INDIAN SCHOOL AL WADI AL KABIR		
Class: XII	**DEPARTMENT: SCIENCE 2024 2025** **SUBJECT: PHYSICS**	**DATE: 09-09-2024**
WORKSHEET NO: 7 WITH ANSWERS	**TOPIC: ALTERNATING CURRENT**	**NOTE: A4 FILE FORMAT**
NAME OF THE STUDENT:	**CLASS & SEC:**	**ROLL NO.**

COMPETENCY BASED QUESTIONS; - [1 MARK]

1 The peak value of an alternating e.m.f. which is given by $E = E_0 \cos\omega t$ is 10 volts and its frequency is 50 Hz. At time $t = \frac{1}{600}$ s, the instantaneous e.m.f. is

(1) 10 V (2) $5\sqrt{3}$ V (3) 5 V (4) 1V

2 If an A.C. main supply is given to be 220 V. What would be the average e.m.f. during a positive half cycle :-

(1) 198 V (2) 386 V

(3) 256 V (4) None of these

3 For an alternating current $I = I_0 \cos\omega t$, What is the rms value and peak value of current :-

(1) $I_0, \frac{I_0}{\sqrt{2}}$ (2) $\frac{I_0}{\sqrt{2}}, I_0$

(3) $I_0, \frac{I_0}{2}$ (4) $2I_0, \frac{I_0}{\sqrt{2}}$

4 A capacitor of capacity C and reactance X if capacitance and frequency become double then reactance will be :–

(1) 4X (2) $\frac{X}{2}$

(3) $\frac{X}{4}$ (4) 2X

5 The impedence of a circuit, when a resistance R and an inductor of inductance L are connected in series in an A.C. circuit of frequency (f) is :-

(1) $\sqrt{R + 4\pi fL^2}$ (2) $\sqrt{R + 4\pi^2 f^2 L^2}$

(3) $\sqrt{R^2 + 4\pi^2 f^2 L^2}$ (4) $\sqrt{R^2 + 2\pi^2 f^2 L^2}$

6 The inductive reactance of an inductive coil with $\frac{1}{\pi}$ henry and 50 Hz :–

(1) $\frac{50}{\pi}$ ohm (2) $\frac{\pi}{50}$ ohm

(3) 100 ohm (4) 50 ohm

7 Which is not correct for average power P at resonance :

(1) $P=I_{rms}\,V_{rms}$

(2) $P = \frac{V}{\sqrt{2}}\frac{I}{\sqrt{2}}$

(3) P=VI

(4) $P=I^2_{rms}\,R$

8 A bulb and a capacitor are connected in series to a source of alternating current. If its frequency is increased, while keeping the voltage of the source constant, then

(1) Bulb will give more intense light.

(2) Bulb will give less intense light.

(3) Bulb will give light of same intensity as before

(4) Bulb will stop radiating light.

9 At resosnance in a series LCR circuit, which of the following statements is true:-

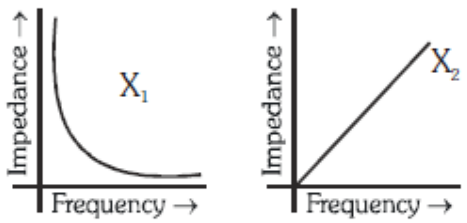
(1) Current in the circuit is maximum and phase difference between E and I is $\pi/2$

(2) Current in the circuit is maximum and phase difference between E and I is zero

(3) Voltage is maximum and phase difference between E and I is $\pi/2$

(4) Current is minimum and phase difference between E and I is zero

10. The graphs given below depict the dependence of two reactive impedances X_1 and X_2 on the frequency of the alternating e.m.f. applied individually to them. We can then say that :



(1) X_1 is an inductor and X_2 is a capacitor

(2) X_1 is a resistor and X_2 is a capacitor

(3) X_1 is a capacitor and X_2 is an inductor

(4) X_1 is an inductor and X_2 is a resistor

11. In a series LCR circuit, resonant frequency depends on

(a) $\frac{L}{C}$ (b) $\frac{1}{\sqrt{LC}}$ (c) $\sqrt{LC}$ (d) $\sqrt{\frac{L}{C}}$

12. For an LCR circuit, the power transfer from the driving source to the driving oscillator is $P = I^2Z\cos\varphi$. Which of the following is incorrect?

