wavelength of the electron when it jumps from the first excited state to the third orbit. 1

(A) λ (B) 2λ (C) 3λ (D) 4λ

Ans: (A) λ

7 Figure shows the variation of inductive reactance X_L of two ideal inductors of inductance L_1 and L_2, with angular frequency ω. The value of L_1/L_2 is 1



(A) $1/3$ (B) 3 (C) $1/\sqrt{3}$ (D) $\sqrt{3}$

Ans: (A) $1/3$

8 Which of the following correctly describes isotopes, isobars, and isotones? 1

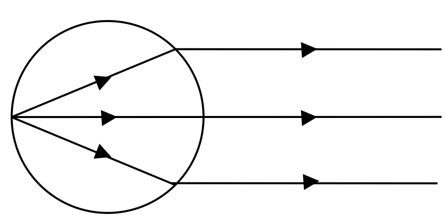
Ans:

(C) **Isotopes:** Same number of protons, different number of neutrons.

Isobars: Same mass number, different atomic number.

Isotones: Same number of neutrons, different number of protons.

9 For a medium in the form of sphere, rays starting from one end of a diameter emerge from the opposite surface as a parallel beam. The refractive index of material of the sphere is 1



(A) 2/3 (B) 3/2 (C) 1/2 (D) 2

Ans: (D) 2

10 Which of the following frequency ranges corresponds to radio waves in the electromagnetic spectrum? 1

(A) $3 \times 10^3 Hz$ to $3 \times 10^{11} Hz$ (B) $3 \times 10^{12} Hz$ to $3 \times 10^{15} Hz$

(C) $3 \times 10^{15} Hz$ to $3 \times 10^{17} Hz$ (D) $3 \times 10^{17} Hz$ to $3 \times 10^{19} Hz$

Ans: (A) $3 \times 10^{3} Hz$ to $3 \times 10^{11} Hz$

11 In a Young's Double Slit Experiment, the intensity I at a point on the screen depends on its distance x from the central maximum. If the fringe width is β and intensity at the centre of central fringe is I_0, which of the following expressions correctly gives the intensity at that point? **1**

(A) $I = I_o \cos^2\left(\frac{2\pi x}{\beta}\right)$ (B) $I = 4I_o \cos^2\left(\frac{\pi x}{2\beta}\right)$

(C) $I = I_o \cos^2\left(\frac{\pi x}{\beta}\right)$ (D) $I = 4I_o \cos^2\left(\frac{\pi x}{\beta}\right)$

Ans: (C) $I = I_o \cos^2\left(\frac{\pi x}{\beta}\right)$

12 Which one of the following statements is correct? **1**

Electric field due to induced charges developed through electromagnetic induction is

(A) conservative and field lines do not form closed loops.

(B) conservative and field lines form closed loops.

(C) non-conservative and field lines do not form closed loops.

(D) non-conservative and field lines form closed loops.

Ans: (D) non-conservative and field lines form closed loops.

For Questions 13 to 16, two statements are given, one labelled **Assertion (A)** and other labelled **Reason (R).** Select the correct answer to these questions from the options given below.

(A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.

(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.

(C) Assertion is true, but Reason is false.

(D) Both Assertion and Reason are false.

13 **Assertion (A):** To get maximum magnifying power in a telescope, final image should be formed at near point of the observer. **1**

Reason (R): In an astronomical telescope, focusing is done by adjusting the distance between objective and eyepiece.

(B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.

14 **Assertion (A):** A sensitive device can be protected from external electric fields by enclosing it in a metallic case. **1**

Reason (R): The electric field inside a metallic enclosure is zero due to charges outside the enclosure.

(A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.

15 **Assertion (A):** The diffraction pattern spreads out more when light passes through a broader slit. **1**

Reason (R): In a single-slit diffraction pattern, the secondary maxima is twice as wide as the central maximum.

(D) Both Assertion and Reason are false.

16 **Assertion (A):** Condensed matter like solids, liquids, and dense gases can emit or absorb radiation of any wavelength. **1**

Reason (R): Since atoms are very close to each other, the electron energy levels become nearly continuous in these substances.

(A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.

SECTION B

17 (a) Define the term temperature coefficient of resistance. Write its unit. **2**

(b) Draw graphs to show the variation of resistivity of (i) semiconductor and (ii) nichrome with temperature.

