# PRACTICE MCQs

CLASS 12 PHYSICS (TERM - I)

## ALTERNATING CURRENT

BY

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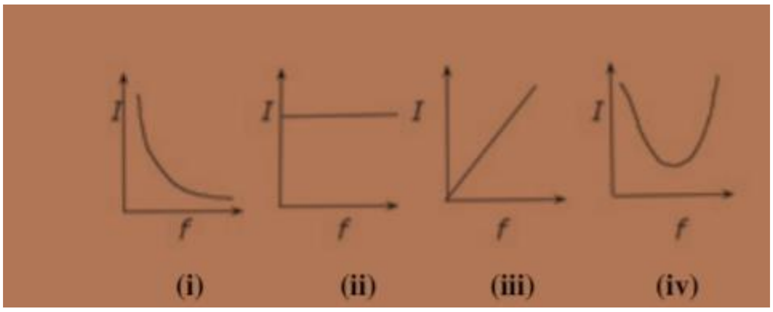
learning simplified

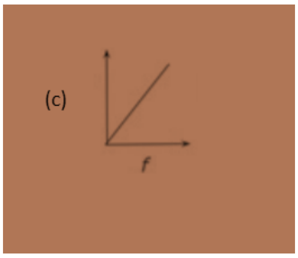
**Question 1:**
Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon the
(a) rate at which current change in the two coils
(b) relative position and orientation of the coils
(c) rate at which voltage induced across two coils
(d) currents in the two coils

**Answer: (b) relative position and orientation of the coils**
Mutual inductance of a pair of two coils depends on the relative position and orientation of two coils, other statements are incorrect.

**Question 2:**
Which of the following graphs represent the variation of current (I) with frequency (f) in an AC circuit containing a pure capacitor?




**Answer:**
$I = (V/X_C)$ in Pure Capacitor
$= (V/1/2\pi fc)$
I α f other parameters kept constant




**Question 3:**
The instantaneous values of emf and the current in a series ac circuit are-
$E = E_o \sin \omega t$ and $I = I_o \sin(\omega t + \pi/3)$ respectively, then it is
(a) Necessarily a RL circuit
(b) Necessarily a RC circuit
(c) Necessarily a LCR circuit
(d) Can be RC or LCR circuit

**Answer: (d) Can be RC or LCR circuit**

$E = E_0 \sin \omega t$

$I = I_0 \sin t + (\omega t + (\pi /3))$

as I can lead the Voltage in RC and LCR circuit, so it can be RC or LCR circuit.

**Question 4:**

An alternating voltage source of variable angular frequency 'w' and fixed amplitude 'V' is connected in series with a capacitance C and electric bulb of resistance R(inductance zero). When 'w' is increased-

(a) The bulb glows dimmer.

(b) The bulb glows brighter.

(c) Net impedance of the circuit remains unchanged.

(d) Total impedance of the circuit increases.

**Answer: (b) The bulb glows brighter.**

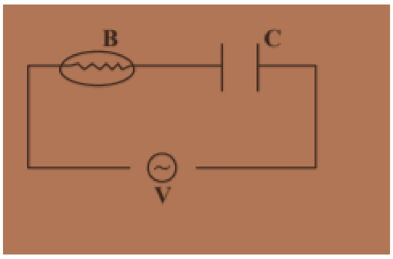
As$\omega$ increases ,

Therefore, $X_c = (1/2\pi fc)$

As $(1/\omega c)$ decreases therefore, $X_c$ decreases.

As a result, current increases

Therefore, brightness of the bulb increases.




**Question 5:**

In a pure capacitive circuit if the frequency of ac source is doubled, then its capacitive reactance will be

(a) remains same

(b) doubled

(c) halved

(d) zero

**Answer: (c) halved**

Capacitive reactance, $X_C = (1)/(2\pi \upsilon C)$

Or $X_C \propto (1/\upsilon)$

If $\upsilon$ is doubled, $X_C$ will be halved.

**Question 6:**
The electric mains supply in our homes and offices is a voltage that varies like a sine function with time such a voltage is called … A… and the current driven by it in a circuit is called the … B… Here, A and B refer to
(a) DC voltage, AC current
(b) AC voltage, DC current
(c) AC voltage, DC voltage
(d) AC voltage, AC current

**Answer: (d) AC voltage, AC current**
The electric mains supply in our homes and offices is a voltage that varies like a sine function with time. Such a voltage is called alternating voltage and the current driven by it in a circuit is called the alternating current.

