

1	2	3	4	5	Total

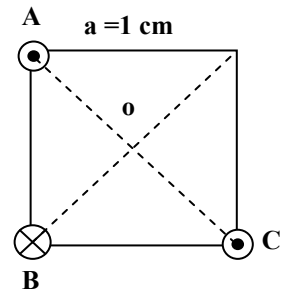
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Full mark: 40

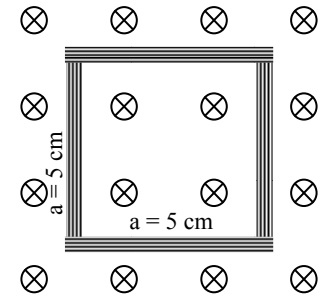
Please check that your test paper has 5 pages.

Q1. [8 Marks] Three parallel wires are placed at the corners A B and C of a square of side $a = 1 \text{ cm}$ as shown in the figure. The wires are perpendicular to the pane of the square. The wires at the corners A and C carry a current of 1 A directed out of the page and the wire at the corner B carries a current of 4 A directed into the page.

- What is the magnitude of the magnetic field at the centre O of the square?
- Draw on the figure the net magnetic field at the point O.
- Find the magnitude and direction of the total magnetic force per unit length on the wire at the corner B.
- Draw on the figure the force on the wire B. Indicate clearly the angle.

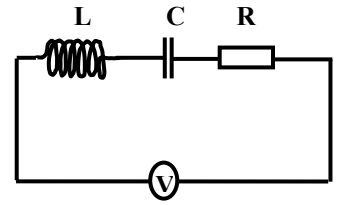


- Q2.** [10 Marks]. A square coil of side $a = 5\text{ cm}$ is placed in a 2 T magnetic field directed perpendicular to the plane of the coil. The length of the coil is $L = 2\text{ mm}$. The coil has 200 turns and internal resistance of $3\ \Omega$.
- What is the inductance of the coil?
 - What is the magnetic flux through the coil?
 - The direction of the magnetic field is reversed (now pointing out of the page). The time taken to reverse the field is 20 ms . What is the current in the coil as the field is reversed?
 - Draw on the figure the direction of the current in the coil.
 - Explain in simple words why the current is in that direction.



Q3. [7 Marks] An LRC circuit is connected in series to a $100\text{ V}_{\text{rms}}$, AC voltage source. The frequency of the source is 1 kHz . The values of the components in the circuit are $R = 10\ \Omega$, $C = 16\ \mu\text{F}$ and $L = 1\text{ mH}$.

- a. Find the impedance of the circuit.
- b. Calculate the phase difference between the voltage and the current in the circuit.
- c. Calculate the power factor of the circuit.
- d. What is the rms current in the circuit?
- e. What is the average power dissipated in the circuit?



Q4. [5 Marks] In the table below write the correct name and symbol for the **unit** of the quantity expressed by the equation. (Follow the example of the first line).

Equation	Name	Symbol
$P = VI$	Watt	W <i>(Note : VA is not accepted!)</i>
$\Phi = \vec{B} \cdot \vec{A}$		
$\tau = \frac{L}{R}$		
$L = \frac{\mu_0 N^2 A}{\ell}$		
$X_C = \frac{1}{C\omega}$		
$r = \frac{mv}{qB}$		

Q5. [10 Marks] Answer all the following questions (2 marks each)

a. A transformer has 1000 windings on the primary and 5000 windings on the secondary. If $220 \text{ V}_{\text{rms}}$ is applied to the primary what is the rms voltage on the secondary?

b. In an LRC circuit R is 10Ω , C is 100 pF and L is 30 mH . What is the resonance frequency of the circuit?

c. An inductor has inductance 50 mH and internal resistance 2Ω . What is its time constant?

d. An electron is moving in a uniform magnetic field B with speed $v = 2 \times 10^4 \text{ m/s}$ on a circular path of radius 0.1 m . The field is perpendicular to the velocity of the electron. What is the magnitude of the magnetic field?

e. A magnetic moment of magnitude 2 Am^2 is placed with its direction at 20 degrees to the direction of a 3 T magnetic field. What is the torque on the magnetic moment?