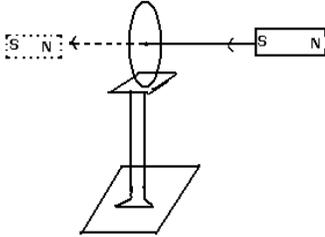




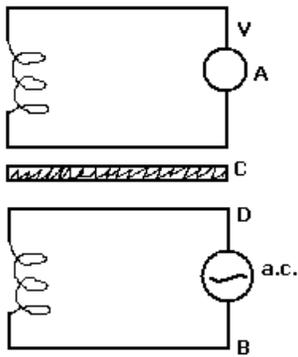
PLOT 5C, 2ND FLOOR, GANAPATI COMPLEX, SEC-13, OPP. JAIPURIA
SCHOOL, VASUNDHARA, GHAZIABAD (U.P)

ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENT

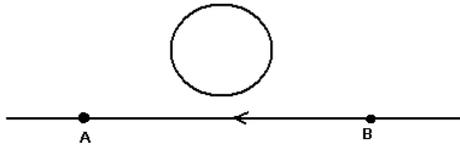
1. The power factor of an a.c circuit is 0.5. What will be the phase difference between voltage and current in this circuit?
2. Give the direction in which the induced current flows in the coil mounted on an insulating stand when a bar magnet is quickly moved along the axis of the coil from one side to the other as shown in fig.



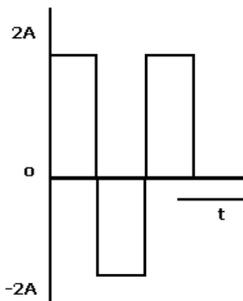
3. Two identical loops, one of copper and another of constantan are removed from a magnetic field within the same time interval. In which loop will the induced current be greater?
4. In a series LCR circuit the voltage across an inductor, capacitor and resistor are 20 V, 20 V and 40 V respectively. What is the phase difference between the applied voltage and the current in the circuit?
5. What is the power dissipated in a.c. circuit in which voltage and current are given by $V = 230\sin\left(\omega t + \frac{\pi}{2}\right)$ and $I = 10\sin\omega t$?
6. A solenoid with an iron core and a bulb are connected to a d.c. source. How does the brightness of the bulb change, when the iron core is removed from the solenoid?
7. Find the capacitance of the capacitor that would have a reactance of 100 ohm when used with an a.c. source of frequency $(5/\pi)$ kHz.
8. Find the inductance of the inductor that would have reactance of 50 ohm when used with an a.c. source of frequency $(\frac{25}{\pi})$ kHz.
9. Define henry.
10. If the self inductance of an air core inductor increases from 0.01 mH to 10 mH on introducing an iron core into it, what is the relative permeability of the core used?
11. Draw a graph to show the variation of capacitive reactance with frequency of an A.C. source.
12. If the number of turns of a solenoid is doubled, keeping the other factors constant, how does the self inductance of the solenoid change?
13. A coil A is connected to a voltmeter V and the other coil B to an alternating current source D. If a large copper sheet C, is placed between two coils, how does the induced e.m.f in the coil A change due to current in the coil B?



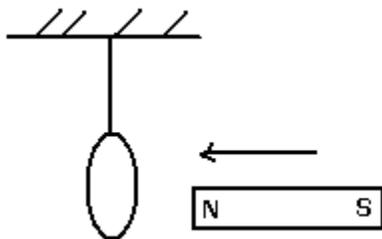
14. The electric current in a wire in the direction from B to A is decreasing. What is the direction of induced current in the metallic loop kept above the wire as shown in the figure?



15. What is p.f. of LCR circuit at resonance?
 16. Calculate the r.m.s value of the alternating current shown in the figure.



