ISC SEMESTER 1 EXAMINATION
SPECIMEN QUESTION PAPER
PHYSICS
PAPER - 1
(THEORY)

Maximum Marks: 70

Time allowed: One and a half hours

(*Candidates are allowed additional **15 minutes** for **only** reading the paper.*)

ALL QUESTIONS ARE COMPULSORY

The marks intended for questions are given in brackets [ ].

Select the correct option for each of the following questions

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Question 1

The ratio of forces between two small spheres having a constant charge 'q' when placed in air to when placed in a medium of dielectric constant *K*, is; **[1]**

(a) 1: K (b) $K : 1$

(c) $1 : K^2$ (d) $K^2 : 1$

Question 2

When a soap bubble is given a positive charge, then its radius: **[1]**

(a) Decreases (b) Increases

(c) Remains unchanged (d) Nothing can be predicted as information is insufficient

Question 3

Four charges are arranged at the corners of a square $ABCD$, as shown in the adjoining figure. The force on the charge 'Q' kept at the centre *O* is: **[1]**

(a) Zero (b) Along the diagonal AC

(c) Along the diagonal BD (d) Perpendicular to side AB

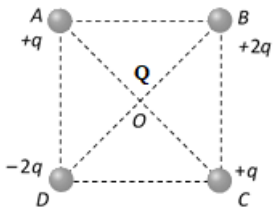

figure 1

Question 4

The surface charge density of a conductor, in the absence of another conductor: **[1]**

(a) Is proportional to the charge on the conductor and its surface area

(b) Inversely proportional to the charge and directly proportional to the surface area

(c) Directly proportional to the charge and inversely proportional to the surface area

(d) Inversely proportional to the charge and the surface area

Question 5

Which of the following is not the characteristic of resonance in an LCR series circuit? **[1]**

(a) $X_L = X_C$ (b) $\omega L = \frac{1}{\omega C}$

(c) $2\pi fL = 2\pi fC$ (d) $f_0 = \frac{1}{2\pi}\sqrt{\frac{1}{LC}}$

Question 6

A graph showing variation in impedance **Z** of a series LCR circuit, with frequency **f** of alternating emf applied to it is shown below. What is the minimum value of this impedance? **[1]**

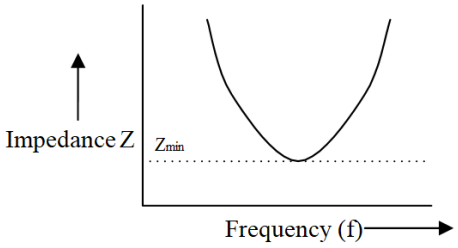

figure 2

(a) R (b) $Z = \sqrt{R^2 + (X_L - X_C)^2}$

(c) Z_{min} (d) $X_L = X_C$

Question 7

An electric dipole of moment $\vec{p}$ is placed in a uniform electric field $\vec{E}$. It has maximum (negative) potential energy when the angle between $\vec{p}$ and $\vec{E}$ is: **[1]**

(a) $\frac{\pi}{2}$ (b) Zero

(c) π (d) $\frac{3\pi}{2}$

Question 8

A charge placed at a distance from a short electric dipole in the end-on position experiences a force F. If the distance is halved, then the force will become: **[1]**

(a) 4F (b) 8F

(c) F/4 (d) F/8

Question 9

In ***figure 3*** given below, Electric field intensity 'E' at a point P, at a perpendicular distance 'r' from an infinitely long line charge X'X having linear charge density λ is given by: **[1]**

