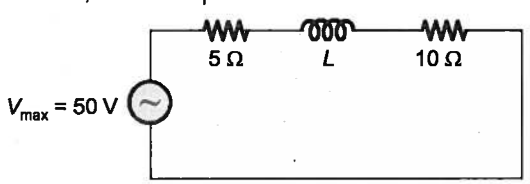
2 Steady State AC Analysis

Multiple Choice Questions

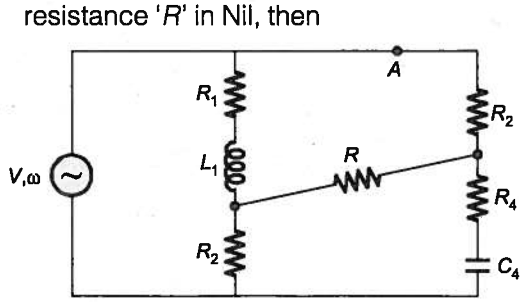
Q.1 In the circuit shown in the given figure, if the power consumed by the 5 ohm resistor is 10 W, then the power factor of the circuit is



(a) 0.8 (b) 0.6
(c) 0.5 (d) zero [ESE-1996]

Q.2 A series circuit containing passive elements has the following current and applied voltage :
$v = 200 \sin(2000\,t + 50°)$
$i = 4 \cos(2000\,t + 13.2°)$
The circuit elements
(a) must be resistance and capacitance
(b) must be resistance and inductance
(c) must be inductance, capacitance and resistance
(d) could be either resistance and capacitance or resistance, inductance and capacitance. [ESE-1996]

Q.3 In the circuit shown in the figure, if the current in resistance 'R' in Nil, then



(a) $\dfrac{\omega L_1}{R_1} = \dfrac{1}{\omega C_4 R_4}$

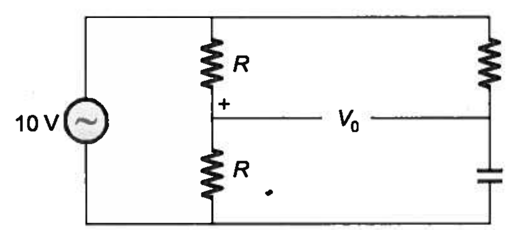
(b) $\dfrac{\omega L_1}{R_1} = \omega C_4 R_4$

(c) $\tan^{-1}\dfrac{\omega L_1}{R_1} + \tan^{-1}\omega C_4 R_4 = 0$

(d) $\tan^{-1}\dfrac{\omega L_1}{R_1} + \tan^{-1}\dfrac{1}{\omega C_4 R_4} = 0$

[ESE-1999]

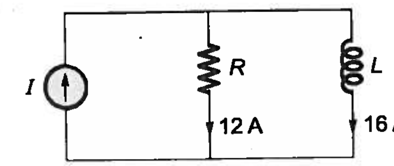
Q.4 In the circuit shown in the figure, output $|V_0(j\omega)|$ is



(a) indeterminable as values of R and C are not given
(b) 2.5 V
(c) $5\sqrt{2}$ V
(d) 5 V [ESE-1999]

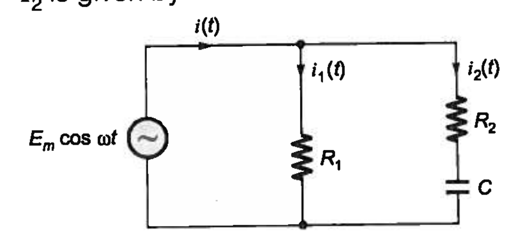
Q.5 A series LCR circuit with R = 10 Ω, $|X_L|$ = 20 Ω and $|X_C|$ = 20 Ω is connected across an AC supply of 200 V_{rms}. The rms voltage across the capacitor is
(a) 200 ∠ − 90° V (b) 200 ∠ 90° V
(c) 400 ∠ 90° V (d) 400 ∠ − 90° V
[ESE-2000]