Ans: (a) Definition ½ Mark, Unit ½ Mark

(b) Graphs ½ x 2 = 1 Mark

18 During the charging or discharging of a capacitor, current flows through the connecting wires despite the physical gap between its plates. Explain how this apparent discontinuity in current is resolved and show that Kirchhoff's junction rule is valid at any plate. **2**

Ans: Explanation ½ Mark. $I_d = \varepsilon_0 \frac{d\phi}{dt}$ ½ Mark, Show that $I_C = I_d$ 1 Mark

19 Define the term electric flux. Using the concept of flux, show that electric field strength of a point charge has a $1/r^2$ dependance, where r is the distance measured from the point charge. **2**

Ans: Definition of flux ½ Mark. Diagram ½ Mark, explanation 1 Mark

20(I) You are required to design a device that employs mutually perpendicular electric and magnetic fields (crossed fields) to allow only those charged particles that move with a specific velocity to pass through undeflected. **2**

(a) Draw a neat, labeled diagram of the experimental setup.

(b) Derive the relation between the electric field, magnetic field, and the velocity of the selected particles.

Ans:

(a) Velocity selector diagram ½ Mark

$F_e = Eq$ ½ Mark $F_m = Bqvsin\theta$ ½ Mark $v = E/Bsin\theta$ ½ Mark

OR

20(II) (a) A magnetised needle in a uniform magnetic field experiences a torque but no net force. An iron nail near a bar magnet, however, experiences a force of attraction in addition to a torque. Why? **2**

(b) Must every magnetic configuration have a north pole and a south pole? Justify your answer with one example.

Ans:

(a) No force if the field is uniform. The iron nail experiences a non uniform field due to the bar magnet. There is induced magnetic moment in the nail, therefore, it experiences both force and torque. The net force is attractive because the induced south pole (say) in the nail is closer to the north pole of magnet than induced north pole. 1 Mark

(b) Not necessarily. ½ Mark True only if the source of the field has a net non zero magnetic moment. This is not so for a toroid or even for a straight infinite conductor. ½ Mark

21(I) (a) What is meant by the distance of closest approach in the context of the Geiger-Marsden experiment? **2**

(b) An alpha particle and a proton are accelerated through the same potential difference and directed toward a gold nucleus. Derive the ratio of their distances of closest approach.

Ans:

(a) Distance of closest approach definition ½ Mark

(b) $r = \frac{kZe}{V}$ 1 Mark, $\frac{r_1}{r_2} = 1$ ½ Mark

OR

21(II) A hydrogen atom in its ground state is excited by absorbing a photon of energy 12.1eV. Calculate the maximum wavelength of photon that can be emitted in the resulting emission spectrum. Assume all transitions are allowed. **2**

Ans:

Ground state energy of hydrogen: $E_1 = -13.6eV$

After absorbing a photon of 12.1 eV:

$E_n = E_1 + 12.1 = -13.6 + 12.1 = -1.5eV$

This corresponds to the $n = 3$ **½ Mark**

Maximum wavelength corresponds to the smallest energy transition, i.e.,

$n = 3 \rightarrow n = 2$ **½ Mark**

Energy difference:

$$\Delta E = E_2 - E_3 = -3.4 - (-1.5) = 1.9eV$$

Use the formula:

$\lambda = \frac{hc}{E}$ **½ Mark** $= \frac{1240\ eV.nm}{1.9\ eV} \approx 653\ nm$ **½ Mark**

SECTION C

22 The fission properties of ${}^{239}_{94}Pu$ are very similar to those of ${}^{235}_{92}U$. The average energy released per fission is 180 MeV. How much energy, in MeV, is released if all the atoms in 1 kg of pure ${}^{239}_{94}Pu$ undergo fission? Also write the balanced fission reaction of ${}^{235}_{92}U$ when a neutron is used as projectile, and ${}^{235}_{92}U$ splits into ${}^{144}_{56}Ba$ and ${}^{89}_{36}Kr$ along with the outgoing neutrons. **3**

Ans:

No of ${}^{239}_{94}Pu$ atoms in 1 kg ${}^{239}_{94}Pu$ = $\frac{1000}{239} N_A = 2.52 \times 10^{24}$ 1 Mark

Energy released = $E = 2.52 \times 10^{24} \times 180 = 4.5 \times 10^{26} MeV$ $1\ Mark$

$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{144}_{56}Ba + {}^{89}_{36}Kr + 3{}^{1}_{0}n$ 1 Mark

23 (a) Draw a neat schematic diagram showing the forward bias connection. **3**

(b) Using the diagram, answer the following:

(i) What happens to the thickness of the depletion region when the diode is forward biased?

