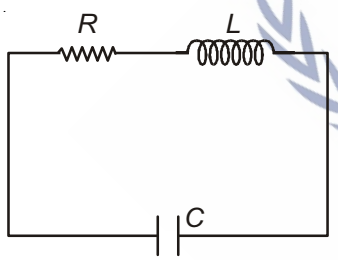
Alternating Current

1. In a series LCR circuit R = 200 Ω and the voltage and the frequency of the main supply is 220 V and 50 Hz respectively. On taking out the capacitance from the circuit the current lags behind the voltage by 30º. On taking out the inductor from the circuit the current leads the voltage by 30º. The power dissipated in the LCR circuit is **[AIEEE-2010]**

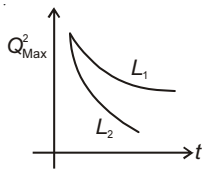
   (1) 242 W (2) 305 W

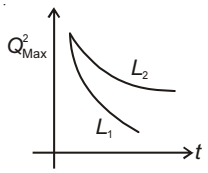
   (3) 210 W (4) 0 W

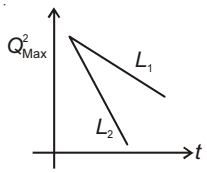
2. An *LCR* circuit is equivalent to a damped pendulum. In an *LCR* circuit the capacitor is charged to Q_0 and then connected to the L and R as shown below :

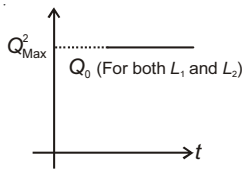


   If a student plots graphs of the square of maximum charge $\left(Q_{Max}^2\right)$ on the capacitor with time (t) for two different values L_1 and L_2 ($L_1 > L_2$) of L then which of the following represents this graph correctly? (Plots are schematic and not drawn to scale) **[JEE (Main)-2015]**

(1) 

(2) 

(3) 

(4) 

3. An arc lamp requires a direct current of 10 A at 80 V to function. If it is connected to a 220 V (rms), 50 Hz AC supply, the series inductor needed for it to work is close to **[JEE (Main)-2016]**

   (1) 0.08 H (2) 0.044 H

   (3) 0.065 H (4) 80 H

4. In an a.c. circuit, the instantaneous e.m.f. and current are given by

   $e = 100 \sin 30t$

   $$i = 20 \sin\left(30t - \frac{\pi}{4}\right)$$

   In one cycle of a.c., the average power consumed by the circuit and the wattless current are, respectively **[JEE (Main)-2018]**

   (1) 50, 10 (2) $\frac{1000}{\sqrt{2}}, 10$

   (3) $\frac{50}{\sqrt{2}}, 0$ (4) 50, 0

5. For an RLC circuit driven with voltage of amplitude v_m and frequency $\omega_0 = \frac{1}{\sqrt{LC}}$ the current exibits resonance. The quality factor, Q is given by **[JEE (Main)-2018]**

   (1) $\frac{\omega_0 L}{R}$ (2) $\frac{\omega_0 R}{L}$

   (3) $\frac{R}{(\omega_0 C)}$ (4) $\frac{CR}{\omega_0}$

6. A series AC circuit containing an inductor (20 mH), a capacitor (120 μF) and a resistor (60 Ω) is driven by an AC source of 24 V/50 Hz. The energy dissipated in the circuit in 60 s is **[JEE (Main)-2019]**

   (1) 5.65×10^2 J (2) 5.17×10^2 J

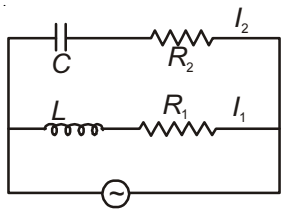
   (3) 2.26×10^3 J (4) 3.39×10^3 J

7. A power transmission line feeds input power at 2300 V to a step down transformer with its primary windings having 4000 turns. The output power is delivered at 230 V by the transformer. If the current in the primary winding of the transformer is 5 A and its efficiency is 90%, the output current would be

[JEE (Main)-2019]

(1) 25 A (2) 50 A

(3) 45 A (4) 35 A

8. 

