

Alternating Current — NEET Physics PYQ (2005-2021)

Class 12 Physics · 27 real NEET & AIPMT questions, year-tagged · answers checked by RankUp

NEET 2021

1. A series LCR circuit containing 5.0 H inductor, 80 μF capacitor and 40 Ω resistor is connected to 230 V variable frequency ac source. The angular frequencies of the source at which power transferred to the circuit is half the power at the resonant angular frequency are likely to be :

- (A) 25 rad/s and 75 rad/s
- (B) 50 rad/s and 25 rad/s
- (C) 46 rad/s and 54 rad/s
- (D) 42 rad/s and 58 rad/s

NEET 2021

2. A step down transformer connected to an ac mains supply of 220 V is made to operate at 11 V, 44 W lamp. Ignoring power losses in the transformer, what is the current in the primary circuit ?

- (A) 0.2 A
- (B) 0.4 A
- (C) 2 A
- (D) 4 A

NEET 2020 · Q154

3. A 40 μF capacitor is connected to a 200 V, 50 Hz ac supply. The rms value of the current in the circuit is, nearly :

- (A) 1.7 A
- (B) 2.05 A
- (C) 2.5 A
- (D) 25.1 A

NEET 2020 · Q169

4. A series LCR circuit is connected to an ac voltage source. When L is removed from the circuit, the phase difference between current and voltage is $\pi/3$. If instead C is removed from the circuit, the phase difference is again $\pi/3$ between current and voltage. The power factor of the circuit is :

- (A) zero
- (B) 0.5
- (C) 1.0
- (D) -1.0

NEET 2018 · Q28

5. An inductor 20 mH, a capacitor 100 μF and a resistor 50 Ω are connected in series across a source of emf, $V = 10 \sin 314 t$. The power loss in the circuit is

- (A) 2.74 W
- (B) 0.43 W
- (C) 0.79 W
- (D) 1.13 W

NEET 2017 (Gujarati paper) · Q157

6. A bulb connected in series with an air-cored solenoid is lit by an a.c. source. If a soft iron core is introduced in the solenoid:

- (A) The bulb will glow brighter.
- (B) There is no change in glow of bulb.
- (C) The bulb will become dimmer
- (D) The bulb stops glowing.

NEET 2016 Phase 2 · Q30

7. Which of the following combinations should be selected for better tuning of an L-C-R circuit used for communication?

- (A) $R = 20\ \Omega$, $L = 1.5\ \text{H}$, $C = 35\ \mu\text{F}$
- (B) $R = 25\ \Omega$, $L = 2.5\ \text{H}$, $C = 45\ \mu\text{F}$
- (C) $R = 15\ \Omega$, $L = 3.5\ \text{H}$, $C = 30\ \mu\text{F}$
- (D) $R = 25\ \Omega$, $L = 1.5\ \text{H}$, $C = 45\ \mu\text{F}$

NEET 2016 Phase 2 · Q32

8. The potential differences across the resistance, capacitance and inductance are 80 V, 40 V and 100 V respectively in an L-C-R circuit. The power factor of this circuit is

- (A) 0.4
- (B) 0.5
- (C) 0.8
- (D) 1.0

NEET 2016 Phase 1 · Q43

9. A small signal voltage $V(t) = V_0 \sin \omega t$ is applied across an ideal capacitor C:

- (A) Current $I(t)$, lags voltage $V(t)$ by 90° .
- (B) Over a full cycle the capacitor C does not consume any energy from the voltage source.
- (C) Current $I(t)$ is in phase with voltage $V(t)$.
- (D) Current $I(t)$ leads voltage $V(t)$ by 180° .