**Question 7:**
Phase difference between voltage and current in a capacitor in an ac circuit is
(a) π
(b) π/2
(c) 0
(d) π/3

**Answer: (b) π/2**
In a capacitive ac circuit, the voltage lags behind the current in phase by (π/2).

**Question 8:**
In tuning, we vary the capacitance of a capacitor in the tunning circuit such that the resonant frequency of the circuit becomes nearly equal to the frequency of the radio signal received. When this happens, the …A… with the frequency of the signal of the particular radio station in the circuit is maximum. Here A refers to
(a) resonant frequency
(b) impedance
(c) amplitude of the current
(d) reactance

**Answer: (a) resonant frequency**
When this happens the amplitude of the current with the frequency of the signal of the particular radio station in the circuit is maximum.

**Question 9:**
The core of transformer is laminated to reduce
(a) flux leakage
(b) hysteresis
(c) copper loss
(d) eddy current

**Answer: (d) eddy current**
The core of a transformer is laminated to minimize the energy losses due to eddy currents.

**Question 10:**
An AC voltage source of variable angular frequency ω and fixed amplitude $V_0$ is connected in series with a capacitance C and an electric bulb of resistance R (inductance zero). When ω is increased then,
(a) The bulb glows dimmer
(b) The bulb glows brighter
(c) Total impedance of the circuit is unchanged
(d) Total impedance of the circuit increases

**Answer: (b) The bulb glows brighter**
In RC circuit, the impedance is
$Z = \sqrt{R^2 + (1/\omega^2C^2)}$,
$X_C = (1/\omega C)$
As ω increase, $X_C$ increases, so, $X_C$ increases Z decreases.
Since, Power ∝ (1/impedance)
Therefore, the bulb glow brighter.

**Question 11:**
A resistance R, inductance L and a capacitorC all are connected ina series with an AC supply. Theresistance of R is 16 Ω, and for a given frequency, the inductive reactance of L is 24 Ω,and capacitive reactanceof C is 12 Ω. If the current in the circuit is 5 A, what will be the impedance of the circuit?
(a) 20 Ω
(b) 10 Ω
(c) 100 Ω
(d) 0

**Answer: (a) 20 Ω**
Given, R = 16

$X_L = 24\ \Omega$
$X_C = 12\ \Omega$
I = 5A
$Z = \sqrt{R^2 + (X_L - X_C)^2}$
$= \sqrt{(16)^2 + (24 - 12)^2}$
$= 20\ \Omega$

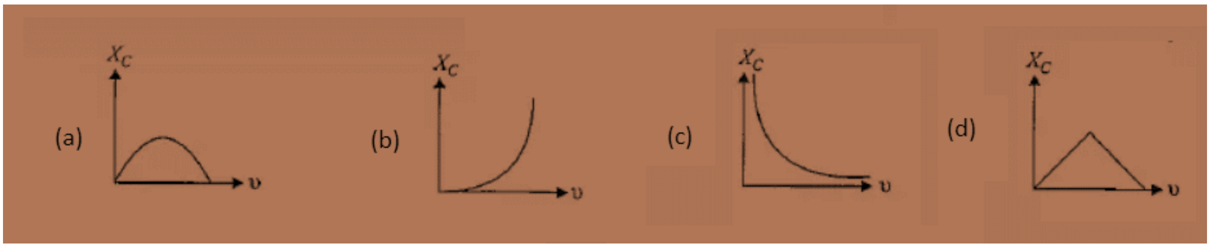
**Question 12:**
If the rms current in a 50 Hz ac circuit is 5 A, the value of the current 1/300 seconds after its value becomes zero is:
(a) 5√2 A
(b) 5(√3/2) A
(c) (5/6) A
(d) (5/√2) A

**Answer: (b) 5(√3/2)A**
The expression of sinusoidal current is $I = I_p \sin \omega t$
$I = (I_{rms} \times \sqrt{2}) \sin(2\pi \times 50 \times 1/300)$
$= 5\sqrt{2} \sin (\pi/3)$
$= 5\sqrt{2} \times (3\sqrt{2})$
$= 5(3\sqrt{2})$ A

