ISC Physics Paper 2024 with Answers

SECTION A – 14 MARKS

Question 1

(A) In questions (i) to (vii) given below, choose the correct alternative (a), (b), (c) or (d) for each of the questions.

(i) If potential difference between the two ends of a metallic wire is doubled, **drift speed** of free electrons in the wire: [1]

(a) remains same.

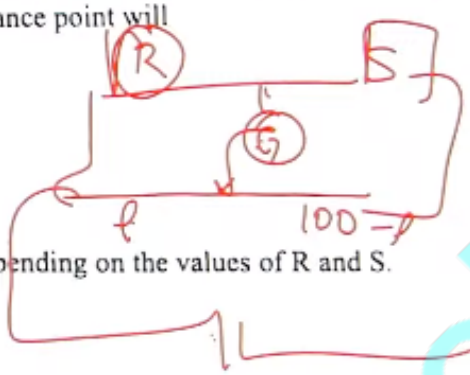
(b) becomes double.

(c) becomes four times.

(d) becomes half.

$v_d = \frac{eE\tau}{m} = \frac{eV\tau}{ml}$

(ii) A **metre bridge** is balanced with a known resistance (R) in the left hand gap and an unknown resistance (S) in the right hand gap. Balance point is found to be at a distance of *l* cm from the left hand side. When the battery and the galvanometer are interchanged, balance point will [1]



(a) shift towards left.

(b) shift towards right.

(c) remain same.

(d) shift towards left or right depending on the values of R and S.

(iii) **Lorentz force** in **vector** form is: [1]

(a) $F = B\ q\ v \sin\theta$

(b) $\vec{F} = q\ (\vec{v} \times \vec{B})$

(c) $\vec{F} = q\ (\vec{B} \times \vec{v})$

(d) $\vec{F} = \vec{v}\ (q \times \vec{B})$

(iv) **Assertion:** When an electric current is passed through a moving coil galvanometer, its coil gets deflected. [1]

Reason: A circular coil produces a uniform magnetic field around itself when an electric current is passed through it.

(a) Both Assertion and Reason are true and Reason is the correct explanation for Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.

(c) Assertion is true and Reason is false.

(d) Assertion is false and Reason is true.

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(v) When a ray of **white** light is incident obliquely on the first surface of a prism, then [1]

(a) red colour is deviated most.

(b) green colour is deviated most.

(c) yellow colour is deviated most.

(d) violet colour is deviated most.

(vi) The **de-Broglie** wavelength (λ) associated with a moving electron having kinetic energy (E) is given by: [1]

(a) $\frac{2h}{\sqrt{2mE}}$

(b) $\frac{2\sqrt{2mE}}{h}$

(c) $\frac{h}{\sqrt{2mE}}$

(d) $\sqrt{2mhE}$

(vii) The **majority** charge carriers in a ***P***-type semiconductor are [1]

(a) electrons.

(b) holes.

(c) protons.

(d) ions.

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(c) protons.

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SECTION B

(d) ions.

(B) Answer the following questions **briefly**.

(i) In an electric dipole, what is the **locus** of a point having zero potential? [1]

(ii) Three identical cells each of emf 'e' are connected in **parallel** to form a battery. What is the emf of the battery? [1]

(iii) Three bulbs B_1(230V, 40W), B_2(230V, 60W) and B_3(230V, 100W) are connected in **series** to a 230V supply. Which bulb glows the brightest? [1]

(iv) Explain the meaning of the following statement: [1]
Curie temperature for soft iron is 770°C.

(v) What type of wavefronts are associated with a **point source** of light? [1]

(vi) What is '**Pair production**'? [1]

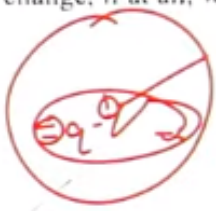
(vii) In semiconductor physics, what is the **function** of a rectifier? [1]

Question 2 [2]

(i) A hollow sphere of radius R has a point charge **q** at its centre. **Electric flux** emanating from the sphere is X. How will the electric flux change, if at all, when

(a) radius of the sphere is **doubled**? Rem. same

(b) charge q is **replaced** by an electric dipole? 0



OR

(ii) In case of an **infinite line charge**, how does intensity of electric field at a point change, if at all, when

(a) charge on it is **doubled**? doubled

(b) distance of the point is **halved**? doubled

$E = K \frac{2q}{r}$

Question 3 [2]

(i) What is meant by the statement: "**Relative permittivity** of water is 81"?