(ii) Describe the motion of charge carriers (electrons and holes) under forward bias and explain minority charge carrier injection.

(c) Draw a graph showing the variation of junction potential (barrier potential) of a junction diode when it is connected in forward bias.

Ans:

(a) Diagram forward bias ½ Mark

(b) (i) Thickness of depletion region decreases ½ Mark (ii) Explanation of motion of charge carriers and minority charge carrier injection. ½ + 1 Mark

(c) Graph ½ Mark

24 Define 'mutual-inductance' of pair of coils. Two concentric circular coils, one of small radius r_1 and the other of large radius r_2 , such that $r_1 << r_2$, are placed co-axially with centres coinciding. Obtain the mutual inductance of the arrangement. **3**

Ans:

Definition – mutual inductance ½ Mark

Let a current I_2 flow through the outer circular coil.

The field at the centre of the coil is $B_2 = \frac{\mu_0 I_2}{2r_2}$. ½ Mark

Since the other co-axially placed coil has a very small radius, B_2 may be considered constant over its cross-sectional area. Hence,

$\Phi_1 = \pi r_1^2 B_2$ ½ Mark

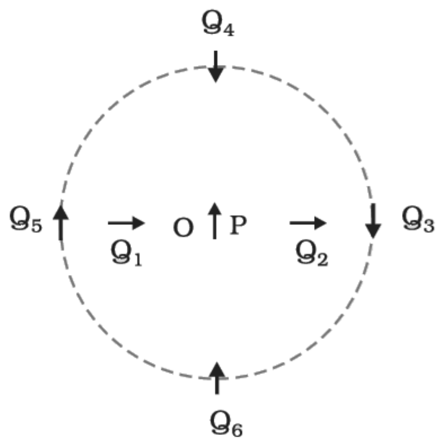
$= \pi r_1^2 \frac{\mu_0 I_2}{2r_2}$

$\Phi_1 = M_{12} I_2$ 1 Mark

Thus

$M_{12} = \mu_o \frac{\pi r_1^2}{2r_2}$ ½ Mark

25(I) Figure shows a small magnetised needle P placed at point O. The arrow shows the direction of its magnetic moment. The other arrows show different positions (and orientations of the magnetic moment) of another identical magnetised needle Q. **3**



(a) In which configuration is the system not in equilibrium?

(b) In which configuration is the system in (i) stable, and (ii) unstable equilibrium? Justify your answer in each case.

(c) Which configuration corresponds to the lowest potential energy among all the configurations shown?

Ans:

(a) Q_1 *and* Q_2

(b) (i) PQ_3 , PQ_6 (stable); (ii) PQ_5 , PQ_4 (unstable) 1 Mark + 1 Mark (Justification)

(c) PQ_6 ½ Mark

OR

25(II) A solenoid has a core of material with relative permeability 200. The windings of the solenoid are insulated from the core and carry a current of 1A. If the number of turns is 2000 per metre, calculate **3**

(a) magnetic intensity, (b) magnetic field, (c) magnetisation

Ans:

Given: $\mu_r = 200, \; I = 1A \; N = 200 turn/m$

(a) $H = nI$ ½ **Mark** , $H = 2000 \times 1 = 2 \times 10^3 A/m$ ½ **Mark**

(b) $B = \mu_o \mu_r H$, ½ **Mark** $B = 0.50T$ ½ **Mark**

(c) $M = (\mu r - 1)H$ ½ **Mark** $M = 1.99 \times 10^5 \; A/m$ ½ **Mark**

26 An object is placed 30 cm from a thin convex lens of focal length 10 cm. The lens forms a sharp image on a screen. If a thin concave lens is placed in contact with the convex lens, the sharp image on the screen is formed when the screen is moved by 45 cm from its initial position. Calculate the focal length of the concave lens. **3**

Ans:

