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C. U. Q

INSTANTANEOUS, PEAK,R.M.S & AVERAGE VALUES OF A.C AND A.V

1. **In an ac circuit the current**
   1) is in phase with the voltage
   2) leads the voltage
   3) lags the voltage
   4) any of the above depending on the circumstances
2. **The average e.m.f during the positive half cycle of an a.c. supply of peak value E_0 is**
   1) E_0/π 2) $E_0/\sqrt{2}$ 3) $E_0/2\pi$ 4) $2E_0/\pi$
3. **Alternating current is transmitted to distant places at**
   1) high voltage and low current
   2) high voltage and high current
   3) low voltage and low current
   4) low voltage and high current
4. **In case of a.c circuit, Ohm's law holds good for**
   a) Peak values of voltage and current
   b) Effective values of voltage and current
   c) Instantaneous values of voltage and current
   1) only a is true 2) only a and b are true
   3) only c is true 4) a, b and c are true
5. **In case of AC circuits the relation V = i Z, where Z is impedance, can directly applied to**
   1) peak values of voltage and current only
   2) rms values of voltage and current only
   3) instantaneous values of voltage and current only
   4) both 1 and 2 are true
6. **Alternating current can not be measured by direct current meters, because**
   1) alternating current can not pass through an ammeter
   2) the average value of current for complete cycle is zero
   3) some amount of alternating current is destroyed in the ammeter
   4) peak value of current is zero
7. **The r.m.s. value of potential due to superposition of given two alternating potentials $E_1 = E_0 \sin \omega t$ and $E_2 = E_0 \cos \omega t$ will be**
   1) E_0 2) $2E_0$ 3) $E_0\sqrt{2}$ 4) Zero
8. **If the instantaneous values of current is $I = 2\cos(\omega t + \theta)$ A in a circuit, the r.m.s. value of current in ampere will be**
   1) 2 2) $\sqrt{2}$ 3) $2\sqrt{2}$ 4) zero

9. **If a capacitor is connected to two different A.C. generators, then the value of capacitive reactance is**
1) directly proportional to frequency
2) inversely proportional to frequency
3) independent of frequency
4) inversely proportional to the square of frequency

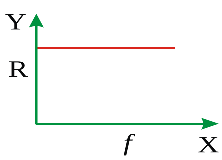
10. **In general in an alternating current circuit**
1) the average value of current is zero
2) the average value of square of the current is zero
3) average power dissipation is zero
4) the phase difference between voltage and current is zero

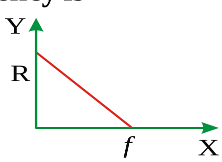
A.C ACROSS R-L,R-C,L-C & L-C-R SERIES CIRCUIT

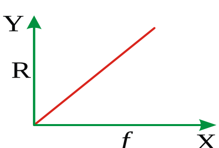
11. **The magnitude of induced e.m.f in an LR circuit at break of circuit as compared to its value at make of circuit will be**
1) less 2) more
3) some times less and some times more
4) nothing can be said

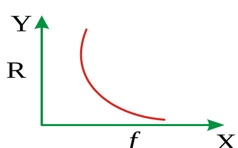
12. **The emf and current in a circuit are such that $E = E_0 \sin \omega t$ and $I = I_0 \sin(\omega t - \theta)$. This AC circuit contains.**
1) R and L 2) R and C 3) only R 4) only C

13. **The correct graph between the resistance of a conductor with frequency is**

1) 

2) 

3) 

4) 

14. **Same current is flowing in two alternating circuits. The first circuit contains only inductance and the other contains only a capacitor. If the frequency of the e.m.f. is increased, the current will**
1) increase in first circuit and decrease in the other
2) increase in both circuits
3) decrease in both circuits
4) decrease in first circuit and increase in the other

15. **When an a.c source is connected across a resistor**
1) The current leads the voltage in phase
2) The current lags behind the voltage in phase
3) The current and voltage are in same phase
4) The current and voltage are out of phase

16. **The phase angle between current and voltage in a purely inductive circuit is**
1) zero 2) π 3) $\pi/4$ 4) $\pi/2$