(a) $E = \left(\frac{1}{4\pi\epsilon_0}\right)\frac{2\lambda}{r^2}$

(b) $E = \left(\frac{1}{4\pi\epsilon_0}\right)\frac{2\lambda}{r}$

(c) $E = \left(\frac{1}{4\pi\epsilon_0}\right)\frac{\lambda}{r^2}$

(d) $E = \left(\frac{1}{4\pi\epsilon_0}\right)\frac{\lambda}{r}$

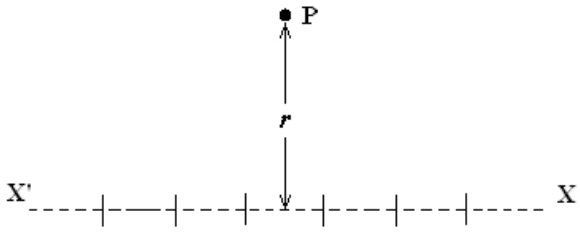

figure 3

Question 10

Three capacitors, each of capacitance C, are connected in series. Their equivalent capacitance is C_s. The same three capacitors are now connected in parallel. Their equivalent capacitance becomes C_p. The ratio of C_p to C_s is: **[1]**

(a) 9 : 1 (b) 1 : 9

(c) 3 : 1 (d) 1 : 3

Question 11

The charges $q_1 = 3\mu F$, $q_2 = 4\mu F$ and $q_3 = -7\mu F$ are placed on the circumference of a circle of radius 1.0m as shown in the figure below. What is the value of charge q_4 placed on the same circle if the potential at the centre is? **[1]**

(a) -4μF (b) -3μF

(c) 7μF (d) 0

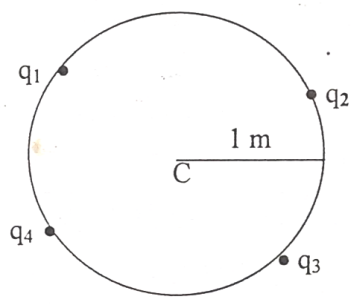

figure 4

Question 12

Three equal charges of 5.0μC each, are placed at the three vertices of an equilateral triangle of side 5.0cm each. The electrostatic potential energy of the system of charges is: **[1]**

(a) 13.5 J (b) 17.5 J

(c) 27 J (d) 15 J

Question 13

Three capacitors $C_1 = 3\mu F$, $C_2 = 6\mu F$ and $C_3 = 10\mu F$ are connected to a 50V battery as shown in the figure below: **[1]**

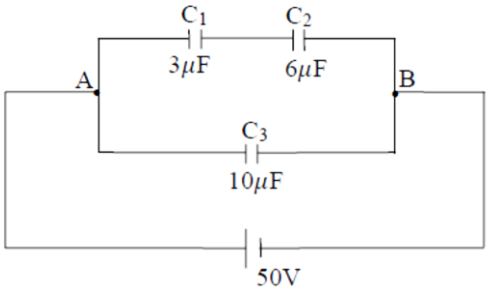

figure 5

The equivalent capacitance of the circuit between point A and B and the charge on C_1 are…

(a) 12μF, 150C (b) 4.75μF, 100C

(c) 12μF, 100C (d) 4.75μF, 150C

Question 14

A substance behaves like a magnet only if there are: **[1]**

(a) at least some tiny current loops within the magnet

(b) stationary charges within the magnet

(c) magnet within the magnet

(d) none of these

Question 15

A straight long wire is turned into a loop of radius R = 10 cm, as shown in ***figure 6*** below. If a current I = 16 A is passed through the wire, then the magnetic field at the centre of the loop is: **[1]**

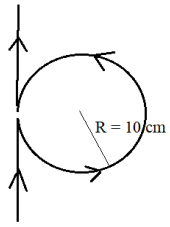

figure 6

(a) $3.4 \times 10^{-5}T$ (b) $6.8 \times 10^{-5}T$

(c) $1.7 \times 10^{-5}T$ (d) $5.1 \times 10^{-5}T$

Question 16

The current in the circuit shown in ***figure 7*** below, will be: **[1]**

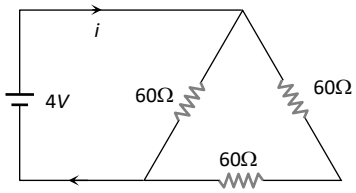

figure 7

(a) 1/45 A (b) 1/15 A

(c) 1/10 A (d) 1/5 A

Question 17

A cell of e.m.f. E is connected to an external resistance R. The potential difference across cell is V. The internal resistance of cell will be: **[1]**