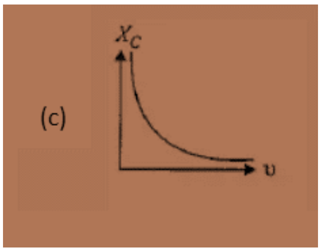
**Question 13:**
L, C and R represent physical quantities inductance, capacitance and resistance. Which of the following combination does not have the dimensions of frequency?
(a) (1/RC) and (R/L)
(b) (C/L)
(c) (1/√RC) and (√R/L)
(d) (1/√LC)

**Answer: (b) (C/L)**
Time constant of RL circuit is L/R Time constant of RC circuit is RC
So, $[1/RC] = [T^{-1}]$ and $[R/L] = [T^{-1}]$
have the dimension of frequency.
$[\sqrt{LC}) = [T^{-1}]$
is the dimension of frequency.
$[C/L] = [M^{-2}L^{-4}T^{6}T^{4}]$

**Question 14:**
Which one of the following graphs in figure represents variation of reactance '$X_c$' of a capacitor with frequency 'f' of an ac supply?




**Answer:**




Capacitive reactance
$X_C = (1/\omega C) = (1/2\pi\upsilon C)$
$X_C \times \upsilon$ = constant
With an increase in frequency, $X_C$ decreases.

**Question 15:**
Which of the following combinations should be selected for better tuning of at L-C-R circuit used for communication?
(a) R = 20 Ω, L = 1.5 H, C = 35 μF
(b) R = 25 Ω, L = 2.5 H, C = 45 μF
(c) R = 15 Ω, L = 3.5 H, C = 30 μF
(d) R = 25 Ω, L = 1.5 H, C = 45 μF

**Answer. (c) R = 15 Ω, L = 3.5 H, C = 30 μF**
Turning of an LCR circuit depends on quality factor of the circuit. Tuning will be better when quality factor of the circuit is high.
As, quality factor (Q) of an LCR circuit is given by,
$Q = (\omega_0 L/R)$
$= (1/\sqrt{LC})(1/R)$
$Q = (1/R)(\sqrt{L/C})$
For Q to be high, R and C should be small and L should be high.
$Q_1 = (1/20)(\sqrt{1.5})/(35 \times 10^{-6})$
$= 50 \times \sqrt{(3/70)}$
$= 10.35$
$Q_2 = (1/25)(\sqrt{2.5})/(45 \times 10^{-6})$
$= 40 \times \sqrt{(5/90)}$
$= 9.43$

$Q_3 = (1/15)(\sqrt{3.5})/(30 \times 10^{-6})$
$= (100/15)\sqrt{(35/3)}$
$= 22.77$
$Q_4 = (1/25)(\sqrt{1.5})/(45 \times 10^{-6})$
$= (40/\sqrt{(30)})$
$= 7.30$

**Question 16:**
The output of a step-down transformer is measured to be 24 V when connected to a 12-watt light bulb. The value of the peak current is
(a) (1/√2) A
(b) √2 A
(c) 2A
(d) 2√2 A

**Answer: (a) (1/√2) A**
Here, $V_s = 24$ V,
Power associated with secondary, $P_s = 12$ W
Current in the secondary,
$I_s = (P_s)/(V_s)$
$= (12)/(24)$
$= 0.5$ A
Peak value of the current in the secondary,
$I_0 = I_s\sqrt{2}$
$= (0.5)(1.414)$
$= 0.707$
$= (1/\sqrt{2})$ A

**Question 17:**
In an oscillating L–C circuit, the maximum charge on the capacitor is Q. The charge on the capacitor, when the energy is stored equally between the electric and magnetic field is:
(a) (Q/2)
(b) (Q/√2)
(c) (Q/√3)
(d) (Q/3)

**Answer: (b) (Q/√2)**
Let Q denote maximum charge on capacitor.
Let q denote charge when energy is equally shared.

Total energy stored = $(1/2)(Q^2/C)$
At any time, electrostatic energy is equal to magnetic energy.
$(1/2)(Q^2/C) = (1/2)(q^2/C) + (1/2)LI^2$ ..........(1)
As $(q^2/2C) = (LI^2/C)$
Therefore equation (1) becomes:-
$(1/2)(Q^2/C) = (q^2/C)$
Or $q = (Q/\sqrt{2})$
where q is the charge on capacitor at this instant.

## Assertion Reason Based Questions

**Questions from 18-23 are based on assertion reason questions.**
Given below are two statements labelled as Assertion (A) and Reason (R)
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not the correct explanation of A.
(c)A is true but R is false.
(d) A is false and R is also false.