(ii) Can a body be given a charge of $2{\cdot}2 \times 10^{-19}$ C? Give a reason for your answer.

$F_{med} = \frac{1}{81} F_{vac}$ $\quad \frac{F_{vac}}{F_{med}} = 81$

$E_{med} = \frac{1}{81} E_{vacu}$

Question 4 [2]

What **type** of transformer is used in a mobile phone charger?

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(i) What **type** of transformer is used in a mobile phone charger? S Down T.

(ii) Why is the **core of a transformer** made of soft iron and not of steel?

In

Question 5 [2]

(i) Name the electromagnetic radiation whose frequency is 10^{11} Hz. Microwa

(ii) What is the speed of radio waves in **vacuum**? 3×10^8 m/s

Question 6 [2]

Draw a **labelled** graph showing the variation in **intensity of diffracted light** with diffracting angle in a single slit **Fraunhofer diffraction** experiment.

Question 7 [2]

(i) ***Figure 1*** below is the Energy level diagram for Hydrogen atom. Study the transitions shown and answer the following questions.

(a) State the type of spectrum obtained. visible spec.

(b) Name the series of spectrum obtained. Balmer Se

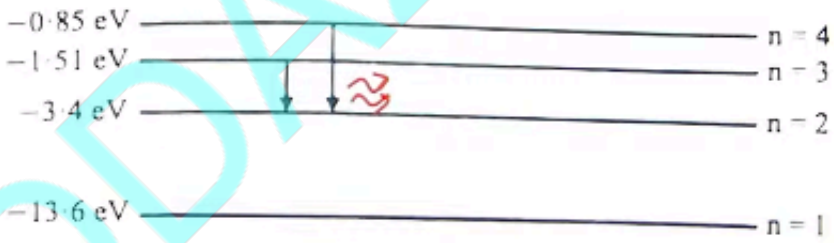

Figure 1

OR

(ii) In a **nuclear reactor**, state the use of the following:

(a) Graphite rods

(b) Cadmium rods

SECTION C-27 MARKS

Question 7 [2]

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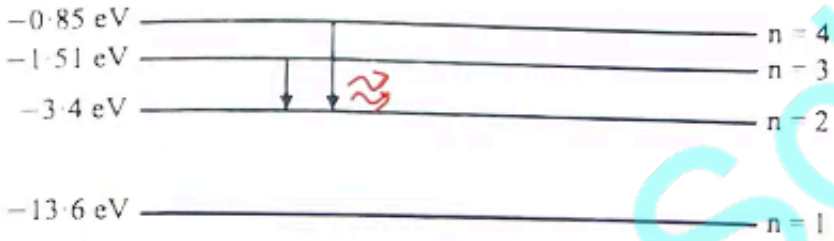

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Question 8

Concerning a semiconductor diode, define the following terms:

(1) depletion region

(11) potential barrier

Question 9

Obtain an expression for equivalent capacitance C when three capacitors C1, C2 and Cy are connected in series.

Question 10 [3]

(i) ***Figure 2*** below shows two batteries E_1 and E_2 having emfs of 18V and 10V and internal resistances of 1Ω and 2Ω respectively. W_1, W_2 and W_3 are uniform metallic wires AC, FD and BE having resistance of 8Ω, 6Ω and 10Ω respectively. **B** and **E** are **midpoints** of the wires W_1 and W_2. Using **Kirchhoff's laws** of electrical circuits, calculate the current flowing in the wire W_3.

