CHAPTERWISE QUESTION

PHYSICS

SET A

ALTERNATING CURRENT

CLASS - XII **Time : 1½ hrs.**

Marks : 35

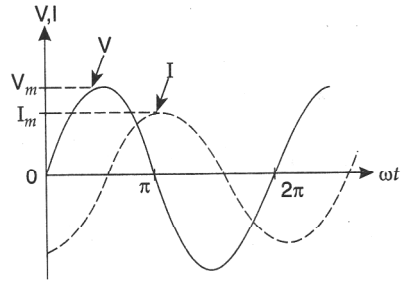
SECTION - A **8 × 1 = 8**

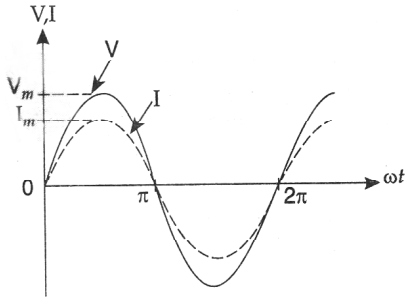
1. Alternating voltage (V) is represented by the equation.

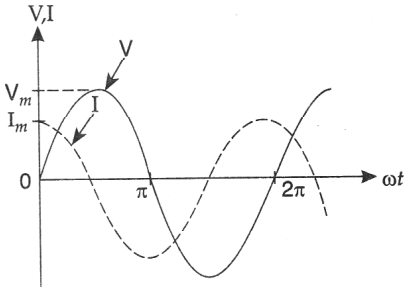
   a) $V(t) = V_{m e^{\omega t}}$ b) $V(t) = V_m \sin \omega t$

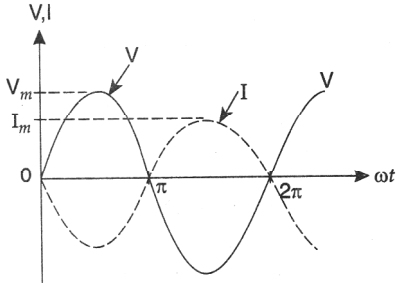
   c) $V(t) = V_m \cot \omega t$ d) $V(t) = V_m \tan \omega t$

2. The phase relationship between current and voltage in a pure resistive circuit is best represented by

   a) 

   b) 

   c) 

   d) 

3. In the case of an inductor

   a) voltage lags the current by $\frac{\pi}{2}$ b) voltage leads the current by $\frac{\pi}{2}$

   c) voltage leads the current by $\frac{\pi}{3}$ d) voltage leads the current by $\frac{\pi}{4}$

4. In series LCR circuit, the phase angle between supply voltage and current is

   a) $\tan \phi = \frac{X_L - X_C}{R}$ b) $\tan \phi = \frac{R}{X_L - X_C}$

   c) $\tan \phi = \frac{R}{X_L + X_C}$ d) $\tan \phi = \frac{X_L + X_C}{R}$

5. At resonance frequency the impedance in series LCR circuit is

   a) maximum b) minimum c) zero d) infinity

6. For an ideal-step-down transformer, the quantity which is constant for both the coils is

   a) current in the coils b) voltage across the coils

   c) resistance of coils d) power in the coils

For question numbers 7-8 two statements are given - one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

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

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

c) Assertion (A) is true but Reason (R) is false.

d) Assertion (A) is false but Reason (R) is true.

7. Assertion (A) : The alternating current lags behind the e.m.f. by a phase angle of $\pi/2$ when A.C. flows through in inductor.

   Reason (R) : The inductive reactance increases as the frequency of A.C. source decreases.

8. Assertion (A) : A transformer cannot work on D.C. supply.

   Reason (R) : D.C. changes neither in magnitude nor in direction.

SECTION - B **2 × 2 = 4**

9. Prove that an ideal capacitor in an A.C. circuit does not dissipate power.

10. A light bulb is rated 100 W for 220 V ac supply of 50 Hz. Calculate.

    i) the resistance of the bulb;

    ii) the rms current through the bulb.

OR

Determine the average value of a.c over a half cycle and full cycle.

SECTION - C **3 × 3 = 9**

11. An alternating voltage given by V = 70 sin $100\pi t$ is connected across a pure resistor of 25Ω. Find

    i) the frequency of the source, and

    ii the rms current through the resistor.

12. A resistor R and an element X are connected in series to an AC source of voltage. The voltage is found to lead the current in phase by $\pi/4$. If X is replaced by another element Y, the voltage lags behind the current by $\pi/4$.

i) Identify elements X and Y.

ii) When both X and Y are connected in series with R to the same source, will the power dissipated in the circuit be maximum or minimum? Justify your answer.

OR

a) Name the device used to change the alternating voltage to a higher or lower value. State one cause for power dissipation in this device.

b) Explain with an example, how power loss is reduced if the energy is transmitted over long distances as an alternating current rather than a direct current.

