INDIAN SCHOOL MUSCAT

CLASS : XII

SUBJECT: PHYSICS

WORKSHEET-7

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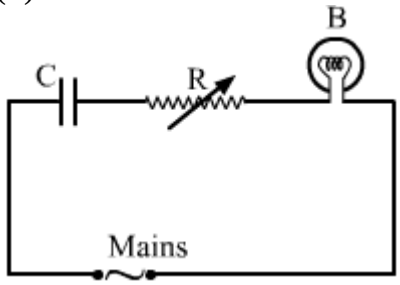
CHAPTER 7. ALTERNATING CURRENT

SECTION A CONCEPTUAL AND APPLICATION TYPE QUESTIONS

1 The instantaneous current and voltage of a.c. circuit are given by i = 10 sin 300 t A ,and v = 200 sin 300 t V. What is power dissipation in the circuit?

2 Why is the use of A.C. voltage preferred over D.C. voltage? Give two reasons.

3 A capacitor 'C', a variable resistor 'R' and a bulb 'B' are connected in series to the ac mains in circuit as shown. The bulb glows with some brightness. How will the glow of the bulb change if:
(i) A dielectric slab is introduced between the plates of the capacitor, keeping resistance R to be the same:
(ii) The resistance R is increased keeping the same capacitance?



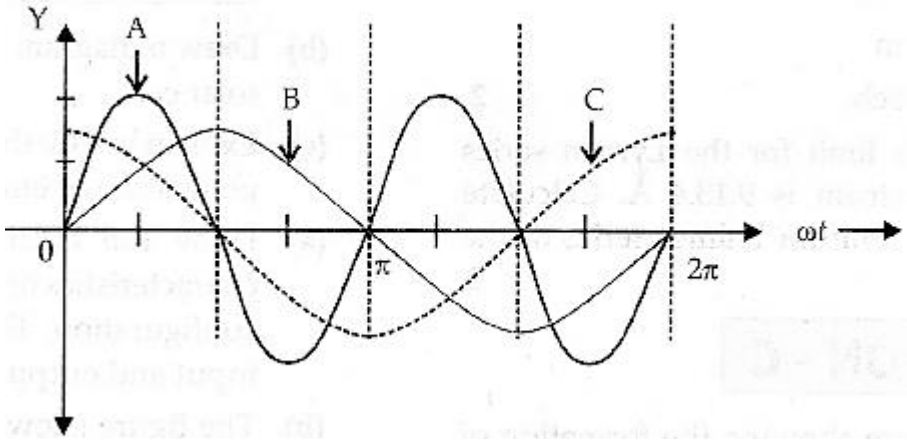
4 What is the significance of power factor in i) electrical appliances ii) transmission of electric power?

5 A copper coil L wound on a soft iron core and a lamp B is connected to a battery E through a tap key K. when the key is closed, the lamp glows dimly .But when the key is suddenly opened, the lamp flashes for an instant to much greater brightness . Explain.

6 A bulb B and an inductor L are connected in series to the AC mains. The bulb glows with some brightness. How will the glow of the bulb change when a i) a soft iron core ii) bismuth core is introduced inside the inductor? Give reasons.

7 A device 'X' is connected to an ac source $\boldsymbol{V} = \boldsymbol{V_0} \sin \omega t$. 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.



8 Prove that an ideal inductor does not dissipate power in an a. c. circuit.

9 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 distances?

10 A voltage V= V_0 sin ωt is applied to a series LCR circuit. Derive the expression for the average power dissipated over a cycle. Under what condition (i) no power is dissipated even though the current flows through the circuit? (ii) Maximum power is dissipated in the circuit?

11 In a series LCR circuit connected to an ac source of variable frequency and voltage $\boldsymbol{v = v_m sin\ \omega t}$ draw a plot showing the variation of current (I) with angular frequency (ω) for two different values of resistance $\boldsymbol{R_1}$ and $\boldsymbol{R_2}$ ($\boldsymbol{R_1 > R_2}$). Write the condition under which the phenomenon of resonance occurs. For which values of the resistance out of the two curves, a sharper resonance is produced? Define Q-factor of the circuit and give its significance.

12 A bulb B and a capacitor C are connected in series to the AC mains. The bulb glows with some brightness. How will the glow of the bulb change when a dielectric slab is introduced between the plates of the capacitor? Give reasons.

13 (a) For circuits used for transporting electric power, a low power factor implies large power loss in transmission. Explain.
(b) Power factor can often be improved by the use of a capacitor of appropriate capacitance in the circuit. Explain.

14 A lamp is connected in series with a capacitor. Predict your observations for dc and ac connections. What happens in each case if the capacitance of the capacitor is reduced?