AIPMT 2015

10. A resistance 'R' draws power 'P' when connected to an AC source. If an inductance is now placed in series with the resistance, such that the impedance of the circuit becomes 'Z', the power drawn will be:

- (A) P
- (B) $P(R/Z)^2$
- (C) $P\sqrt{R/Z}$
- (D) $P(R/Z)$

AIPMT 2014

11. A transformer having efficiency of 90% is working on 200 V and 3 kW power supply. If the current in the secondary coil is 6 A, the voltage across the secondary coil and the current in the primary coil respectively are:

- (A) 450 V, 15 A
- (B) 450 V, 13.5 A
- (C) 600 V, 15 A
- (D) 300 V, 15 A

NEET 2013

12. 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) a capacitance of reactance $X_C = X_L$ is included in the same circuit
- (D) an iron rod is inserted in the coil

AIPMT 2012 Mains

13. The instantaneous values of alternating current and voltage in a circuit are given as

$$i = (1/\sqrt{2}) \sin(100\pi t) \text{ ampere}$$

$$e = (1/\sqrt{2}) \sin(100\pi t + \pi/3) \text{ volt}$$

The average power in watts consumed in the circuit is

- (A) $1/4$
- (B) $\sqrt{3}/4$
- (C) $1/2$
- (D) $1/8$

AIPMT 2012 Prelims

14. In an electrical circuit R, L, C and an a.c. voltage source are all connected in series. When L is removed from the circuit, the phase difference between the voltage and the current in the circuit is $\pi/3$. If instead, C is removed from the circuit, the phase difference is again $\pi/3$. The power factor of the circuit is

- (A) $\sqrt{3}/2$
- (B) $1/2$
- (C) $1/\sqrt{2}$
- (D) 1

AIPMT 2011 Mains

15. A coil has resistance 30 ohm and inductive reactance 20 ohm at 50 Hz frequency. If an ac source of 200 volt, 100 Hz is connected across the coil, the current in the coil will be

- (A) $20/\sqrt{13}$ A
- (B) 2.0 A
- (C) 4.0 A
- (D) 8.0 A

AIPMT 2011 Prelims

16. In an ac circuit an alternating voltage $e = 200\sqrt{2} \sin 100t$ volts is connected to a capacitor of capacity $1 \mu\text{F}$. The r.m.s. value of the current in the circuit is

- (A) 20 mA
- (B) 10 mA
- (C) 100 mA
- (D) 200 mA

AIPMT 2011 Prelims

17. An ac voltage is applied to a resistance R and inductor L in series. If R and the inductive reactance are both equal to 3Ω , the phase difference between the applied voltage and the current in the circuit is

- (A) Zero
- (B) $\pi/6$
- (C) $\pi/4$
- (D) $\pi/2$

AIPMT 2010 Mains · Q81

18. A condenser of capacity C is charged to a potential difference of V_1 . The plates of the condenser are then connected to an ideal inductor of inductance L. The current through the inductor when the potential difference across the condenser reduces to V_2 is

- (A) $[C(V_1 - V_2)^2/L]^{(1/2)}$
- (B) $C(V_1^2 - V_2^2)/L$
- (C) $C(V_1^2 + V_2^2)/L$
- (D) $[C(V_1^2 - V_2^2)/L]^{(1/2)}$

19. A 220 volt input is supplied to a transformer. The output circuit draws a current of 2.0 ampere at 440 volts. If the efficiency of the transformer is 80%, the current drawn by the primary windings of the transformer is

- (A) 5.0 ampere
- (B) 3.6 ampere
- (C) 2.8 ampere
- (D) 2.5 ampere

20. Power dissipated in an LCR series circuit connected to an a.c. source of emf ε is:

- (A) $\varepsilon^2 \sqrt{[R^2 + (L\omega - 1/C\omega)^2]}/R$
- (B) $\varepsilon^2 [R^2 + (L\omega - 1/C\omega)^2]/R$
- (C) $\varepsilon^2 R / \sqrt{[R^2 + (L\omega - 1/C\omega)^2]}$
- (D) $\varepsilon^2 R / [R^2 + (L\omega - 1/C\omega)^2]$

21. In an a.c. circuit the e.m.f. (e) and the current (i) at any instant are given respectively by

$$e = E_0 \sin \omega t$$

$$i = I_0 \sin(\omega t - \phi)$$

The average power in the circuit over one cycle of a.c. is

- (A) $E_0 I_0$
- (B) $E_0 I_0 / 2$
- (C) $(E_0 I_0 / 2) \sin \phi$
- (D) $(E_0 I_0 / 2) \cos \phi$

22. 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 amp, the efficiency of the transformer is approximately

- (A) 50%
- (B) 90%
- (C) 10%
- (D) 30%

23. What is the value of inductance L for which the current is maximum in a series LCR circuit with $C = 10 \mu\text{F}$ and $\omega = 1000 \text{ s}^{-1}$?