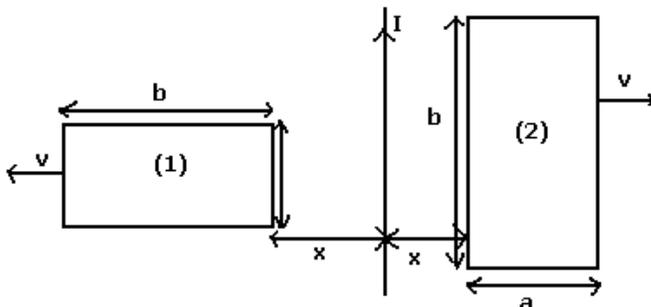
17. An ideal inductor is in turn across 220 V, 50 Hz and 220 V, 100 Hz supplies. Will the current flowing through it in the two cases be the same or different?
 18. Give the direction in which the induced current flows in the wire loop, when the magnet moves towards it as shown in the figure.



19. A conducting rod of length l is moved in a magnetic field of magnitude B with velocity v such that the arrangement is mutually perpendicular. Prove that the emf induced in the rod is $|\mathcal{E}| = Blv$.
 20. A rectangular coil of area A , having number of turns N is rotated at f revolutions per second in a uniform magnetic field B , the field being perpendicular to the coil. Prove that the maximum emf induced in the coil is $2\pi f NBA$.
 21. An alternating voltage of frequency f is applied across a series LCR circuit. Let f_r be the resonance frequency for the circuit. Will the current in the circuit lag, lead or remain in phase with the applied voltage when (i) $f > f_r$, (ii) $f < f_r$? Explain your answer in each case.
 22. A capacitor and a resistor are connected in series across C, R are 120 V, 90 V respectively and if the r.m.s. current of the circuit is 3 A, calculate the (i) impedance, (ii) power factor of the circuit.

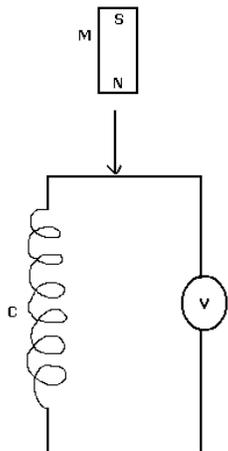
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23. An inductor 200 mH, a capacitor C and a resistor 10 ohm are connected in series with a voltage 100 V, 50 s^{-1} a.c. source. If the current and voltage are in phase with each other, calculate the capacitance of the capacitor.
24. In the figure given below, a bar magnet moving towards the right or left induces an e.m.f. in the coils (1) and (2). Find giving reason, the directions of the induced currents through the resistors AB and CD when the magnet is moving (a) towards the right, and (b) towards the left.
25. (i) Draw the graphs showing variation of inductive reactance and capacitive reactance with frequency of applied a.c. source.
(ii) Can the voltage drop across the inductor or the capacitor in a series LCR circuit be greater than the applied voltage of the a.c. source? Justify your answer.
26. The figure shows two identical rectangular loops (1) and (2) placed on a table along with a straight line current carrying conductor between them.
- What will be the directions of the induced currents in the loops when they are pulled away from the conductor with same velocity v ?
 - Will the e.m.f induced in the two loops be equal? Justify your answer.