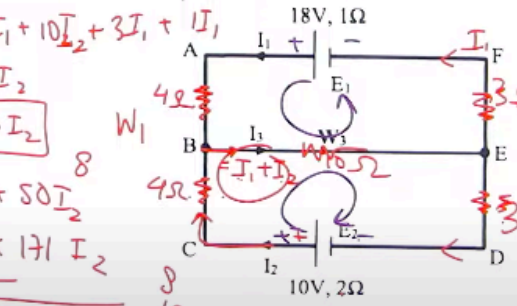

Figure 2

OR

(ii) ***Figure 3*** below shows a **potentiometer** circuit in which the **driver cell D** has an emf of 6V and internal resistance of 2Ω. The potentiometer wire **AB** is 10m long and has a resistance of 28Ω. The series resistance R_S is of 20Ω.

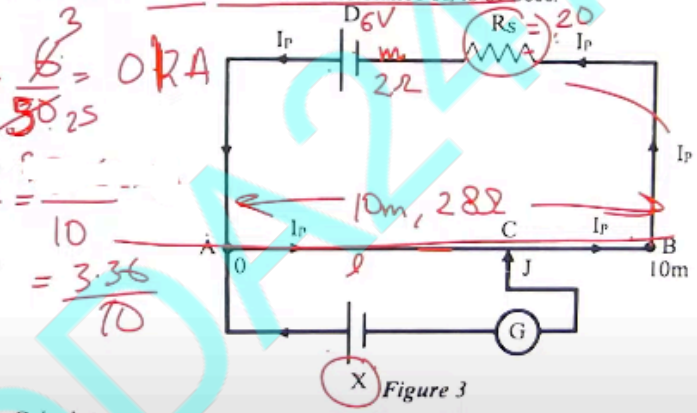

Figure 3

Calculate:

(a) The current I_p flowing in the potentiometer wire AB when the jockey (J) **does not touch** the wire AB.

(b) emf of the cell **X** if the **balancing length** AC is 4·5m.

Question 11 [3]

Using **Biot-Savart law,** show that **magnetic flux density 'B'** at the centre of a current carrying circular coil of radius R is given by:

$$\mathbf{B} = \frac{\mu_0 I}{2R}$$

where the terms have their usual meaning.

Question 12 [3]

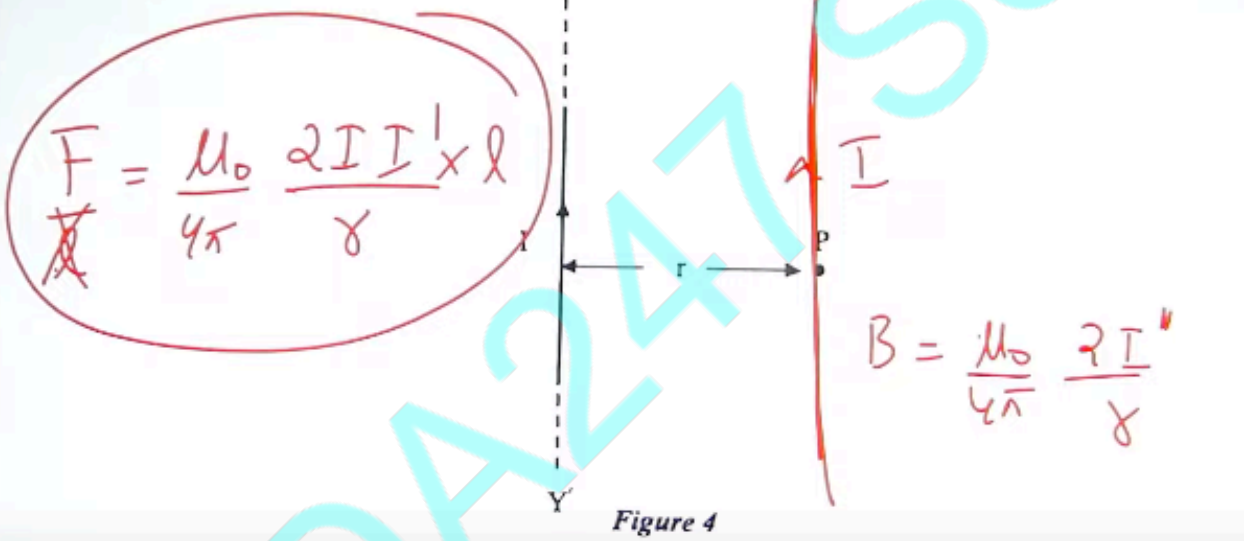

Figure 4

(i) What is the **direction** of magnetic flux density **B** of the magnetic field at the point P?