**Question 18:**
**Assertion (A):** Capacitor serves as a block for dc and offers an easy path to ac.
**Reason (R):** Capacitive reactance is inversely proportional to frequency.

**Answer: (a) Both A and R are true and R is the correct explanation of A**
The capacitive reactance of capacitor is given by
$X_C = (1)/(\omega C)$
$= (1)/(2\pi fC)$
So, this is infinite for dc (f = 0) and has a very small value for ac.
Therefore, a capacitor blocks dc.

**Question 19:**
**Assertion (A):** An alternating current does not show any magnetic effect.
**Reason (R):** Alternating current varies with time.

**Answer: (b) Both A and R are true but R is not the correct explanation of A.**
An alternating current also produces magnetic field like in DC. But the magnitude and direction of the field goes on changing continuously with time.

**Question 20:**
**Assertion (A):** When ac circuit contain resistor only, its power is minimum.
**Reason (R):** Power of a circuit is independent of phase angle.

**Answer: (d) A is false and R is also false.**
The power of an ac circuit is given by P=EI cosϕ where cosϕ is power factor and f is phase angle. In case of circuit containing resistance only, phase angle is zero and power factor is equal to one. Therefore, power is maximum in case of circuit containing resistor only.

**Question 21:**
**Assertion (A):** In a series LCR circuit, at resonance condition power consumed by circuit is maximum.
**Reason (R):** Average power consumed by capacitor and inductor is zero.

**Answer: (a) Both A and R are true and R is the correct explanation of A**
For ideal inductors and capacitors there will be no dissipation of energy. They first take energies and then release them again for an AC circuit.
But in resistors there is dissipation of energy which equals $i^2R$
Average power consumed in an ac circuit is equal to average power consumed by resistors in the circuit.

**Question 22:**
**Assertion (A):** The electrostatic energy stored in capacitor plus magnetic energy stored in inductor will always be zero in series LCR circuit driven by ac voltage source under condition of resonance.
**Reason (R):** The complete voltage of ac source appears across the resistor in a series LCR circuit driven by ac voltage source under condition of resonance.

**Answer: (d) A is false and R is also false.**
In resonance condition when energy across capacitor is maximum, energy stored in a inductor is 0, vice-versa is also true.

**Question 23:**
**Assertion (A):** At resonance power, factor is maximum.
**Reason (R):** The value of power factor will be -1.

**Answer: (c) A is true but R is false.**
At resonance power factor is maximum. It is given by
cos ϕ = (Z/R)

= (R/R)
= 1
Maximum power is dissipated at resonance.

## Case Study Based Questions

**Question 24:**
Read the following paragraph and answers the questions:
The large-scale transmission and distribution of electrical energy over long distances are done with the use of transformers. The voltage output of the generator is stepped-up. It is then transmitted over long distances to an area sub-station near the consumers. There the voltage is stepped down. It is further stepped down at distributing sub-stations and utility poles before a power supply of 240 V reaches our homes.

1) Which of the following statement is true?
(a) Energy is created when a transformer steps up the voltage
(b) A transformer is designed to convert an AC voltage to DC voltage
(c) Step–up transformer increases the power for transmission
(d) Step–down transformer decreases the AC voltage

2) If the secondary coil has a greater number of turns than the primary,
(a) the voltage is stepped-up ($V_s > V_p$ ) and arrangement is called a step-up transformer
(b) the voltage is stepped-down ($V_s < V_p$ ) and arrangement is called a step-down transformer
(c) the current is stepped-up ($I_s > I_p$ ) and arrangement is called a step-up transformer
(d) the current is stepped-down ($I_s < I_p$ ) and arrangement is called a step-down transformer

3) We need to step-up the voltage for power transmission, so that
(a) the current is reduced and consequently, the $I^2R$ loss is cut down
(b) the voltage is increased , the power losses are also increased
(c) the power is increased before transmission is done
(d) the voltage is decreased so $V_2/R$ losses are reduced

4) A power transmission line feeds input power at 2300 V to a step down transformer with its primary windings having 4000 turns. The number of

turns in the secondary in order to get output power at 230 V are
(a) 4
(b) 40
(c) 400
(d) 4000

5) A transformer is based on the principle of
(a) mutual induction
(b) self-induction
(c) Ampere's law
(d) X-ray crystallography

**Answer:**

**1) (d) Step–down transformer decreases the AC voltage**
AC Voltage is decreased by step-down transformer.

**2) (a) the voltage is stepped-up ($V_s$>$V_p$ ) and arrangement is called a step-up transformer**
$(N_s/N_p) = (E_s/E_P)$
i.e., if no. of turns in secondary coil are more than no. of turns in primary, then voltage is increased or stepped up in secondary, so-called step-up transformer.