17. **Ratio of impedence to capacitive reactance has**
1) no units 2) ohm 3) ampere 4) tesla

18. **An inductor coil having some resistance is connected to an AC source. Which of the following have zero average value over a cycle**
1) induced emf in the inductor only
2) current only 3) both 1 and 2 4) neither 1 nor 2

19. **The current does not rise immediately in a circuit containing inductance**
1) because of induced emf
2) because of high voltage drop
3) both 1 and 2 4) because of joule heating

20. **In an AC circuit containing only capacitance the current**
1) leads the voltage by 180°
2) lags the voltage by 90°
3) leads the voltage by 90°
4) remains in phase with the voltage

21. **A bulb is connected first with dc and then ac of same voltage.Then it will shine brightly with**
1) AC 2) DC 3) Equally with both
4) Brightness will be in ratio 1/14

22. **A capacitor of capacity C is connected in A.C. circuit. If the applied emf is $V = V_0 \sin \omega t$, then the current is**
1) $I = \frac{V_0}{L\omega} \sin \omega t$ 2) $I = \frac{V_0}{\omega C} \sin\left(\omega t + \frac{\pi}{2}\right)$
3) $I = V_0 C\omega \sin \omega t$ 4) $I = V_0 C\omega \sin\left(\omega t + \frac{\pi}{2}\right)$

23. **At low frequency a condenser offers**
1) high impedance 2) low impedance
3) zero impedance
4) impedance of condenser is independent of frequency

24. **Statement (A) : The reactance offered by an inductance in A.C. circuit decreases with increase of AC frequency.**
Statement (B) : The reactance offered by a capacitor in AC circuit increases with increase of AC frequency.
1) A is true but B is false
2) Both A and B are true
3) A is false but B is true
4) Both A and B are false

25. **Statement (A) : With increase in frequency of AC supply inductive reactance increases.**
Statement (B) : With increase in frequency of AC supply capacitive reactance increase
1) A is true but B is false
2) Both A and B are true
3) A is false but B is true
4) Both A and B are false

26. In an A.C circuit having resistance and capacitance

1) emf leads the current
2) current lags behind the emf
3) both the current and emf are in phase
4) current leads the emf.

27. Select the correct options among the following: In an R-C circuit

a) instantaneous A.C is given by $I = I_0 \sin(wt+\phi)$

b) the alternating current in the circuit leads the emf by a phase angle ϕ.

c) Its impedance is $\sqrt{R^2+(\omega c)^2}$

d) Its capacitive reactance is ω c

1) a, b are ture　　2) b, c, d are true
3) c, d are true　　4) a, c are true

28. If the frequency of alternating e.m.f. is f in L-C-R circuit, then the value of impedance Z will change with log (frequency) as

1) increases
2) increases and then becomes equal to resistance, then it will start decreasing
3) decreases and when it becomes minimum equal to the resistance then it will start increasing
4) go on decreasing

29. An inductance and resistance are connected in series with an A.C circuit. In this circuit

1) the current and P.d across the resistance lead P.d across the inductance by $\pi/2$
2) the current and P.d across the resistance lags behind the P.d across the inductance by angle $\pi/2$
3) The current across resistance leads and the P.d across resistance lags behind the P.d across the inductance by $\pi/2$
4) the current across resistance lags behind and the P.d across the resistance leads the P.d across the inductance by $\pi/2$

30. An LCR circuit is connected to a source of alternating current. At resonance, the applied voltage and the current flowing through the circuit will have a phase difference of

1) $\pi/4$　2) zero　3) π　4) $\pi/2$

31. The incorrect statement for L-R-C series circuit is

1) The potential difference across the resistance and the appleid e.m.f. are always in same phase
2) The phase difference across inductive coil is 90^0
3) The phase difference between the potential difference across capacitor and potential difference across inductance is 90^0
4) The phase difference between potential difference across capacitor and potential difference across resistance is 90^0

32. In series L - C - R resonant circuit, to increase the resonant frequency

1) *L* will have to be increased
2) *C* will have to be increased
3) *LC* will have to be decreased
4) *LC* will have to be increased