(a) $\frac{(E-V)R}{E}$ (b) $\frac{(E-V)R}{V}$

(c) $\frac{(V-E)R}{V}$ (d) $\frac{(V-E)R}{E}$

Question 18

The ***figure 8*** given below shows currents in a part of an electric circuit. The current *i* is: **[1]**

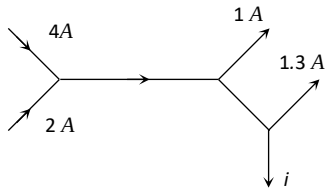

figure 8

(a) 1.7 *A* (b) 3.7 *A*

(c) 2.7 *A* (d) 4.7 *A*

Question 19

n identical cells each of e.m.f. *E* and internal resistance *r* are connected in parallel. An external resistance *R* is connected in series to this combination. The current through *R* is: **[1]**

(a) $\frac{nE}{R+nr}$ (b) $\frac{nE}{nR+r}$

(c) $\frac{E}{R+nr}$ (d) $\frac{nE}{R+r}$

Question 20

The circuit shown in ***figure 9*** below is used to compare the e.m.f. of two cells E_1 and E_2 where $E_2 > E_1$. The null point is at *C* when the galvanometer is connected to E_1. When the galvanometer is connected to E_2, the null point will be: **[1]**

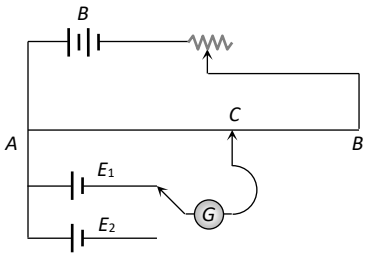

figure 9

(a) To the left of *C* (b) To the right of *C*

(c) At *C* itself (d) Nowhere on *AB*

Question 21

Figure 10 given below shows a graph of emf 'ε' generated by an ac generator verses time. What is the frequency of the emf? **[1]**

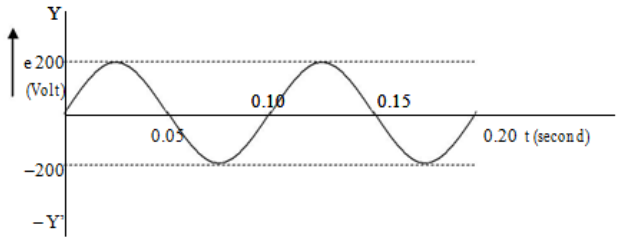

figure 10

(a) 10 Hz (b) 0.10 Hz

(c) 20 Hz (d) 50 Hz

Question 22

If m, e, τ and *n* respectively represent the mass, charge, average relaxation time and density of the electron, then what will be the resistance of a wire of length *l* and area of cross-section A? **[1]**

(a) $\frac{ml}{ne^2\tau A}$ (b) $\frac{m\tau^2 A}{ne^2 l}$

(c) $\frac{ne^2\tau A}{2ml}$ (d) $\frac{ne^2 A}{2m\tau l}$

Question 23

The drift velocity of a current carrying conductor is *v*. What will be the drift velocity if *the cu*rrent flowing through the wire is doubled? **[1]**

(a) *v / 4* (b) *v / 2*

(c) **2***v* (d) 4*v*

Question 24

The resistance of a wire is 10Ω. It is stretched so that its length becomes four times. What will be the new resistance of the wire? **[1]**

(a) 40 Ω (b) 160.0 Ω

(c) 120 Ω (d) 80.0 Ω

Question 25

What is the angle between the current element $\vec{dl}$ and the magnetic flux density $\vec{B}$ at point 'P' in the ***figure 11*** given below? **[1]**