Q.6 In the circuit shown in the figure below, the current supplied by the sinusoidal current source I is

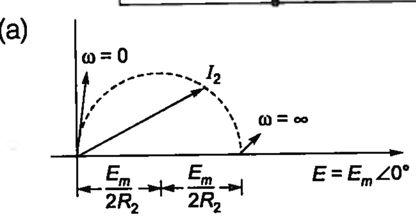


(a) 28 A
(b) 4 A
(c) 20 A
(d) not determinable from the data given
[ESE-2000]

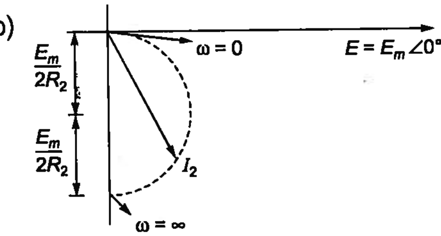
Q.7 When the angular frequency ω in the figure is varied from 0 to ∞, the locus of the current phasor I_2 is given by



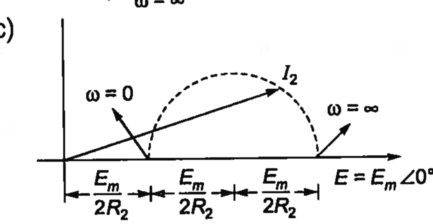
(a)



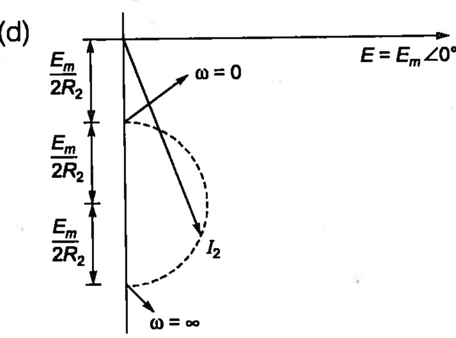
(b)



(c)



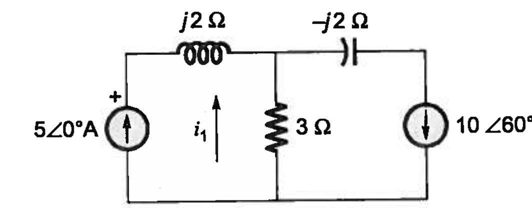
(d)



[GATE-2001]

Q.8 What is the locus of the tip of the voltage phasor across R in a series R-L-C circuit?
(a) A parabola
(b) An ellipse
(c) A circle
(d) A rectangular hyperbola [ESE-2004]

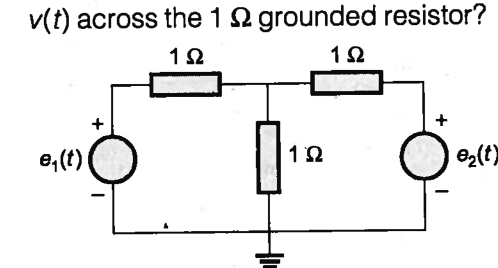
Q.9 For the circuit shown in the figure, the instantaneous current $i_1(t)$ is



(a) $\dfrac{10\sqrt{3}}{2}\angle 90°$ (b) $\dfrac{10\sqrt{3}}{2}\angle -90°$
(c) 5∠60° Amps. (d) 5∠−60° Amps.
[GATE-2005]

Q.10 An RLC series circuit has a resistance R of 20 Ω and a current which lags behind the applied voltage by 45°. If the voltage across the inductor is twice the voltage across the capacitor, what is the value of inductive reactance?
(a) 10 Ω (b) 20 Ω
(c) 40 Ω (d) 60 Ω
[ESE-2005]

Q.11 In the circuit shown in the below figure, $e_1(t) = \sqrt{3}\cos(\omega t + 30°)$ and $e_2(t) = \sqrt{3}\sin(\omega t + 60°)$. What is the voltage $v(t)$ across the 1 Ω grounded resistor?