33. If in a series L - C - R ac circuit, the voltages across R, L, C are V_1, V_2, V_3 respectively. Then the voltage of applied AC source is always equal to

1) $V_1+V_2+V_3$　　2) $\sqrt{V_1^2+(V_2+V_3)^2}$
3) $V_1-V_2-V_3$　　4) $\sqrt{V_1^2+(V_2-V_3)^2}$

34. In non-resonant circuit, the nature of circuit for frequencies greater than the resonant frequency is

1) resistive　　2) capacitive
3) inductive　　4) both 1 and 2

35. The phase difference between voltage and current in an LCR series circuit is

1) zero always　　2) $\pi/4$ always
3) π　　4) between 0 and $\pi/2$

36. In an LCR a.c circuit at resonance, the current

1) Is always in phase with the voltage
2) Always leads the voltage
3) Always lags behind the voltage
4) May lead or lag behind the voltage

37. An inductance L and capacitance C and resistance R are connected in series across an AC source of angular frequency ω. If $\omega^2 > \frac{1}{LC}$ then

1) emf leads the current
2) both the emf and the current are in phase
3) current leads the emf
4) emf lags behind the current

38. Consider the following two statements A and B and identify the correct answer.

A) At resonance of *L - C - R* series circuit, the reactance of circuit is minimum.

B) The reactance of a capacitor in an A.C circuit is similar to the resistance of a capacitor in a D.C. circuit

1) A is true but B is false
2) Both A and B are true
3) A is false but B is true
4) Both A and B are false

39. Choose the wrong statement of the following.

1) The peak voltage across the inductor can be less than the peak voltage of the source in an LCR circuit
2) In a circuit containing a capacitor and an ac source the current is zero at the instant source voltage is maximum

3) When an AC source is connected to a capacitor,then the rms current in the circuit gets increased if a dielectric slab is inserted into the capacitor.

4) In a pure inductive circuit emf will be in phase with the current.

40. The essential difference between a d.c. dynamo and an a.c. dynamo is that

1) a.c. has an electromagnet but d.c. has a permanent magnet

2) a.c. will generate a higher voltage

3) a.c.has slip rings but the d.c. has a commutator

4) a.c. dynamo has a coil wound on soft iron, but the d.c. dynamo has a coil wound on copper

41. The unit of impedence is

1) ohm 2) mho 3) ampere 4) volt

42. The power factor of a.c. circuit having L and R connected in series to an a.c. source of angular frequency ω is given by

1) $\frac{\sqrt{R^2+\omega^2L^2}}{R}$ 2) $\frac{R}{\sqrt{R^2+\omega^2L^2}}$ 3) $\frac{\omega L}{R}$ 4) $\frac{R}{\omega L}$

43. The capacitor offers zero resistance to

1) D.C. only 2) A.C. & D.C.

3) A.C. only 4) neither A.C. nor D.C.

44. Power factor is defined as

1) apparent power/true power

2) true power/apparent power

3) true power (apparent power)^2

4) true power x apparent power

TRANSFORMER

45. The core of a transformer is laminated so that

1) energy loss due to eddy currents may be reduced

2) rusting of the core may be prevented

3) change in flux may be increased

4) ratio of voltage in the primary to that in the secondary may be increased

46. A step up transformer is used to

1) increase the current and increase the voltage

2) decrease the current and increase the voltage

3) increase the current and decrease the voltage

4) decrease the current and decrease the voltage

47. A transformer changes the voltage

1) without changing the current and frequency

2) without changing the current but changes the frequency

3) without changing the frequency but changes the current

4) without changing the frequency as well as the current

48. A step up transformer is connected on the primary side to a rechargable battery which can deliver a large current. If a bulb is connected in the secondary, then

1) the bulb will glow very bright

2) the bulb will get fused

3) the bulb will glow, but with less brightness

4) the bulb will not glow

49. The ratio of primary voltage to secondary voltage in a transformer is '*n*'. The ratio of the primary current to secondary current in the transformer is