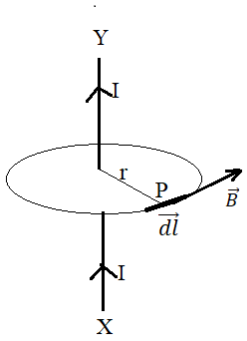

figure 11

(a) Parallel to each other (b) Perpendicular to each other

(c) Normal to each other (d) Any angle between them is possible

Question 26

An A.C. generator generating an e.m.f of ε = 300 sin (100π) t is connected to a **series** combination of 16μ F capacitor, 1H inductor and 100 Ω resistor. What is the frequency of A.C.? **[1]**

(a) 100 Hz (b) 50 Hz

(c) 300 Hz (d) 25 Hz

Question 27

Four identical cells each having an e.m.f. of 4*V* are connected in parallel. What will be the e.m.f. of this combination? **[1]**

(a) 1 V (b) 16 V

(c) 1/4V (d) 4 V

Question 28

A 2 *volt* battery, a 15Ω resistor and a potentiometer of 100 cm length, all are connected in series. If the resistance of potentiometer wire is 5Ω, then the potential gradient of the potentiometer wire is… **[1]**

(a) 0.005 *V/cm* (b) 0.05 *V/cm*

(c) 0.02 *V/cm* (d) 0.2 *V/cm*

Question 29

The potential gradient along the length of a uniform wire is 20 volt/metre. B and C are the two points at 40cm and 70cm point on a meter scale fitted along the wire. What is the potential difference between B and C? **[1]**

(a) 6 V (b) 0.4 V

(c) 0.6 V (d) 4 V

Question 30

In an experiment of meter bridge, a null point is obtained at the centre of the bridge wire. When a resistance of 5 is connected in one gap, what is the value of resistance in the other gap? **[1]**

(a) 10Ω (b) 5Ω

(c) 1/5Ω (d) 500Ω

Question 31

What is the locus of an electron, projected perpendicular to a uniform magnetic field? **[1]**

(a) Circle (b) Right bisector

(c) Parabola (d) Straight line

Question 32

Which of the following is the right expression to define the magnetic field B? **[1]**

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

(c) $\frac{\vec{F}}{l} = \frac{\mu_0}{2\pi}\frac{I^2}{a}$ (d) B = $\mu_0 n$ i

Question 33

What is the SI (base unit) unit of permeability? **[1]**

(a) kg m s^{-2} A^{-2} (b) kg m^2 s^{-2} A^{-2}

(c) kg m^2 s A^{-2} (d) kg m s^2 A^{-2}

Question 34

The loss of power in a transformer can be reduced by: **[1]**

(a) Increasing the number of turns in primary.
(b) Using solid core made of steel.
(c) Increasing ac voltage applied to primary.
(d) Using a laminated core of soft iron.

Question 35

Which is the most harmful radiation entering the atmosphere of earth from outer space? **[1]**

(a) X - Rays (b) Visible rays

(c) Gamma radiations (d) Radio waves

Question 36

Radio waves and gamma waves are both transverse in nature and electromagnetic in character and have the same speed in vacuum. In what respects are they different? **[1]**

(a) Frequency (b) wavelength

(c) Both, (a) and (b) (d) None of these

Question 37

Which of the following groups belongs only to the electromagnetic spectrum? **[1]**

(a) alpha rays, beta rays, gamma rays (b) ultra-sonic rays, radio waves, infra red rays

(c) gamma rays, cathode rays, X-rays (d) X-rays, radio waves, infra red rays

Question 38

Which electromagnetic radiation has wavelength greater than that of X-rays and smaller than that of visible light? **[1]**

(a) Radio waves (b) Microwaves

(c) Infra Red Rays (d) Ultra Violet Rays

Question 39

A parallel plate capacitor of plate area A=600cm^2 and plate separation d=2.0 mm is connected to a dc source of 200V. **[2]**

(i) What is the magnitude of the uniform electric field E between the plates?