**3) (a) the current is reduced and consequently, the $I^2R$ loss is cut down**
i.e. current is reduced if voltage is stepped – up so corresponding $I^2R$ losses are cut down.

**4) (c) 400**
Given, $E_i$ = 2300V
$E_O$ = 230V
$N_P$ = 4000
$(E_i/E_O) = (N_P/N_S)$
(2300/230) = (4000/x)
Therefore, x = 400 = $N_S$ = number of turns in secondary coil.

**5) (a) mutual induction**
A transformer is based on the principle of Mutual inductance.

**Question 25:**
An LC circuit also called a resonant circuit, tank circuit or tuned circuit is an electric circuit consisting of an inductor represented by the letter L and a capacitor, represented by the letter C connected together. An LC circuit is an idealized model since it assumes there is no dissipation of energy due to resistance.
An LC circuit contains a 20 mH inductor and a 50 μF capacitor with an initial charge of 10 mC. The resistance of the circuit is negligible. Let the instant the circuit is closed be t = 0.

1) The total energy stored initially is
(a) 5 J
(b) 3 J
(c) 10 J
(d) 1 J

2) The natural frequency of the circuit is
(a) 159.24 Hz
(b) 200.12 Hz
(c) 110.25 Hz
(d) 95 Hz

3) At what time is the energy stored completely electrical?
(a) T, 5T, 9T
(b) (T/2), (5T/2), (9T/2)
(c) 0, T, 2T, 3T
(d) 0, (T/2), T, (3T/2)

4) At what time is the energy stored completely magnetic?
(a) (T/2), (3T/2), (T/4)
(b) (T/3), (T/9), (T/12)
(c) 0, 2T, 3T
(d) (T/4), (3T/4), (5T/4)

5) If a resistor is inserted in the circuit, how much energy is eventually dissipated as heat?
(a) 200 J
(b) 1 J
(c) 60 J
(d) 50 J

**Answer:**

**1) (d) 1 J**

Given:

Inductance of the inductor, $L = 20\ mH = 20 \times 10^{-3}\ H$

Capacitance of the capacitor, $C = 50\ \mu F = 50 \times 10^{-6}\ F$

Initial charge on the capacitor, $Q = 10\ mC = 10 \times 10^{-3}\ C$

Total energy stored initially in the circuit is given as:

$E = (1/2)\ (Q^2/C)$

$= (10 \times 10^{-3})^2/(2 \times 50 \times 10^{-6})$

$= 1\ J$

Hence, the total energy stored in the LC circuit will be conserved because there is no resistor connected in the circuit.

**2) (a) 159.24 Hz**

Natural frequency of the circuit is given by the relation,

$f = (1/2\pi\sqrt{LC})$

$= (1/2\pi\sqrt{20 \times 10^{-3} \times 50 \times 10^{-6}})$

$= (10^3)/(2\pi)$

$= 159.25\ Hz$

**3) (d) 0, (T/2), T, (3T/2)**

At any instant of energy stored in the circuit is completely the electrical energy on the capacitor.

$Q' = Q \cos \omega t$

For time period $T = (1/\nu) = (1/159.24) = 6.28\ ms^{-1}$

Total charge on capacitor at time t is

$Q' = Q \cos(2\pi/T)t$

For energy stored to be electrical then $Q' = Q$

Therefore, energy stored in the capacitor is completely electrical at time

$t = 0, (T/2), T, (3T/2), \ldots\ldots$

**4) (d) (T/4), (3T/4), (5T/4)**

Magnetic energy is maximum when the electrical energy is zero. $Q' = 0$.

Therefore, energy stored in the capacitor is completely magnetic at that time,

$t = (T/4), (3T/4), (5T/4), \ldots\ldots$

**5) (b) 1 J**

If a resistor is inserted in the circuit, then total initial energy is dissipated as heat energy in the circuit. The resistance damps out the LC oscillation.

The energy stored initially is

$E = (Q^2/2C)$

$= (10 \times 10^{-3})^2/(2 \times 50 \times 10^{-6})$

$= 1$ Joules

When the resistor is inserted in the circuit, it will dissipate entire 1 J in heat.

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