In the above circuit, $C = \frac{\sqrt{3}}{2}$ μF, R_2 = 20 Ω, $L = \frac{\sqrt{3}}{10}$ H and R_1 = 10 Ω. Current in L-R_1 path is I_1 and in C–R_2 path it is I_2. The voltage of A.C source is given by

$V = 200\sqrt{2}\sin(100t)$ volts. The phase difference between I_1 and I_2 is **[JEE (Main)-2019]**

(1) 0° (2) 60°

(3) 150° (4) 90°

9. An alternating voltage $v(t)$ = 220 sin 100πt volt is applied to a purely resistive load of 50 Ω. The time taken for the current to rise from half of the peak value to the peak value is **[JEE (Main)-2019]**

(1) 2.2 ms

(2) 7.2 ms

(3) 5 ms

(4) 3.3 ms

10. A circuit connected to an ac source of emf $e = e_0\sin(100t)$ with t in seconds, gives a phase difference of $\frac{\pi}{4}$ between the emf e and current i. Which of the following circuits will exhibit this?

[JEE (Main)-2019]

(1) RL circuit with R = 1 kΩ and L = 10 mH

(2) RL circuit with R = 1 kΩ and L = 1 mH

(3) RC circuit with R = 1 kΩ and C = 10 μF

(4) RC circuit with R = 1 kΩ and C = 1 μF

11. A transformer consisting of 300 turns in the primary and 150 turns in the secondary gives output power of 2.2 kW. If the current in the secondary coil is 10 A, then the input voltage and current in the primary coil are : **[JEE (Main)-2019]**

(1) 440 V and 5 A (2) 220 V and 20 A

(3) 220 V and 10 A (4) 440 V and 20 A

12. A LCR circuit behaves like a damped harmonic oscillator. Comparing it with a physical spring-mass damped oscillator having damping constant 'b' the correct equivalence would be **[JEE (Main)-2020]**

(1) $L \leftrightarrow m, C \leftrightarrow \frac{1}{k}, R \leftrightarrow b$

(2) $L \leftrightarrow k, C \leftrightarrow b, R \leftrightarrow m$

(3) $L \leftrightarrow \frac{1}{b}, C \leftrightarrow \frac{1}{m}, R \leftrightarrow \frac{1}{k}$

(4) $L \leftrightarrow m, C \leftrightarrow k, R \leftrightarrow b$

13. In LC circuit the inductance L = 40 mH and capacitance C = 100 μF. If a voltage $V(t)$ = 10 sin (314 t) is applied to the circuit, the current in the circuit is given as **[JEE (Main)-2020]**

(1) 0.52 sin 314 t (2) 5.2 cos 314 t

(3) 10 cos 314 t (4) 0.52 cos 314 t

14. An inductance coil has a reactance of 100 Ω. When an AC signal of frequency 1000 Hz is applied to the coil, the applied voltage leads the current by 45°. The self-inductance of the coil is

[JEE (Main)-2020]

(1) 6.7×10^{-7} H (2) 5.5×10^{-5} H

(3) 1.1×10^{-1} H (4) 1.1×10^{-2} H

15. A 750 Hz, 20 V (rms) source is connected to a resistance of 100 Ω, an inductance of 0.1803 H and a capacitance of 10 μF all in series. The time in which the resistance (heat capacity 2 J/°C) will get heated by 10°C. (assume no loss of heat to the surroudings) is close to

[JEE (Main)-2020]

(1) 348 s (2) 418 s

(3) 245 s (4) 365 s

16. An AC circuit has R = 100 Ω, C = 2 μF and L = 80 mH, connected in series. The quality factor of the circuit is **[JEE (Main)-2020]**

(1) 20 (2) 2

(3) 0.5 (4) 400

17. An electrical power line, having a total resistance of 2 Ω, delivers 1 kW at 220 V. The efficiency of the transmission line is approximately

[JEE (Main)-2020]

(1) 85% (2) 96%

(3) 72% (4) 91%

18. In a series *LR* circuit, power of 400 W is dissipated from a source of 250 V, 50 Hz. The power factor of the circuit is 0.8. In order to bring the power factor to unity, a capacitor of value C is added in series to the *L* and *R*. Taking the value of *C* as $\left(\frac{n}{3\pi}\right)\mu F$, then value of *n* is _____. **[JEE (Main)-2020]**

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