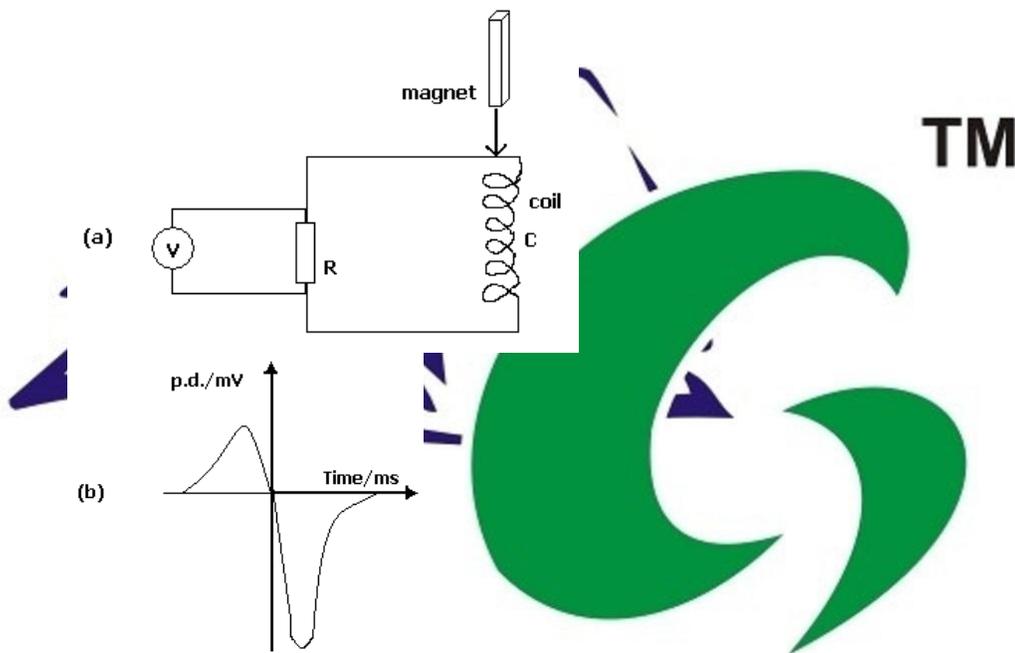
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27. Figure shows a bar magnet M falling under gravity through an air cored coil C. plot a graph showing variation of induced e.m.f. (ϵ) with time (t). what does the area enclosed by the ϵ - t curve depict?

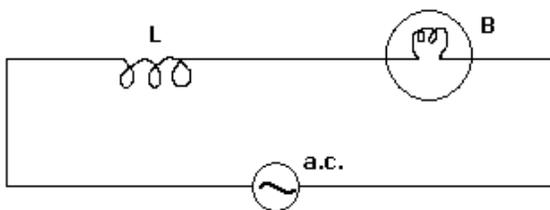


28. State the underlying principle of an a.c. generator. Write the relationship between the peak value and r.m.s value of alternating voltage.
29. A circular coil of radius 8 cm and 20 turns rotates about its vertical diameter with an angular speed of 50 s^{-1} in a uniform horizontal magnetic field of magnitude $3 \times 10^{-2} \text{ T}$. find the maximum and average value of the emf induced in the coil.
30. State the condition under which the phenomenon of resonance occurs in a series LCR circuit. Plot a graph showing variation of current with frequency of a.c. source in a series LCR circuit.

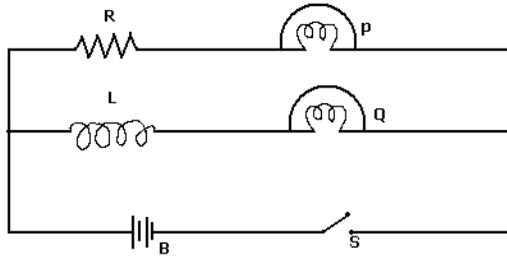
31. Mention the factors on which the resonant frequency of a series LCR circuit depends. Plot a graph showing variation of impedance of a series LCR circuit with the frequency of the applied a.c. source.
32. Draw the graphs showing the variations of (i) inductive reactance, and (ii) capacitive reactance, with frequency of applied voltages in a.c. circuit. How do the values of (i) inductive, and (ii) capacitive reactance change, when the frequency of applied voltage is tripled?
33. Two circular coils, one of radius r and the other of radius R are placed coaxially with their centers coinciding. For $R \gg r$, obtain an expression for the mutual inductance of the arrangement.
34. A coil of inductance L , a capacitor of capacitance, C , and a resistance R , are put in series with an alternating sources of emf $E(=E_0 \sin \omega t)$. Write an expression for the (i) total impedance of the circuit, (ii) frequency of the source emf for which the circuit will show resonance.
35. A bar magnet M is dropped so that it falls vertically through the coil C in figure (a). the graph obtained for voltage produced across the coil vs time is shown in figure (b)
 - i) Explain the shape of the graph.
 - ii) Why is the negative peak longer than the positive peak.