(a) $\{\cos \omega t\}$ V
(b) $\{\sin(\omega t + 30°) + \cos(\omega t + 60°)\}$ V
(c) $\{1\angle 90°\}$ V
(d) $\{j\,1\}$ V [ESE-2006]

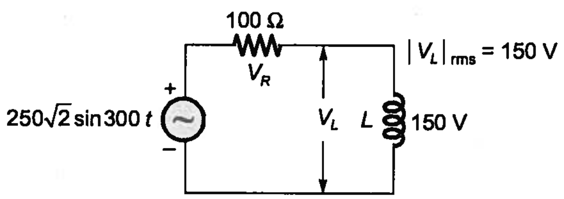
Q.12 Assertion (A): Power factor is defined as the ratio of apparent power to the average power in an a.c. circuit.

Reason (R) : The magnitude of power factor is always less than unity.

(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 but R is true.

[ESE-2008]

Q.13 Consider the following with respect to the circuit as shown below:



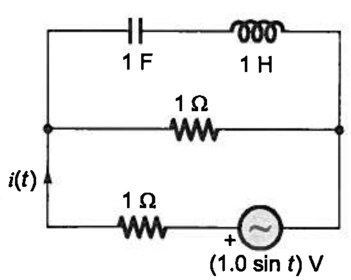
1. $V_R = 100\sqrt{2}\ V$
2. $|I|_{rms} = 2$ A
3. $L = 0.25$ H

Which of the above statements is/are correct?

(a) 1 only (b) 2 and 3
(c) 1 and 3 (d) 1 and 2

[ESE-2009]

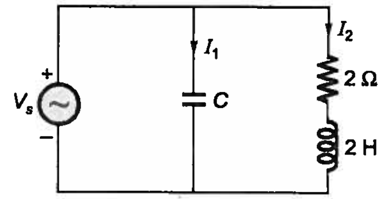
Q.14 The r.m.s. value of the current $i(t)$ in the circuit shown below is



(a) $\frac{1}{2}$ A (b) $\frac{1}{\sqrt{2}}$ A
(c) 1 A (d) $\sqrt{2}$ A

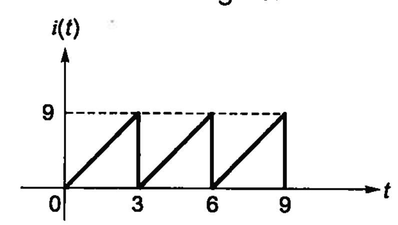
[GATE-2011]

Q.15 In the network shown below $V_s = 4\cos 2t$. The value of C is so chosen that the circuit impedance is maximum. Then I_1 leads I_2 by



(a) 45° (b) 90°
(c) 0° (d) 135° [ESE-2013]

Q.16 The current waveform $i(t)$ in a pure resistor of 20 Ω is shown in the figure.



The power dissipated in the resistor is

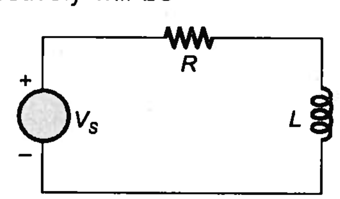
(a) 135 W (b) 270 W
(c) 540 W (d) 14.58 W [ESE-2014]

Q.17 A 230 V rms source supplies power to two loads connected in parallel. The first load draws 10 kW at 0.8 leading power factor and the second one draws 10 kVA at 0.8 lagging power factor. The complex power delivered by the source is

(a) (18 + j 1.5) kVA (b) (18 – j 1.5) kVA
(c) (20 + j 1.5) kVA (d) (20 – j 1.5) kVA

[GATE-2014]

Q.18 $V_S = 5\cos t$ and the complex power drawn in $P_{complex} = \frac{3}{2} + 2j$, the value of R and L respectively will be