(a) E = 1.0 x 10^5 V/m, (b) E = 1.0 x 10^7 V/m,

(c) E = 0.5 x 10^5 V/m, (d) E = 0.5 x 10^7 V/m,

(ii) What is the charge density σ on any one of the two plates?

(a) σ =8.85 x 10^{-7} C/m^2 (b) σ =8.85 x 10^{-9} C/m^2

(c) σ =4.45 x 10^{-7} C/m^2 (d) σ =4.45 x 10^{-9} C/m^2

Question 40

A torch bulb rated as 4.5 *W*, 1.5 *V* is connected as shown in ***figure 12*** given below. **[2]**

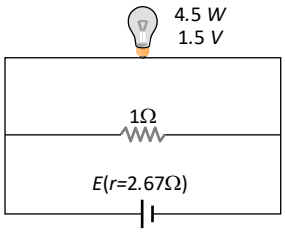

figure 12

(i) What should be the *e.m.f.* of the cell required to make this bulb glow at full intensity?

(a) 4.5 *V* (b) 1.5 *V*

(c) 2.67 *V* (d) 13.5 *V*

(ii) What is the current passing through 1Ω resistor?

(a) 4.5 *A* (b) 1.5 *A*

(c) 2.67 *A* (d) 13.5 *A*

Question 41

The specific resistance of manganin is 50 x 10^{-8} Ω m. **[2]**

(i) The resistance of a cube of length 50m will be:

(a) 10^{-6} Ω (b) 2.5 x 10^{-5}Ω

(c) 10^{-8}Ω (d) 50 x 10^{-8} Ω

(ii) The specific resistance of the combination of two cubes of length 50m in series will be:

(a) 10^{-6} Ω m (b) 2.5 x 10^{-5} Ω m

(c) 2 x10^{-6} Ω m (d) 50 x 10^{-8} Ω m

Question 42

A metallic rod CD rests on a thick metallic wire PQRS with arms PQ and RS parallel to each other, at a distance l = 50 cm, as shown in ***figure 13*** below. A uniform magnetic field B = 0.1T acts perpendicular to the plane of this paper, pointing inwards into the plane. (i.e. away from the reader). **[2]**

The rod is now made to slide towards right, with a constant velocity of v= 5.0 m/s.

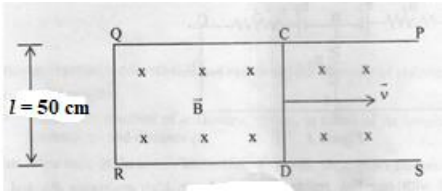

figure 13

(i) How much emf is induced between the two ends of the rod CD?

(a) 25.0 V (b) 0.25 V

(c) 2.50 V (d) .025 V

(ii) What is the direction in which the induced current flows?

(a) Along 'CQRDC' (b) Along the direction of motion of the conductor

(c) Along 'CDRQC' (d) Against the direction of motion of the conductor

Question 43

Study the diagram given below: **[2]**

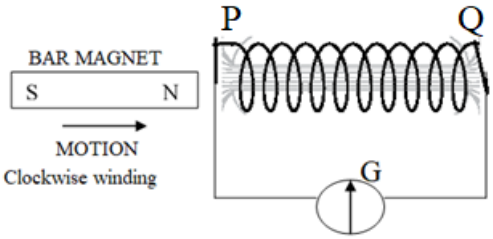

figure 14

(i) The direction of the current at end 'P' will be:

(a) Anti clockwise (b) Clockwise

(c) Towards the magnet (d) away from the magnet

(ii) The magnetic poles induced at the end 'Q' of the coil will be:

(a) North pole (b) South pole

(c) Anti clockwise (d) No pole

Question 44

The resistance of a galvanometer is 50 Ω. It is converted into a voltmeter or an ammeter. **[2]** Calculate the resistance of the voltmeter and ammeter to an accuracy of 2sf. Only with the mention below in the subparts.