13. Define the quality factor in an AC circuit. Why should the quality factor have high value in receiving circuits? Name the factors on which it depends. **3**

SECTION - D **2 × 5 = 10**

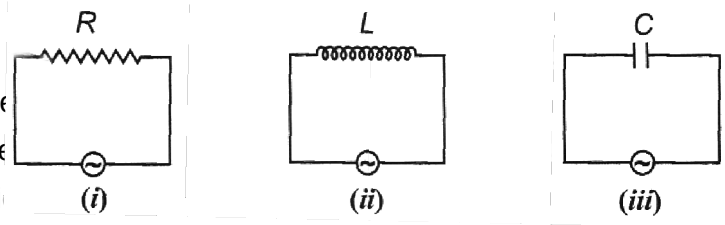
14. Draw a schematic sketch of an AC generator describing its basic elements. State briefly its working principle. Show a plot of variation of

i) Magnetic, flux and

ii) Alternating emf versus time generated by a loop of wire rotating in a magnetic field.

15. a) What do you understand by sharpness of resonance in a series LCR circuit? Derive an expression for Q-factor of the circuit.

b)



Three quency are shown in the figure e. If the frequency of the appli ving in these circuits be affected? Give reasons for your answer.

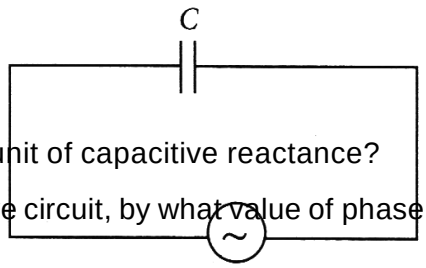
OR

An AC source generating a voltage $v = v_m \sin \omega t$ is connected to a capacitor of capacitance C. Find the expression for the current, *i*, flowing through it. Plot a graph of v and *i* versus to show that the current is $\pi/2$ ahead of the voltage. A resistor of 200Ω and a capacitor of $15.0\mu F$ are connected in series to a 220 V, 50 Hz AC source. Calculate the current in the circuit and the rms voltage across the resistor and the capacitor. Is the algebraic sum of these voltages more than the source voltage? If yes, resolve the paradox.

SECTION - E

Case Study

16. Let a source of alternating e.m.f. $E = E_0 \sin \omega t$ be connected to a capacitor of capacitance C. If 'I' is the instantaneous value of current in the circuit at instant t, then $I = \frac{E_0}{1/\omega C} \sin\left(\omega t + \frac{\pi}{2}\right)$. The capacitive reactance limits the amplitude of current in a purely capacitive circuit and it is given by $X_C = \frac{1}{\omega C}$.



i) What is the unit of capacitive reactance? **1**

ii) In a capacitive circuit, by what value of phase angle does not alternating current leads the emf? **1**

iii) One micro farad capacitor is joined to a 200 V, 50 Hz alternator. Find the rms current through the capacitor. **2**

OR

Find the capacitive reactance of $5\mu F$ capacitor for frequency of 10^6Hz.

CHAPTERWISE QUESTION

PHYSICS

SET B

ALTERNATING CURRENT

CLASS - XII **Time : 1½ hrs.**

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SECTION - A **8 × 1 = 8**

1. To reduce the resonant frequency in an L-C-R series circuit with a generator.
   a) the generator frequency should be reduced
   b) another capacitor should be added in parallel to the first
   c) the iron core of the inductor should be removed
   d) dielectric in the capacitor should be removed
2. The output of a step-down transformer is measured to be 24 V when connected to a 12W light bulb. The value of the peak current is
   a) $1/\sqrt{2}$ A b) $\sqrt{2}$ A c) 2 A d) $2/\sqrt{2}$ A
3. As the frequency of an ac circuit increases, the current first increases and then decreases. What combination of circuit elements is most likely to comprise the circuit?
   a) Inductor and capacitor b) Resistor and inductor
   c) Resistor and capacitor d) Inductor only
4. In an LCR circuit, capacitance is charged from C ot 2C. For resonant frequency to remain unchanged, the inductance should be changed from L to
   a) 4 *L* b) 2 *L* c) *L*/2 d) *L*/4
5. If coil is open, then *L* and *R* becomes
   a) infinity, zero b) zero, infinity c) infinity, infinity d) zero, zero
6. A transformer is used to light a 100 W and 110 V lamp from a 220 V mains. If the main current is 0.5 A, the efficiency of the transformer is approximately.
   a) 30% b) 50% c) 90% d) 10%

For question numbers 7-8 two statements are given - one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

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

c) Assertion (A) is true but Reason (R) is false.

d) Assertion (A) is false but Reason (R) is true.

7. Assertion (A) : An alternating current shows magnetic effect.

   Reason (R) : Magnitude of alternating current varies with time.