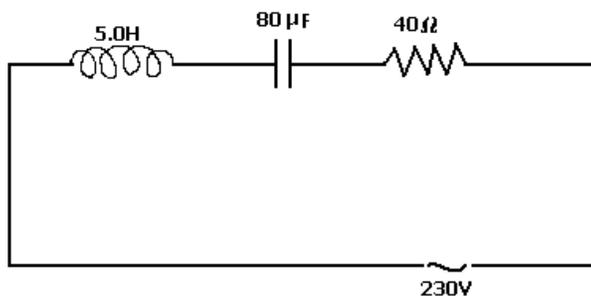
36. An a.c. voltage $E = E_0 \sin \omega t$ is applied across an inductor L . obtain an expression for current I .
37. Derive an expression for the mutual inductance of a pair of coaxial solenoids having number of turns N_1 and N_2 .
38. Prove that the energy stored in an inductor is given by $\frac{1}{2} i_{max}^2 L$.
39. An inductor 'L' of reactance X_L , connected in series with a bulb 'B' to an a.c. source as shown in figure. Briefly explain how does the brightness of the bulb change, when (i) number of turns of the inductor is reduced and (ii) a capacitor of reactance $X_C = X_L$ is induced in series in the same circuit.



40. Calculate the current drawn by the primary of a transformer, which steps down 200 V to 20 V to operate a device of resistance $20\ \Omega$. Assume the efficiency of the transformer to be 80%.
41. A circular copper disc 10 cm in radius rotates at 20π rad/s about an axis through its centre and perpendicular to the disc. A uniform magnetic field of 0.2T acts perpendicular to the disc.
- Calculate the potential difference developed between the axis of the disc and the rim.
 - What is the induced current, if the resistance of the disc is $2\ \Omega$?
42. How are eddy currents produced? Give two applications of eddy currents.
43. The given figure shows an inductor L and resistor R connected in parallel to a battery B through a switch S. The resistance of R is the same as that of coil that makes L. Two identical bulbs, P and Q are put in each arm of the circuit as shown in fig. When S is closed, which of the two bulbs will light up earlier? Justify your answer.



44. A radio frequency choke is air cored coil whereas an audio frequency choke is iron cored. Give reasons for the difference.
45. Prove mathematically that the average power over a complete cycle of alternating current through an ideal inductor is zero.
46. How is the mutual inductance of a pair of coils affected when :
- Separation between the coils is increased?
 - The number of turns of each coil is increased?
 - A thin iron sheet is placed between the two coils, other factors remaining the same?
- Explain your answer in each case.
47. The given circuit diagram shows a series LCR circuit connected to a variable frequency 230V source:



- Determine the source frequency which drives the circuit in resonance.
 - Obtain the impedance of the circuit and the amplitude of current at the resonating frequency.
 - Determine the r.m.s potential drops across the three elements of the circuit.
 - How do you explain the observation that the algebraic sum of the voltages across greater than the supplied voltage?
48. a. Define the term 'impedance of series LCR circuit'. Derive a mathematical expression for it using a phasor diagram.
- b. Obtain the resonant frequency of a series LCR circuit with $L = 0.2\ \text{H}$, $C = 32\ \mu\text{F}$ and $R = 10\ \Omega$.
49. Distinguish between reactance and resistance. An alternating emf is applied across a capacitor. Show mathematically that current in it leads the applied emf by phase angle of $\frac{\pi}{2}$. What is capacitive reactance? Draw a graph showing the variation of capacitive reactance with the frequency of a.c. current.