(a) Here, the power factor $\cos\varphi \geq 0$, $P = \geq 0$.

(b) The driving force can give no energy to the oscillator (P = 0) in some cases.

(c) The driving force cannot syphon out(P<0) the energy out of oscillator.

(d) The driving force can take away energy out of the oscillator.

13. Choose the correct statement

(a) A capacitor can conduct a dc circuit but not an inductor.

(b) In a dc circuit the inductor can conduct but not a capacitor.

(c) In ac circuit both the inductor and capacitor cannot conduct.

(d) The inductor has infinite resistance in a dc circuit.

14. A coil of self-inductance 'L' is connected in series with a bulb B and an ac source. Brightness of the bulb decreases when

(a) frequency of the ac source is decreased.

(b) number of turns in the coil is reduced.

(c) the capacitance of reactance $X_C = X_L$ in included.
(d) an iron rod is inserted in the coil.

15. The reactance of the capacitor C is X. If both the frequency and capacitance be doubled, then new reactance will be

(a) X (b) 2X (c) 4X (d) X/4

ANSWERS OF MCQs; -1. (3),2. (4), 3. (2), 4. (2), 5. (3), 6. (3), 7. (3), 8. (1), 9. (2), 10. (3), 11. (b), 12. (a), 13. (b), 14. (a), 15. (d),

NUMERICALS: -[2 MARKS]

1. A circuit is set up by connecting inductance L= 100 mH, resistor R = 100 Ω, and capacitor of reactance 200 Ω in series. An alternating emf $150\sqrt{2}$ V, $500/\pi$ Hz is applied across this series combination. Calculate the power dissipated in the resistor.

HINTS: - $Z = \sqrt{(XL)2 + R2} = 100\sqrt{2}$ ohm.

$I = 1.5A$

$P = I^2R = 225W$.

2. In India domestic power supply is a 220 V, 50 Hz; while in USA it is 110 V, 50 Hz. Give one advantage and one disadvantage of 220 V supply over 110 V supply.

HINTS: - For transfer of power (=V×I) at higher voltage (220 V instead of 110 V), current carried by wires is just half. Therefore, such wires need not be very thick, saving lot of transmission material and reducing the cost of transmission. This is one advantage of 220 V supply.

But to design a device of particular wattage,

$P=V^2R$, $P=V^2R$ as V^2 is 4 times, R must be four times.

If not, the dissipation or power in the form of heat will be larger on 220 V supply. This is one disadvantage of this supply.

3. In a series LCR circuit with an ac source of effective voltage 50 V, frequency $\nu = 50/\pi$ Hz, R = 300 Ω, C = 20 μF and L = 1.0 H. Find the rms current in the circuit.

HINTS: - find impedance, and then, I = V/Z.

4. A series LCR circuit is connected to an ac source (200 V, 50 Hz). The voltage across the resistor, capacitor and inductor are respectively 200 V, 250 V and 250 V. (i) The algebraic sum of voltages across the three elements is greater than the voltage of the source. How is this paradox resolved?

(ii) Given the value of resistor of R = 40 Ω, calculate the current in the circuit.

HINTS: - (i) voltage drop at inductor is equal and opposite to that of voltage drop at capacitor. Also, by using phasor diagram.

(ii) I = V/R = 5A.

5. (i) An alternating voltage given by V = 140 sin314t is connected across a pure resistor of 50 Ω. Find (a) the frequency of the source. (b) the rms current through the resistor.

(ii) How much current is drawn by the primary coil of a transformer which steps down 220 V to 22 V to operate a device with an impedance of 220 Ω?

HINTS: - (i)(a) 100 Hz (b) 2A,

(ii) current drawn in secondary coil IS = 22/220 = 0.1 A.

Power in primary = power in secondary

$V_sI_s = V_pI_p$

$I_s = V_pI_p / V_s = 0.001A$.