- (A) 1 mH
- (B) cannot be calculated unless R is known
- (C) 10 mH
- (D) 100 mH

24. A transistor-oscillator using a resonant circuit with an inductor L (of negligible resistance) and a capacitor C in series produce oscillations of frequency f . If L is doubled and C is changed to $4C$, the frequency will be :

- (A) $f/4$
- (B) $8f$
- (C) $f/(2\sqrt{2})$
- (D) $2f$

25. The core of a transformer is laminated because :

- (A) energy losses due to eddy currents may be minimised
- (B) the weight of the transformer may be reduced
- (C) rusting of the core may be prevented
- (D) ratio of voltage in primary and secondary may be increased

26. A coil of inductive reactance $31\ \Omega$ has a resistance of $8\ \Omega$. It is placed in series with a condenser of capacitive reactance $25\ \Omega$. The combination is connected to an a.c. source of 110 V . The power factor of the circuit is :

- (A) 0.40
- (B) 0.128
- (C) 0.80
- (D) 0.66

27. In a circuit, L , C and R are connected in series with an alternating voltage source of frequency f . The current leads the voltage by 45° . The value of C is :

- (A) $1/[2\pi f(2\pi fL + R)]$
- (B) $1/[\pi f(2\pi fL + R)]$
- (C) $1/[2\pi f(2\pi fL - R)]$
- (D) $1/[\pi f(2\pi fL - R)]$

Answer key and explanations

1. Answer: (C) 46 rad/s and 54 rad/s

$\omega_0 = 1/\sqrt{LC} = 1/\sqrt{5 \times 80 \times 10^{-6}} = 1/0.02 = 50\text{ rad/s}$. Half-power frequencies are $\omega_0 \pm R/(2L) = 50 \pm 40/10 = 50 \pm 4$, i.e. 46 rad/s and 54 rad/s.

2. Answer: (A) 0.2 A

For an ideal transformer input power equals output power, 44 W. Primary current $= P/V = 44/220 = 0.2\text{ A}$. 4 A is the secondary (lamp) current, 44/11.

3. Answer: (C) 2.5 A

$X_C = 1/(2\pi fC) = 1/(2\pi \times 50 \times 40 \times 10^{-6}) \approx 79.6\ \Omega$, so $I_{\text{rms}} = V_{\text{rms}}/X_C = 200/79.6 \approx 2.5\text{ A}$. Taking 200 V as a peak value and dividing by $\sqrt{2}$ gives about 1.8 A, which is not what the rms supply rating means.

4. Answer: (C) 1.0

With L removed, $\tan(\pi/3) = X_C/R$; with C removed, $\tan(\pi/3) = X_L/R$. So $X_L = X_C$, the full LCR circuit is at resonance, $Z = R$ and the power factor $\cos \phi = R/Z = 1$. 0.5 is $\cos(\pi/3)$, the power factor of the reduced circuits, not of the full one.

5. Answer: (C) 0.79 W

$X_L = 314 \times 0.02 = 6.28\ \Omega$, $X_C = 1/(314 \times 10^{-4}) = 31.85\ \Omega$, $Z = \sqrt{50^2 + 25.57^2} \approx 56.2\ \Omega$. $I_{\text{rms}} = (10/\sqrt{2})/56.2 \approx 0.126\text{ A}$, so $P = I_{\text{rms}}^2 R \approx 0.79\text{ W}$. Using peak instead of rms current doubles the power.

6. Answer: (C) The bulb will become dimmer

Soft iron raises the permeability and hence the inductance L , so the inductive reactance ωL and the circuit impedance increase. The rms current falls and the bulb glows dimmer. It does not go out completely, because the impedance is still finite.