(ii) What is the **magnitude** of magnetic flux density **B** of the magnetic field at the point P?

(iii) Another metallic wire MN having length *l* and carrying a current **I** is **now** kept at the point P. If the two wires are in vacuum and parallel to each other, how much force acts on the wire MN due to the current **I'** flowing in the wire YY'?

Question 13

(i) Using **Huygen's wave theory**, show that (for refraction of light):

$$\frac{Sini}{Sinr} = \text{Constant}$$

where terms have their usual meaning. You must draw a neat and **labelled** diagram.

OR

(ii) In **Young's double slit experiment**, show that:

$$\beta = \frac{\lambda D}{d}$$

where the terms have their usual meaning.

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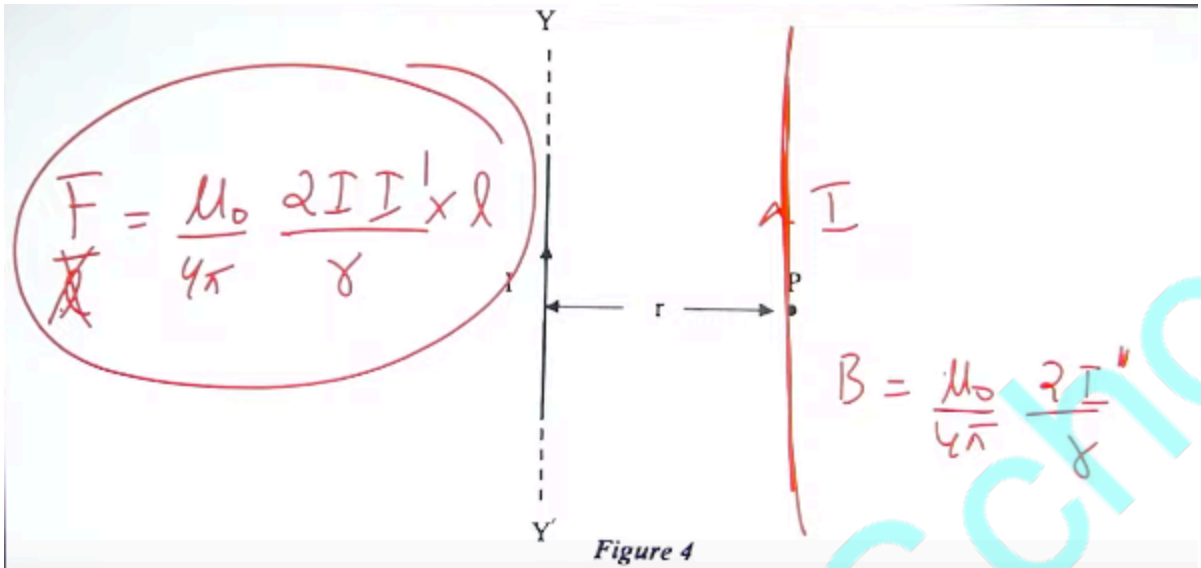

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where terms have their usual meaning. You must draw a neat and **labelled** diagram.

OR

(ii) In **Young's double slit experiment**, show that:

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where the terms have their usual meaning.