1) n 2) $1/n$ 3) n^2 4) $1/n^2$

50. In a step down transformer, the number of turns in the primary is always

1) greater than the number of turns in the secondary

2) less than the number of turns in the secondary

3) equal to the number of turns in the secondary

4) either greater than or less than the number of turns in the secondary

51. The transformer ratio of a step up transformer is

1) greater than one 2) less than one

3) less than one and some times greater than one

4) greater than one and some times less than one

52. A stepup transformer develops 400V in secondary coil for an input of 200V A.C. Then the type of transformer is

1) Steped down 2) Steped up 3) Same

4) Same but with reversed direction

53. Assertion(A) : If changing current is flowing through a machine with iron parts, results in loss of energy.

Reason(R): Changing magnetic flux through an area of the iron parts causes eddy currents.

1)Both A and R are individually true and R is the correct explanation of A

2)Both A and R are individually true but R is not the correct explanation of A

3)A is true but R is false

4)Both A and R are false

54. Transformers are used in

1) d.c circuits only 2) a.c. circuits only

3) Both a.c and d.c circuits 4) Integrated circuits.

55. The magnitude of the e.m.f. across the secondary of a transformer does not depend on

1) The number of the turns in the primary

2) The number of the turns in the secondary

3) The magnitude of the e.m.f applied across the primary

4)The resistance of the primary and the secondary

56. For an ideal transformer ratio of output to the input power is always

1) greater than one 2) equal to one
3) less than one 4) zero

57. Consider the following two statements A and B and identify the correct answer.
A) In a transformer a large alternating current at low voltage can be transformed into a small alternating current at high voltage
B) Energy in current carrying coil is stored in the form of magnetic field.

1) A is true but B is false
2) Both A and B are true
3) A is false but B is true
4) Both A and B are false

58. Statement (A) : Flux leakage in a transformer can be minimized by winding the primary and secondary coils one over the other.
Statement (B) : Core of the transformer is made of soft iron

59. Statement (A) : In high current low voltage windings of a transformer thick wire is used to minimize energy loss due to heat produced
Statement (B) : The core of any transformer is laminated so as to reduce the energy loss due to eddy currents

60. Statement (A) : Step up transformer converts low voltage, high current to high voltage, low current
Statement (B) : Transformer works on both ac and dc

61. To reduce the iron losses in a transformer, the core must be made of a material having

1) low permeability and high resistivity
2) high permeability and high resistivity
3) low permeability and low resistivity
4) high permeability and low resistivity

62. Maximum efficiency of a transformer depends on

1) the working conditions of technicians.
2) weather copper loss =1/2 x iron loss
3) weather copper loss = iron loss
4) weather copper loss =2 x iron loss

63. For a LCR series circuit with an A.C. source of angular frequency ω

1) circuit will be capacitive if $\omega > \frac{1}{\sqrt{LC}}$
2) circuit will be inductive if $\omega = \frac{1}{\sqrt{LC}}$
3) power factor of circuit will be unity if capacitive reactance equals inductive reactance
4) current will be leading voltage if $\omega > \frac{1}{\sqrt{LC}}$

64. The value of current in two series L C R circuits at resonance is same when connected across a sinusoidal voltage source. Then

1) both circuits must be having same value of capacitance and inductance
2) in both circuits ratio of L and C will be same
3) for both the circuits X_L / X_C must be same at that frequency
4) both circuits must have same impedance at all frequencies

65. When an AC source of emf $e = E_0 \sin(100t)$ is connected across a circuit, the phase difference betwen the emf e and the current i in the circuit is observed to be $\frac{\pi}{4}$ ahead,If the circuit consists possibly of $R-C$ or $R-L$ or $L-C$ in series, find the relationship between the two elements:

1) $R = 1k\Omega,\ C = 10\mu F$ 2) $R = 1k\Omega,\ C = 1\mu F$
3) $R = 1k\Omega,\ L = 10H$ 4) $R = 1k\Omega,\ L = 1H$

66. 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

1) the bulb glows dimmer
2) the bulb glows brighter
3) total impendance of the circuit is unchanged
4) total impendance of the circuit increases

ASSERTION & REASON

1) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
2) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
3) Assertion is true but Reason is false
4) Assertion is false but Reason is true