7. Answer: (C) $R = 15\ \Omega$, $L = 3.5\text{ H}$, $C = 30\ \mu\text{F}$

Better tuning means a sharper resonance, i.e. a larger quality factor $Q = (1/R)\sqrt{L/C}$. The values are about 10.4 for $20\ \Omega/1.5\text{ H}/35\ \mu\text{F}$, 9.4 for $25\ \Omega/2.5\text{ H}/45\ \mu\text{F}$, 22.8 for $15\ \Omega/3.5\text{ H}/30\ \mu\text{F}$ and 7.3 for $25\ \Omega/1.5\text{ H}/45\ \mu\text{F}$. The $15\ \Omega$, 3.5 H , $30\ \mu\text{F}$ combination has the highest Q .

8. Answer: (C) 0.8

Net voltage $V = \sqrt{(V_R)^2 + (V_L - V_C)^2} = \sqrt{80^2 + 60^2} = 100\text{ V}$. Power factor $\cos \phi = V_R/V = 80/100 = 0.8$. Taking the ratio of V_C to V_L or assuming resonance gives the other values.

9. Answer: (B) Over a full cycle the capacitor C does not consume any energy from the voltage source.

In an ideal capacitor the current leads the voltage by 90° , so the power factor $\cos 90^\circ = 0$ and the average power over a full cycle is zero: energy stored in one quarter-cycle is returned in the next.

Current lagging by 90° describes an ideal inductor, not a capacitor.

10. Answer: (B) $P(R/Z)^2$

Without L : $P = V^2/R$. With L , $I = V/Z$ and power $= I^2 R = V^2 R/Z^2 = (V^2/R)(R/Z)^2 = P(R/Z)^2$. $P(R/Z)$ misses that both current and power factor fall by R/Z .

11. Answer: (A) 450 V, 15 A

Primary current $= 3000/200 = 15\text{ A}$. Output power $= 0.9 \times 3000 = 2700\text{ W}$, so secondary voltage $= 2700/6 = 450\text{ V}$; ignoring efficiency gives 500 V, which is not offered.

12. Answer: (D) an iron rod is inserted in the coil

An iron rod increases the inductance L , raising $X_L = \omega L$ and the impedance, so the current and the bulb's brightness drop. Lowering the frequency, reducing the turns or adding a capacitor with $X_C = X_L$ all reduce the net reactance and make the bulb brighter.

13. Answer: (D) 1/8

Peak values are $1/\sqrt{2}$, so $I_{rms} = V_{rms} = 1/2$. The phase difference is $\pi/3$, so $P = V_{rms} \cdot I_{rms} \cdot \cos \phi = \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 1/8$ W. Using peak values instead of rms values gives a larger, wrong answer.

14. Answer: (D) 1

Removing L : $\tan(\pi/3) = X_C/R$; removing C : $\tan(\pi/3) = X_L/R$. So $X_L = X_C = \sqrt{3}R$ and with all three present the circuit is at resonance: $Z = R$, power factor $\cos \phi = 1$. $1/2$ is the power factor of each reduced circuit, not of the full RLC circuit.

15. Answer: (C) 4.0 A

Inductive reactance doubles with frequency: at 100 Hz $X_L = 40 \Omega$. $Z = \sqrt{(30^2 + 40^2)} = 50 \Omega$, so $I = 200/50 = 4$ A. Keeping $X_L = 20 \Omega$ gives $20/\sqrt{13}$ A, which is the trap.

16. Answer: (A) 20 mA

$V_{(rms)} = 200\sqrt{2}/\sqrt{2} = 200$ V and $\omega = 100$ rad/s, so $X_C = 1/(\omega C) = 1/(100 \times 10^{-6}) = 10^4 \Omega$. $I_{(rms)} = 200/10^4 = 0.02$ A = 20 mA. Using the peak voltage $200\sqrt{2}$ V would give about 28 mA, which is not the rms value.