Question 14 [3]

Figure 5 below shows a ray of monochromatic light LM incident on the first surface AB of a **regular (equilateral) glass prism** ABC. The emergent ray grazes the adjacent surface AC. Calculate the **angle of incidence.** (Refractive Index of glass = 1·5)

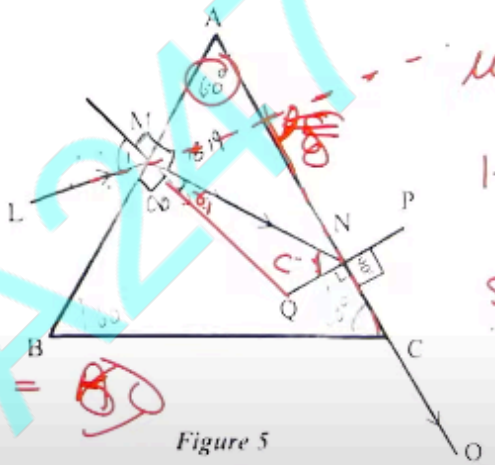


Figure 5

A student is performing an experiment to determine **focal length** of a convex lens by using lens formula i.e., by **no parallax** method. The examiner gives some instructions to the student. The student responds to each instruction as per her understanding of the experiment.
State whether the student's response is correct or incorrect. Give a reason for your answer.

(i) EXAMINER: Image formed by the lens is **magnified**. Reduce the size of the image.
STUDENT moves the lens towards the object pin.

(ii) EXAMINER: Plot a graph of (1/v) **against** (1/u).
STUDENT takes (1/v) on Y axis and (1/u) on X axis.

(iii) EXAMINER: Write the relation between the **optical power** (P) and the **focal length** (f) of the convex lens.
STUDENT writes P = 2f.

SECTION D – 15 MARKS

Question 18

(i) (a) A 220V, 50Hz ac source is connected to a coil having coefficient of self-inductance of 1H and a resistance of 400Ω. Calculate: [5]

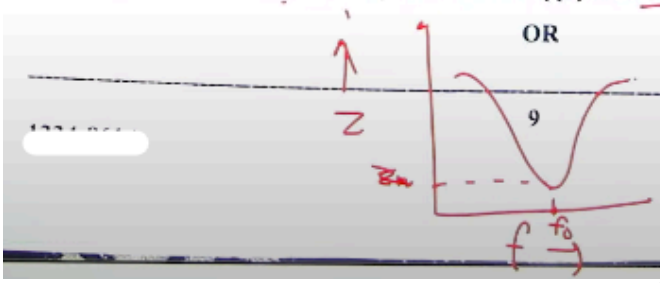
(1) the **reactance** of the coil.

(2) the **impedance** of the coil.

(3) the **current** flowing through the coil.

(b) Draw a **labelled** graph showing variation of **impedance (Z)** of a series LCR circuit Vs **frequency (f)** of the ac supply. Mark the resonant frequency as f_0.

OR



(ii) (a) When current flowing through a solenoid decreases from 5A to 0 in 20 milliseconds, an emf of 500V is induced in it.

(1) What is this phenomenon called?

(2) Calculate **coefficient of self-inductance** of the solenoid.

(b) (1) **RMS** value of an alternating current flowing in a circuit is 5A. Calculate its **peak** value.

(2) State ***any one*** difference between a direct current (dc) and an alternating current (ac).

Question 19 [5]

(i) (a) On the basis of **Bohr's theory**, derive an expression for the **radius** of the n^{th} orbit of an electron of hydrogen atom.

(b) Calculate the energy released in the following nuclear fusion reaction:

$$_1^2H + _1^2H \rightarrow _2^4He + \text{energy}$$

Mass of $_1^2H$ = 2·014102u

Mass of $_2^4He$ = 4·002604u

OR

(ii) (a) Calculate **mass defect** and **binding energy** of $_{10}^{20}Ne$ nucleus, given

Mass of $_{10}^{20}Ne$ = 19·992397u,

Mass of $_1^1H$ = 1·007825u,

Mass of $_0^1n$ = 1·008665u.

(b) State the **Bohr's postulate** of angular momentum of an electron.

(c)

(1) What is the **velocity** of an electron in the 3rd orbit of hydrogen atom if its velocity in the 1st orbit is v_0?

(2) Radius of the 1st orbit of hydrogen atom is r_0. What will be the **radius** of the **4th** orbit?