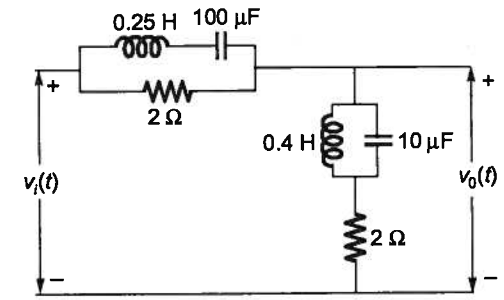
(a) $\frac{3}{2}$ and $\frac{4}{5}$ (b) $\frac{16}{3}$ and $\frac{16}{5}$
(c) 4 and 3 (d) 3 and 4

[ESE-2015]

Q.19 In the RLC circuit shown in the figure, the input voltage is given by

$v_i(t) = 2\cos(200\,t) + 4\sin(500\,t)$

The output voltage $n_0(t)$ is



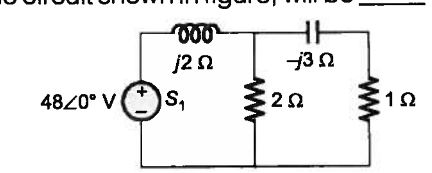
(a) $\cos(200t) + 2\sin(500t)$
(b) $2\cos(200t) + 4\sin(500t)$
(c) $\sin(200t) + 2\cos(500t)$
(d) $2\sin(200t) + 4\cos(500t)$

[GATE-2016]

Numerical Data Type Questions

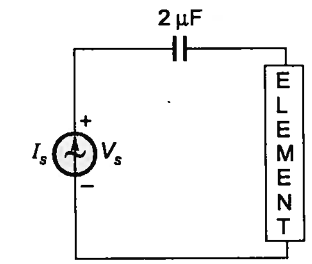
Q.20 A series RLC network with R = 45 Ω and L = 387.5 mH is connected across an ac supply of 200 V (rms) at a frequency of 400 rad/s. The impedance angle is measured to be 36.87°. If the power dissipated in the circuit is 640 W, then what is the value of capacitance C (in μF)?

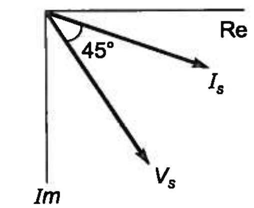
Q.21 The average power delivered to the 1 Ω resistor in the circuit shown in figure, will be_____ watts.



Q.22 A 0.2 H inductor carries an ac current of 0.5 A (peak) at 60 Hz. A capacitor is to be connected in parallel with the inductor such that it reduces the magnitude of the current in the inductor to 0.3 A. Assuming that the total current supplied to the network does not change after adding the capacitor, what values of capacitance will be required (in μF)?

Q.23 For the following circuit, phasor diagram is given. The elements in the box is resistor then its value will be (ω = 500 rad/sec)_____ kΩ.

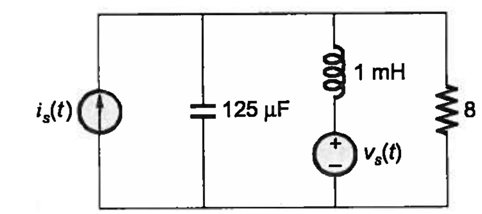




Q.24 The voltage and current source applied to the given circuit are respectively given as

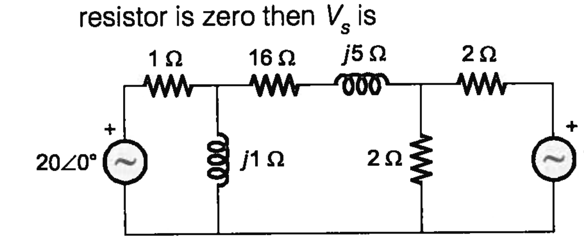
$v_s(t) = 80\cos(8\times10^3 t)$ V

and $i_s(t) = 10\cos(2\times10^3 t)$ A the average power absorbed by the 8 Ω resistor is____ watts.