17. Answer: (C) $\pi/4$

For a series LR circuit $\tan \phi = X_L/R = 3/3 = 1$, so $\phi = \pi/4$ with voltage leading the current. $\pi/2$ would apply only for a pure inductor.

18. Answer: (D) $[C(V_1^2 - V_2^2)/L]^{(1/2)}$

In the LC circuit energy is conserved: $\frac{1}{2}CV_1^2 = \frac{1}{2}CV_2^2 + \frac{1}{2}LI^2$. So $I = [C(V_1^2 - V_2^2)/L]^{(1/2)}$. Using $(V_1 - V_2)^2$ instead of $V_1^2 - V_2^2$ treats the voltage drop wrongly, and omitting the square root gives I^2 rather than I .

19. Answer: (A) 5.0 ampere

Output power = $440 \times 2 = 880$ W. Input = $880/0.8 = 1100$ W, so primary current = $1100/220 = 5.0$ A. Multiplying by 0.8 instead of dividing gives 3.2 A; ignoring efficiency gives 4 A.

20. Answer: (D) $\epsilon^2 R/[R^2 + (L\omega - 1/C\omega)^2]$

Average power $P = \epsilon_{rms} I_{rms} \cos \phi$ with $I = \epsilon/Z$ and $\cos \phi = R/Z$, so $P = \epsilon^2 R/Z^2 = \epsilon^2 R/[R^2 + (L\omega - 1/C\omega)^2]$. Using only one factor of Z (the square-root form) gives the wrong power.

21. Answer: (D) $(E_0 I_0/2) \cos \phi$

Average power = $E_{rms} \times I_{rms} \times \cos \phi = (E_0/\sqrt{2})(I_0/\sqrt{2}) \cos \phi = (E_0 I_0/2) \cos \phi$. $E_0 I_0/2$ holds only when current and emf are in phase ($\phi = 0$), and the $\sin \phi$ form gives the wattless (reactive) component.

22. Answer: (B) 90%

Efficiency = output/input = $100/(220 \times 0.5) = 100/110 \approx 0.91$, i.e. about 90%. 50% comes from comparing the voltages instead of the powers.

23. Answer: (D) 100 mH

Current is maximum at resonance, $\omega^2 LC = 1$: $L = 1/(\omega^2 C) = 1/(10^6 \times 10 \times 10^{-6}) = 0.1$ H = 100 mH. R only sets the height of the peak, not where it occurs.

24. Answer: (C) $f/(2\sqrt{2})$

The resonant frequency is $f = 1/(2\pi\sqrt{LC})$. Replacing L by $2L$ and C by $4C$ multiplies LC by 8, so the frequency becomes $f/\sqrt{8} = f/(2\sqrt{2})$. The frequency decreases; it does not increase to $8f$.

25. Answer: (A) energy losses due to eddy currents may be minimised

A solid iron core lets large eddy currents circulate, wasting energy as heat. Thin insulated laminations break up these current paths and minimise eddy-current loss. Lamination does not change the turns ratio, and its purpose is not to reduce weight or prevent rusting.

26. Answer: (C) 0.80

The net reactance is $X_L - X_C = 31 - 25 = 6 \Omega$, so $Z = \sqrt{(8^2 + 6^2)} = 10 \Omega$. The power factor is $\cos \phi = R/Z = 8/10 = 0.80$. Using $X_L + X_C$ would give a much smaller value; the supply voltage is not needed.

27. Answer: (A) $1/[2\pi f(2\pi fL + R)]$

Current leading the voltage means the circuit is net capacitive: $\tan 45^\circ = (X_C - X_L)/R = 1$, so $X_C = X_L + R$. $1/(2\pi fC) = 2\pi fL + R$ gives $C = 1/[2\pi f(2\pi fL + R)]$. The form with $(2\pi fL - R)$ would come from $X_C = X_L - R$, which makes the circuit inductive with current lagging.

Questions as set in the AIPMT/NEET papers conducted by CBSE and NTA. Answers checked and explanations written by the RankUp team. RankUp is not affiliated with CBSE or NTA.