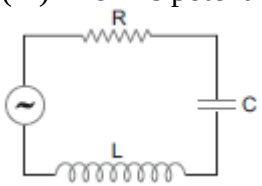
SECTION B NUMERICAL PROBLEMS

1 A 100 μF capacitor in series with a 40 ohm resistance is connected to a 100 V, 60 Hz supply calculate (i) the reactance (ii) the impedance (iii) maximum current in the circuit.

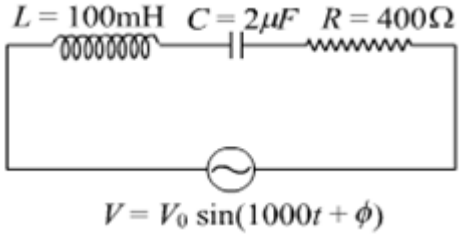
2 An inductor 200mH, capacitor 500μF, resistor 10Ω are connected in series with a 100 V variable frequency a.c. source. Calculate the:
(i) frequency at which the power factor of the circuit is unity
(ii) current amplitude at this frequency
(iii) Q-factor

3 Obtain the resonant frequency ω_r of a series LCR circuit with L = 2.0H, C=32 μF and R = **10 Ω**. What is Q-value of this circuit?

4 The figure shows a series LCR circuit with L = 5.0 H, C = 80 μF, R = 40 ohm connected to a variable frequency 240 V source. Calculate
(i) The angular frequency of the source which drives the circuit at resonance.
(ii) The current at the resonating frequency.
(iii) The rms potential drop across the capacitor at resonance.

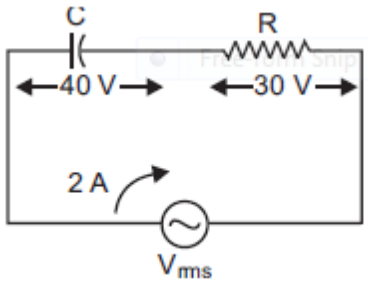


5 (i) Find the value of the phase difference between the current and the voltage in the series LCR circuit shown below. Which one leads in phase: current or voltage ?
(ii) Without making any other change, find the value of the additional capacitor C_1, to be connected in parallel with the capacitor C, in order to make the power factor of the circuit unity.



6 An a.c. source generating a voltage $v = v_m \sin \omega t$ is connected capacitor of capacitance C. find the expression for the current, *i* , through it. Plot a graph of *v* and *I* versus t to show that the current is $\pi/2$ ahead of the voltage.
A resistor of 200 **Ω** and a capacitor of **15. 0** μF Fare connected in series to a 220 V, 50 Hz a.c. 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.

7 Calculate the (i) impedance, (ii) wattless current of the given a.c. circuit.

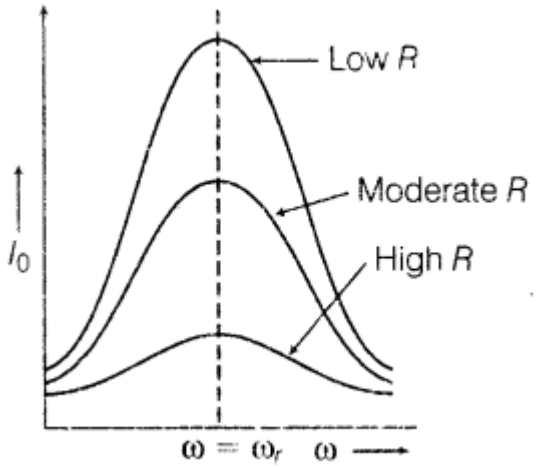


8 In an ideal transformer, the number of turns in the primary and secondary are 200, 1000 respectively. If the input at primary is 10kW-200V, calculate the i) output voltage ii) current in the primary coil.

9 A power transmission line feeds input power at 2300 V to a step down transformer with its primary windings having 4000 turns. What should be the number of turns in the secondary in order to get output power at 230 V?

10 At a hydroelectric power plant, the water pressure head is at a height of 300 m and the water flow available is 100 m^3s^{-1}. If the turbine generator efficiency is 60%, estimate the electric power available from the plant (g = 9.8 ms^{-2}).

11 (i) What do you understand by 'sharpness of resonance' for a series LCR resonant circuit? How is it related with the quality factor 'Q' of the circuit? Using the graphs given in the diagram, explain the factors which affect it. For which graph is the resistance (R) minimum?



(ii) A 2μF capacitor, 100Ω resistor and 8H inductor are connected in series with an ac source. Find the frequency of the ac source for which the current drawn in the circuit is maximum. If the peak value of emf of the source is 200V, calculate the maximum current and inductive and capacitive reactance of the circuit at resonance.