SHORT ANSWERS TYPE QUESTIONS: -[2 MARKS]

1. Show that the current leads the voltage in phase by π/2 in ac circuit containing an ideal capacitor.

Hints: - refer to note book.

2. In a series LCR circuit, obtain the conditions under which (i) the impedance of the circuit is minimum, and (ii) wattless current flows in the circuit.

Hints: - refer to note book.

3. What is meant by back emf in a motor?

Hints: -it is the emf induced in the coil of a motor as it rotates in the magnetic field. It opposes the rotation of the coil in magnetic field.

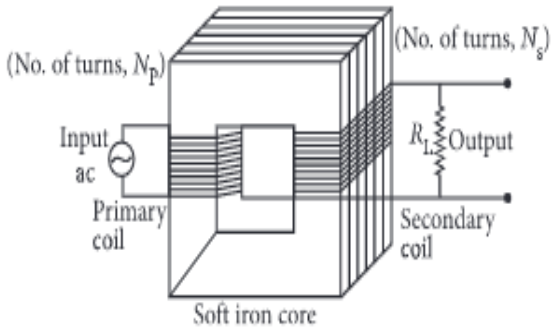
4. What is the use of a motor starter?

Hints: - A motor starter is a variable resistance. When the motor is switched on, the starter offers maximum resistance so that a small current flow through the motor coil in the absence of back emf. This prevents damage to the motor when it is switched on.

CASE STUDY BASED QUESTIONS [4 MARKS]

Transformer

A transformer is an electrical device which is used for changing the a.c. voltages. It is based on the phenomenon of mutual induction *i.e.* whenever the amount of magnetic flux linked with a coil changes, an e.m.f. is induced in the neighbouring coil. For an ideal transformer, the resistances of the primary and secondary windings are negligible.



It can be shown that $\frac{E_s}{E_p} = \frac{I_p}{I_s} = \frac{n_s}{n_p} = k$

where the symbols have their standard meanings.

For a step up transformer, $n_s > n_p; E_s > E_p; k > 1; \ \therefore \ I_s < I_p$

For a step down transformer, $n_s < n_p; E_s < E_p; k < 1$

The above relations are on the assumptions that efficiency of transformer is 100%.

Infact, efficiency $\eta = \frac{\text{output power}}{\text{intput power}} = \frac{E_s I_s}{E_p I_p}$

(i) Which of the following quantity remains constant in an ideal transformer?
(a) Current (b) Voltage (c) Power (d) All of these

(ii) Transformer is used to
(a) convert ac to dc voltage (b) convert dc to ac voltage
(c) obtain desired dc power (d) obtain desired ac voltage and current

(iii) The number of turns in primary coil of a transformer is 20 and the number of turns in a secondary is 10. If the voltage across the primary is 220 ac V, what is the voltage across the secondary?
(a) 100 ac V (b) 120 ac V (c) 110 ac V (d) 220 ac V

(iv) In a transformer the number of primary turns is four times that of the secondary turns. Its primary is connected to an a.c. source of voltage *V*. Then
(a) current through its secondary is about four times that of the current through its primary.
(b) voltage across its secondary is about four times that of the voltage across its primary.
(c) voltage across its secondary is about two times that of the voltage across its primary.
(d) voltage across its secondary is about $\frac{1}{2\sqrt{2}}$ times that of the voltage across its primary.

ANSWERS
[i]c
[ii]d
[iii]c
[iv]a

LONG ANSWERS TYPE QUESTIONS: [5 MARKS]

1. (i) What is impedance?
(ii) A series LCR circuit is connected to an ac source having voltage $V = V_o \sin\omega t$. Derive expression for the impedance, instantaneous current and its phase relationship to the applied voltage. Find the expression for resonant frequency.

2.Describe briefly with the help of a labelled diagram the basic elements of an ac generator.
Hints: - refer to notebook.

3.State its underlying principle.
Show diagrammatically how an alternating emf is generated by a loop of wire rotating in a magnetic field.
Write the expression for the instantaneous value of the emf induced in the rotating loop.
Hints: - refer to notebook.

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