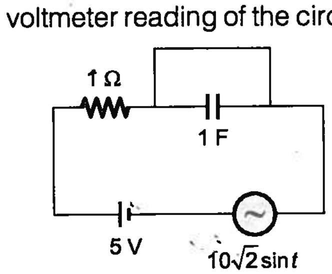


Try Yourself

T1. In the circuit shown if power dissipated in 16 Ω resistor is zero then V_s is



T2. Find voltmeter reading of the circuit shown



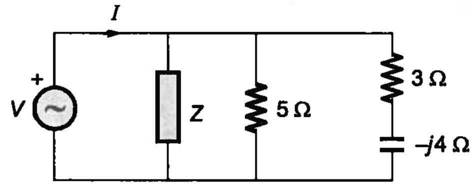
(a) 5 V (b) 7.07 V
(c) 8.66 V (d) 10 V

T3. The resistance of a two element circuit with an instantaneous current of $I = 4.24 \sin(500t + 45°)$ that has taken real power of 180 W at a power factor 0.8 lag is

(a) 25 Ω (b) 15 Ω

(c) 20 Ω (d) 10 Ω

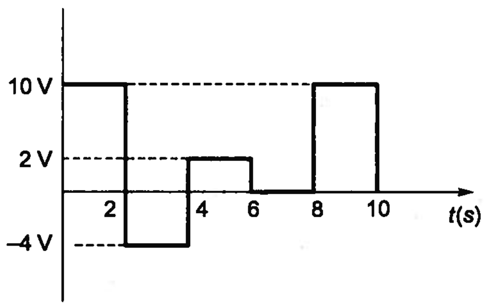
T4. Find Z in the parallel circuit of the network shown if $V = 50 \angle 30°$ and $I = 27.9 \angle 57.8°$



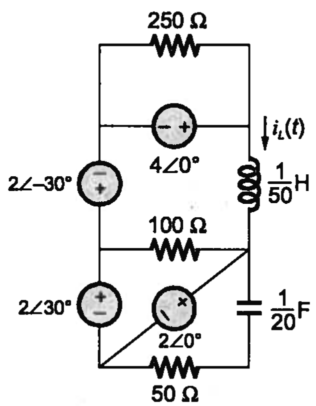
(a) $5 \angle -30$ (b) $6 \angle 30°$

(c) $5 \angle 30°$ (d) None

T5. Find RMS value of the following wave form



T6. In the given circuit of figure, if $\omega = 100$ rad/sec, current $i_L(t)$ is



(a) $2\cos(200\pi t - 45°)$

(b) $1.414\cos(100t + 45°)$

(c) $1.414\cos(100t - 45°)$

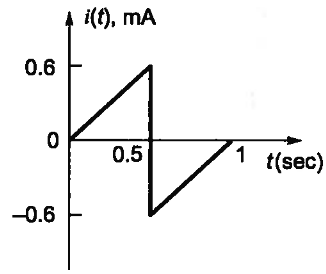
(d) $2\cos(100\pi t + 45°)$

T7. The voltage across a 20 μF capacitor is defined as follows

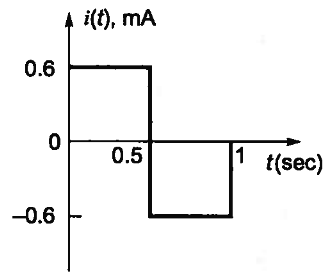
$$v(t) = \begin{cases} (30t^2)V, & 0 < t < 0.5s \\ 30(t-1)^2\ V, & 0.5s < t < 1s \\ 0, & \text{otherwise} \end{cases}$$

The waveform of current, through the capacitor is

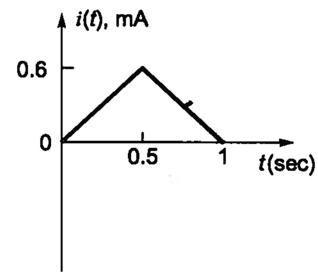
(a)



(b)



(c)



(d)