(i) A voltmeter using a 10 k Ω resistor is:

(a) 10050 Ω (b) 10.050 kΩ

(c) 10000 Ω (d) 10 kΩ

(ii) An ammeter using a 10 m Ω resistor is:

(a) 50 Ω (b) 10 m Ω

(c) 0.0999 Ω (d) 50. 0999 Ω

Question 45

Two bulbs B_1 and B_2 are connected in series with an source of emf 250V as shown in the ***figure 15*** below. The labels on the bulbs read 250V, 80W and 250V, 100W respectively. **[3]**

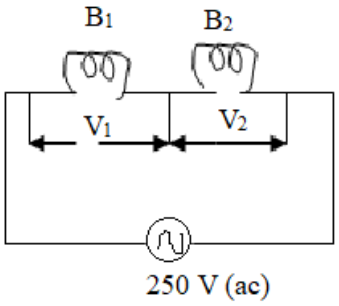

figure 15

(i) What will be the ratio of the resistance of the bulbs R_1/R_2?

(a) 5 : 4 (b) 4 : 5

(c) 1: 1 (d) 5 : 3

(ii) What will be the ratio of the power consumed (P_1/P_2) when connected in series?

(a) 5 : 4 (b) 4 : 5

(c) 1: 1 (d) 5 : 3

(iii) What is the ratio of the pd across the bulbs (V_1/V_2)?

(a) 5 : 4 (b) 4 : 5

(c) 1: 1 (d) 5 : 3

Question 46

A 2 μF capacitor, 100 Ω resistor and 8 H inductor are connected in series with an ac source. At a certain frequency of about 40 Hz for this ac source, the current drawn in the circuit is maximum. If the peak value of e.m.f. of the source is 200V: **[3]**

(i) What is the peak value of current in the circuit?

(a) 1.4 A (b) 2.2 A

(c) 2.0 A (d) 1.8 A

(ii) What is the phase relation between voltages across inductor and resistor?

(a) π/2 radian (b) π/3 radian

(c) π/4 radian (d) π radian

(iii) What is the phase difference between voltages across inductor and capacitor?

(a) π/2 radian (b) π/3 radian

(c) π/4 radian (d) π radian

Question 47

Given below is a neat, labelled diagram to obtain balancing condition of **Wheatstone bridge.** **[3]**

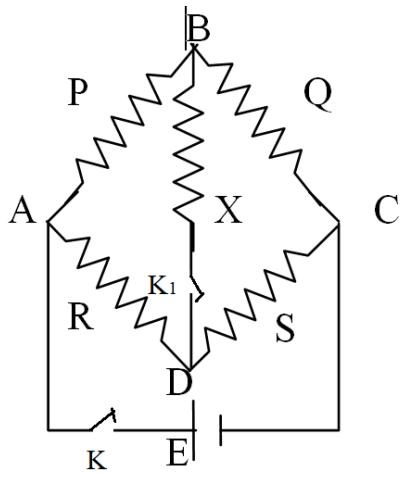

figure 16

(i) Why is the key 'K' pressed before the key K_1?

(a) There is no such requirement

(b) To avoid a back emf in the closed loops

(c) There is no current till the key 'K' is pressed

(d) None of these

(ii) What is the relation between the potential at 'B' and 'D', when the bridge is balanced?

(a) $V_B > V_D$ (b) $V_B < V_D$

(c) $V_B = V_D$ (d) $V_B \geq V_D$

(iii) What is the galvanometer current when the bridge is balanced?

(a) I_g flows from 'B' to 'D' (b) I_g flows from 'D to 'B'

(c) I_g has no significance in this case (d) $I_g = 0$

Question 48

Figure 17 shows a right-angled isosceles triangle PQR having its base equal to 'a'. **[3]** A current of 1.0 A is passing downwards along a thin straight wire cutting the plane of a paper normally as shown at Q. Likewise, a similar wire carries an equal current moving normally upwards at R. Assume the wire is to be infinitely long.