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ ½ **Mark,**

convex lens $v = 20\ cm$ ½ **Mark**

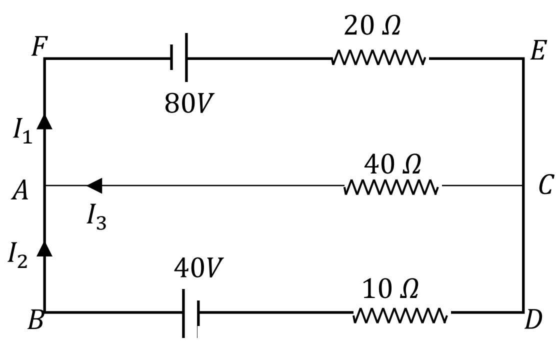
Equivalent lens

$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$ ½ **Mark,** Mark, $v = 60\ cm$ ½ **Mark,** $F = 20\ cm$ ½ **Mark**

Mark, $f = -20\ cm$ ½ **Mark**

Or any other valid method.

27 Find current through 20Ω, 40Ω and 10Ω in the following circuit. **3**



Ans:

Applying Kirchhoff's current rule at the junction A,

$I_1 = I_3 + I_2 \quad ---(1)$ ½ **Mark**

Applying KVL in the loop FECAF, we get

$0 - 20I_1 - 40I_3 = 0$ ½ **Mark**

Using (1) in the above equation,

$80 - 20(I_3 + I_2) - 40I_3 = 0$

$80 - 60I_3 - 20I_2 = 0$

$4 - 3I_3 - I_2 = 0 \quad ---(2)$

Applying KVL in the loop ABDCA, we get

$-40 + 10I_2 - 40I_3 = 0$ ½ **Mark**

$-4 + I_2 - 4I_3 = 0 \quad ---(3)$

Solving equs (2) and (3) we get,

$\boldsymbol{I_1 = 4A, I_2 = 4A \quad and \quad I_3 = 0A}$ **½ x3 = 1.5 Marks**

Or any other valid method.

28 With the help of a neat, labeled diagram, verify Snell's law by considering the propagation of a plane wavefront from a rarer medium to a denser medium. **3**

Ans:

Diagram 1 Mark

Explanation – Huygen's principle 1 mark

Proof 1 Mark

SECTION D

29 A company is designing a solar-powered light sensor system that automatically switches on streetlights at night. The sensor uses a metallic surface that emits electrons when illuminated by light. Engineers notice that the system only works when light of wavelength less than 500 nm falls on the surface. The stopping potential required to prevent electrons from reaching the collector is measured to be 2 V. The engineers are experimenting with different light sources to optimize the system's performance.

I Which of the following explains why no electrons are emitted when the wavelength of light is 600 nm? **1**

(A) The light is reflected from the surface.

(B) Electrons are bound too strongly due to high stopping potential.

(C) The photons do not have enough energy to overcome the work function.

(D) The intensity of light is too low.

Ans: (C)The photons do not have enough energy to overcome the work function.

II If the wavelength of the incident light is 400 nm, calculate the maximum kinetic energy of the emitted electrons. **1**

(A) 1.2 eV (B) 0.9 eV (C) 0.6 eV (D) 0.3 eV

Ans: (C) 0.6 eV

III What is the work function of the metal used in the sensor? **1**

(A) 4.8 eV (B) 2.48 eV (C) 2 eV (D) 1.5 eV

Ans: (B) 2.48 eV

IV What happens to the maximum kinetic energy of emitted electrons if the intensity of incident light is doubled, keeping wavelength constant? **1**

(A) It becomes zero (B) It remains the same

(C) It halves (D) It doubles

Ans: (B) It remains the same

30 A company is designing a temperature-sensitive sensor for an automated cooling system. The sensor uses silicon crystal whose conductivity needs to be controlled precisely. To enhance its conductivity, engineers add small amounts of impurities to the silicon. When phosphorus is added, the sensor's conductivity increases, and when boron is added, the conductivity changes differently. The engineers are testing the resulting semiconductor materials to decide which type is suitable for the high-performance sensor.

I Suppose a pure Si crystal has 5×10^{28} atoms m^{-3}. It is doped by 1 ppm concentration of phosphorus. Calculate the number of electrons and holes. Given that $n_i = 1.5 \times 10^{16}\ m^{-3}$. Also state the type of extrinsic semiconductor formed. **2**

Ans:

Thermally generated electrons ($n_i \sim 1.5 \times 10^{16} 10^{16}\ m^{-3}$) are negligibly small as compared to those produced by doping.