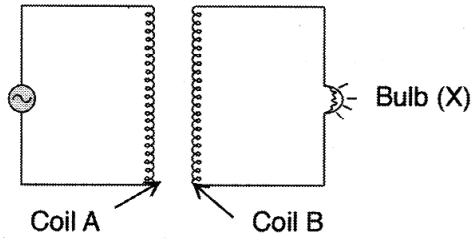
8. Assertion (A) : An electric heater is heated first by direct and then by alternating currents. For both the currents, the potential difference across the ends of the heater is the same. The rate of production of heat will be different in two cases.

   Reason (R) : The resistance of a coil in alternating current will be more than the resistance of a coil in direct current, hence heat produced in case of direct current will be low.

SECTION - B **2 × 2 = 4**

9. A lamp is connected in series with a capacitor. Predict your observation when this combination is connected in turn across (*i*) ac source and (*ii*) a 'dc' battery. What change would you notice in each case if the capacitance of the capacitor is increased?

10. The figure given shows an arrangement by which current flows through the bulb (X) connected with coil B, when a.c. is passed through coil A.



    i) Name the phenomenon involved.

    ii) If a copper sheet is inserted in the gap between the coils, explain, how the brightness of the bulb would change.

OR

Show that the current leads the voltage in phase by $\pi/2$ in an AC circuit containing an ideal capacitor.

SECTION - C **3 × 3 = 9**

11. Define root mean square current. Also, obtain its expression.

12. a) For a given ac, $i = i_m \sin \omega t$ show that the average power dissipated in a resistor *R* over a complete cycle is $\frac{1}{2} i_m^2 R$.

    b) A light bulb is rated at 100 W for a 220 V ac supply. Calculate the resistance of the bulb.

OR

A voltage V = V_m sin ωt is applied across an inductor. Determine the average power dissipated over a cycle. And, hence define wattless current.

13. A capacitor is fully charged. It is allowed to discharge through an inductor. Draw graphs showing variation of

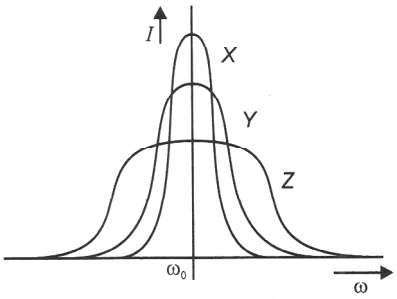
    i) energy stored in the capacitor.

    ii) energy stored in the inductor.

    iii) the total energy with time. **3**

SECTION - D **2 × 5 = 10**

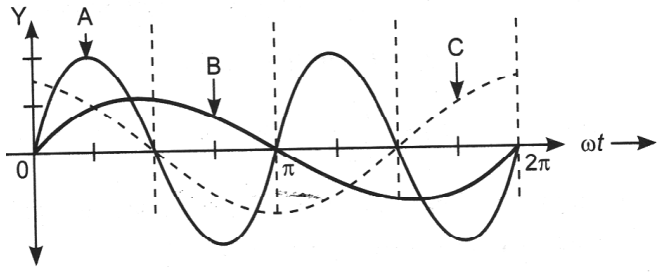
14. Three students X, Y, Z performed an experiment for studying the variation of alternating currents with angular frequency in a series LCR circuit and obtained the graphs shown below. They all used AC sources of the same rms value and inductances of the same value.



What can we (qualitatively) conclude about the (i) capacitance values (ii) resistance used by them? In which case will the quality factor be maximum?

What can we conclude about nature of the impedance of the set up at the frequency ω_0?

15. A device X is connected to an AC source V = V_0 sin ωt. The variation of voltage, current and power in one cycle is shown in the following graph.



a) Identify the device X.

b) Which of the curves A, B and C represent the voltage, current and the power consumed in the circuit? Justify your answer.

c) How does its impedance vary with frequency of the AC source? Show graphically.

d) Obtain an expression for the current in the circuit and its phase relation with AC voltage.

OR

Draw a schematic diagram of a step-up transformer. Explain its working principle. Deduce the expression for the secondary to primary voltage in terms of the number of turns in the

two coils. In an ideal transformer, how is this ratio related to the currents in the two coils? How is the transformer used in large scale transmission and distribution of electrical energy over long distance?

SECTION - E

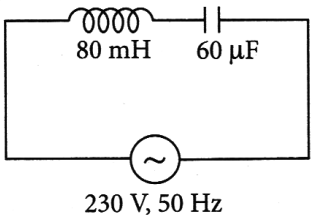
Case Study

15. The power averaged over one full cycle of a.c. is known as average power. It is also known as true power.

$$P_{av} = V_{rms}\, I_{rms} \cos\phi = \frac{V_0 I_0}{2} \cos\phi$$

Root mean square or simply rms watts refer to continuous power.

A circuit containing a 80 mH inductor and a $60\,\mu F$ capacitor in series is connected to a 230 V, 50 Hz supply. The resistance of the circuit is negligible.



i) Find the average power transferred to

a) inductor b) capacitor **2**

OR

Find the value of the current amplitude.

ii) Find the rms value of the current. **1**

iii) What is the total average power absorbed by the circuit? **1**