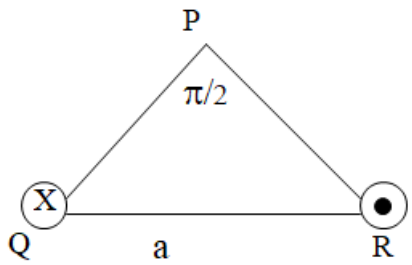

figure 17

(i) The magnitude and the direction of the magnetic induction B at P due to wire at 'Q':

(a) $B = \frac{\mu_0}{\sqrt{2}} \frac{I}{\pi a}$ acting along PQ

(b) $B = \frac{\mu_0}{\sqrt{2}} \frac{I}{\pi a}$ acting along PR

(c) $B = \frac{\mu_0}{\sqrt{2}} \frac{I}{\pi a}$ towards the mid-point of QR

(d) $B = \frac{\mu_0}{\pi} \frac{I}{a}$ towards the mid-point of QR

(ii) The magnitude and the direction of the magnetic induction B at P due to wire at 'R':

(a) $B = \frac{\mu_0}{\sqrt{2}} \frac{I}{\pi a}$ acting along PQ

(b) $B = \frac{\mu_0}{\sqrt{2}} \frac{I}{\pi a}$ acting along PR

(c) $B = \frac{\mu_0}{\sqrt{2}} \frac{I}{\pi a}$ towards the mid-point of QR

(d) $B = \frac{\mu_0}{\pi} \frac{I}{a}$ towards the mid-point of QR

(iii) The net magnitude and the direction of the magnetic induction B at P:

(a) $B = \frac{\mu_0}{\sqrt{2}} \frac{I}{\pi a}$ acting along PQ

(b) $B = \frac{\mu_0}{\sqrt{2}} \frac{I}{\pi a}$ acting along PR

(c) $B = \frac{\mu_0}{\sqrt{2}} \frac{I}{\pi a}$ towards the mid-point of QR

(d) $B = \frac{\mu_0}{\pi} \frac{I}{a}$ towards the mid-point of QR

Question 49

An alternating e.m.f of 100V is applied to a circuit containing a resistance of 40 Ω and an inductance L in series. The current is found to lag behind the voltage by an angle a = $\tan^{-1}$ ¾. **[4]**

(i) The inductive reactance in this case is:

(a) 40 Ω (b) 30 Ω

(c) 50 Ω (d) $10\sqrt{5}$ Ω

(ii) The impedance of the circuit is:

(a) 40 Ω (b) 30 Ω

(c) 50 Ω (d) $10\sqrt{5}$ Ω

(iii) The current flowing through the circuit is:

(a) 2.5 A (b) 3.33 A

(c) 2.0 A (d) 2 $\sqrt{5}$ A

(iv) If the inductance has a value of 0.096 H, and $\pi = 3.14$, the approximate frequency of the applied e.m.f.

(a) 40 Hz (b) 50 Hz

(c) 30 Hz (d) None of these

Question 50

The teacher of Priti's school took the students on a study trip to a power generating station, located nearly 250 km away from the city. The teacher explained that electrical energy is transmitted over such a long distance to their city, in the form of alternating current (ac) raised to a high voltage. At the receiving end in the city, the voltage is reduced to operate the devices. As a result, the power loss is reduced. Priti listened to the teacher and asked questions about how the ac is converted to a higher or lower voltage. **[4]**

(i) What is the device used to change the alternating voltage to a higher or lower value?

(a) Transformer (b) Rectifier

(c) Ammeter (d) Voltmeter

(ii) What is the cause for power dissipation in the device referred to above?

(a) Hysteresis (b) Eddy current

(c) Flux loss (d) All of these

(iii) In the device used above, what is the relation between the power output and power input for an ideal case?

(a) Power output is less than power input. (b) Power output is greater than power input

(c) Power output is equal to power input. (d) It depends upon the situation

(iv) What source input should be used in this device?

(a) A C source (b) D C source

(c) Half wave rectifier (d) Full wave rectifier