$\therefore\ n_e \approx N_D$ **½ Mark**

Since $n_e n_h = n_i^2$, **½ Mark**

$n_h = \frac{2.25 \times 10^{32}}{5 \times 10^{22}} \sim 4.5 \times 10^{9}\ m^{-3}$ **½ Mark**

n-type semiconductor **½ Mark**

II Draw the energy band diagram of a semiconductor formed when a small amount of boron is added to a pure silicon crystal. Label the conduction band, valence band, and the acceptor energy level introduced by the impurity. **1**

Ans:

Energy band diagram of n-type semiconductor 1 Mark

III State any two important criteria for choosing dopant atoms while doping a semiconductor. **1**

Ans:

1. Type of semiconductor required
2. Size of the dopant atom

It should not react chemically in a way that destroys the semiconductor structure

Any two – ½ x2 = 1 Mark

SECTION E

31(I) (a) Define electric potential. Write its unit. **5**

(b) Obtain an expression for electric potential at a point at a distance r from an isolated charge Q.

(c) Two isolated metallic solid spheres of radii R and $2R$ are charged, such that both of these have same charge density σ. The spheres are located far away from each other and connected by a thin conducting wire. Find the new charge density on the bigger sphere.

Ans:

(a) Define electric potential. ½ Mark . Write its unit. ½ Mark

(b) $V = \frac{W}{q}$ ½ Mark, $V = -\int_{\infty}^{r} E.dl$ ½ Mark $E = \frac{kQ}{x^2}$ ½ Mark $V = \frac{kQ}{r}$ ½ Mark.

(c) $\sigma_1 = \sigma_2$ $\frac{Q_1}{Q_2} = \frac{1}{4}$ ½ Mark Total charge $Q = 5Q_1$ ½ Mark

$V_1 = V_2$, ½ Mark, $\sigma' = \frac{5}{6}\sigma$ ½ Mark

OR

31(II) (a) Two parallel plates each of area A are separated by a distance d in vacuum. Charge of Q on each plate with opposite polarity leaves the plates with a potential difference V. Derive an expression for capacitance of this system. **5**

(b) A system of two conductors is placed in air, and they have net charge of $+80\ \mu C$ and $-80\ \mu C$ which causes a potential difference of 16 V between them.

(i) Find the capacitance of the system.

(ii) If the air between the capacitor plates is replaced by a dielectric medium of dielectric constant 3, what will be the potential difference between the two conductors?

(iii) If the charges on two conductors are changed to $+160\ \mu C$ and $-160\ \mu C$, will the capacitance of the system change? Give reason for your answer.

Ans:

(a) $C = \frac{Q}{V}$ ½ Mark. $Q = \sigma A$ ½ Mark. $V = \frac{\sigma d}{\varepsilon_o}$ ½ Mark $C = \frac{A\varepsilon_o}{d}$ ½ mark .

(b)

(i) $C = \frac{Q}{V}$ ½ Mark. $C = 5\mu F$ ½ Mark.

(ii) $V' = \frac{Q}{CK}$ ½ Mark $V' = 5.3\ \mu F$ ½ Mark

(iii)No change ½ Mark. Reason ½ Mark

32(I) (a) A narrow beam of light is incident on one face of a triangular prism. Daw the path of this ray. Using this diagram and a plot between angle of deviation and angle of incidence, derive a relation between refractive index of the prism and angle of prism & angle of minimum deviation. **5**

(b) A thin prism of 5° angle gives a deviation of 3.2°. What is the value of refractive index of the material of the prism?

Ans:

(a) Diagram **1 Mark**, graph ½ **Mark**, $r_1 + r_2 = A$ ½ **Mark**,

$A + \delta = i + e$ ½ **Mark**, $\frac{\sin i}{\sin r} = n$ ½ **Mark**,

when $\delta = \delta_m, i = e, r_1 = r_2 = r$ ½ **Mark** $n = \sin\frac{\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$ ½ **Mark**

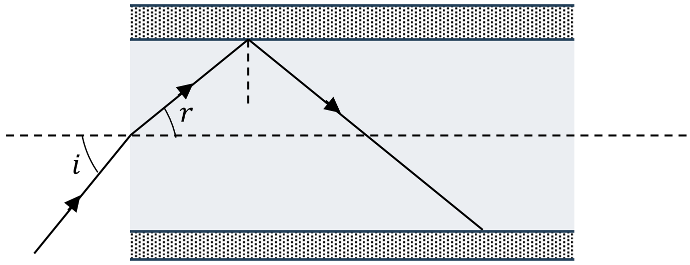
$n = \frac{A+\delta}{A}$ ½ **Mark** $n = 1.64$ ½ **Mark**

OR

32(II) (a) What do you mean by total internal reflection? Obtain the relation between critical angle and refractive index of the medium. **5**

(b) Draw a ray diagram that shows the bending of light through 90^0 with the help of totally reflecting prisms.

(c) Figure shows a cross-section of a 'light pipe' made of a glass fibre of refractive index n_c. The outer covering of the pipe is made of a material of refractive index n_s. What is the range of the angle of the incident rays with the axis of the pipe for which total reflections inside the pipe take place, as shown in the figure.



Ans:

(a) What do you mean by total internal reflection? ½ **Mark**

Diagram ½ **Mark**, $\frac{\sin i}{\sin r} = \frac{1}{n}$ ½ **Mark**, when $i = i_c,\ r = 90^0$½ **Mark**

$i_c = \sin^{-1}(1/n)$ ½ **Mark**

(b) totally reflecting prisms -

Ray diagram -bending of light through 90^0 ½ **Mark**

(c) $\frac{\sin i}{\sin r} = n_c$ ½ **Mark**, $\frac{\sin i}{\cos i_c} = n_c$ ½ **Mark**, $\frac{\sin i}{\sqrt{n_c^2 - n_s^2}} = 1$ ½ **Mark**,

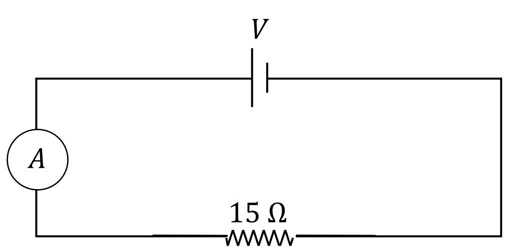
$i = \sin^2\left(\sqrt{n_c^2 - n_s^2}\right)$ ½ **Mark**

33(I) (a) What is current sensitivity of a galvanometer? **5**

(b) Show how the current sensitivity of a galvanometer may be increased.

(c) Explain: Increasing the current sensitivity of a galvanometer may not necessarily increase its voltage sensitivity.

(a) A moving coil galvanometer has a resistance 15Ω and takes 20 mA to produce full scale deflection. If you are asked to use this galvanometer to measure voltage across 15 Ω resistor which is connected to an ideal cell shown in the figure.



(i) What is the maximum voltage this galvanometer can measure across 15 Ω resistor?

(ii) What happens to the ammeter reading in the main circuit when the galvanometer is connected across the resistor?

(iii) How should the galvanometer be modified to convert it into a voltmeter of range 0 –100 V?

Ans:

(a) Definition - current sensitivity ½ **Mark**

(b) Factors of current sensitivity ½ **Mark**

(c) Explain: Increasing the current sensitivity of a galvanometer may not necessarily increase its voltage sensitivity. Proof **1 Mark**

(d) (i) $V = I_g R_g$ ½ **Mark** V =0.3 V ½ **Mark**

(ii) Ammeter reading becomes double. ½ **Mark.**

(iii) A high resistance should be connected in in series ½ **Mark**

$R = \frac{V}{I_g} - R_g$ ½ **Mark.** $R =$ 4985 Ω ½ **Mark**

OR

33(II) (a) In a series LCR circuit connected across an ac source of variable frequency, obtain the expression for its impedance and draw a plot showing its variation with frequency of the ac source. **5**

(b) What is the phase difference between the voltages across inductor and the capacitor at resonance in the LCR circuit?

(c) When an inductor is connected to a 200 V dc voltage, a current of 1A flows through it. When the same inductor is connected to a 200 V, ac source of angular frequency $\sqrt{3}$ rad/s, only 0.5 A current flows. Explain, why? Also, calculate the self-inductance of the inductor.

Ans:

(a) Phasor diagram ½ **Mark**, impedance derivation **1 Mark**, Graph ½ **Mark**

(b) 180^0 ½ **Mark**

(c) Current in ac circuit is smaller than that in dc circuit because of inductive reactance of inductor ½ **Mark**

$R = \frac{V}{I} = 200\ \Omega$ ½ **Mark** , $X_L = \sqrt{3}R$ ½ **Mark** $X_L = \omega L$ ½ **Mark** $L = 200\ H$ ½ **Mark**

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