67. Assertion (A): The average value of $<\sin^2\omega t>$ is zero.
Reason (R): The average value of function $F(t)$ over a period T is $<F(t)> = \frac{1}{T}\int_0^T F(t)dt$

68. **Assertion (A): If current varies sinusoidally the average power consumed in a cycle is zero.**
Reason (R): If current varies sinusoidally the average power consumed is zero

69. **Assertion (A) : The power consumed in an electric circuit is never negative**
Reason (R) : The average power consumed in an electric circuit is $P = \frac{V^2}{R} = I^2R$

70. **Assertion (A): The inductive reactance limits the current in a purely inductive circuit in the same way as the resistance circuit.**
Reason (R): The inductive reactance is directly proportional to the inductance and to the frequency of the varying current.

71. **Assertion (A) : An ac emf which oscillates symmetrically about zero, the current it sustains also oscillates symmetrically about zero.**
Reason (R): In any circuit element, current is always in the phase with voltage

72. **Assertion (A): A lamp is connected in series with a capacitor and ac source connected across their terminals consequently current flow in the circuit and the lamp will shine.**
Reaosn(R): capacitor block dc current and allow ac current

73. **Assertion (A): An electric lamp is connected in series with a long solenoid of copper with air core and then connected to AC source. If an iron rod is inserted in solenoid the lamp will become dim.**
Reason (R): If iron rod is inserted in solenoid, the induction of solenoid increases.

74. **An inductor, capacitor and resistance connected in series. The combination is connecte across AC source.**
Assertion (A): Peak current through each remains same
Reason (R) : Average power delivered by source is equal to average power consumed by resistance.

75. **Assertion (A): when frequency is greater than resonance frequency in a series LCR circuit, it will be an inductive circuit.**
Reason (R): Resultant voltage will lead the current

76. **Assertion (A): Maximum power is dessipated in a circuit (through R) in resonance**
Reason (R) : At resonance in a series LCR circuit, the voltage across indcutor and capacitor are out of phase.

C. U. Q - KEY

1) 4	2) 4	3) 1	4) 2	5) 4	6) 2	7) 1
8) 2	9) 2	10) 1	11) 2	12) 1	13) 1	14) 4
15) 3	16) 4	17) 1	18) 3	19) 3	20) 3	21) 3
22) 4	23) 1	24) 4	25) 1	26) 4	27) 1	28) 3
29) 2	30) 2	31) 3	32) 3	33) 4	34) 3	35) 4
36) 1	37) 1	38) 1	39) 4	40) 3	41) 1	42) 2
43) 4	44) 2	45) 1	46) 2	47) 3	48) 4	49) 2
50) 1	51) 1	52) 2	53) 1	54) 2	55) 4	56) 2
57) 2	58) 4	59) 2	60) 1	61) 2	62) 3	63) 3
64) 3	65) 1	66) 2	67) 4	68) 4	69) 1	70) 2
71) 4	72) 1	73) 1	74) 2	75) 1	76) 1	

C. U. Q - HINTS

67. $< \sin^2 \omega t >= 1/2$

68. $< P >= \frac{1}{2} i_m^2 R$

69. I is scalar in Joules heating effect is independent an direction of current.

70. $I = \frac{V}{X_L}$ & $i = \frac{V}{R}$ $X_L = \omega L = 2\pi v L$

71. In inductor current lags the voltage by $\frac{\pi}{2}$

In capcitor current leads the voltage by $\frac{\pi}{2}$

72. $X_C = \frac{1}{2\pi fC}$

for dc $f = 0$ then $X_L = \infty$

for ac $f \neq 0$ then $X_C = finite$

73. $L \propto \mu_r$
more voltage is present across inductor
so less voltage across bulb

74. In series current is same, inductor and capacitor does not consume power

75. At resonance $X_L = X_C$ and frequency $f_0 = \frac{1}{2\pi}\sqrt{\frac{1}{LC}}$ If $f > f_0$ then $X_L > X_C$, so it will be an inductive circuit. AC current must lag AC voltage.

76. At resonance $P = I_{max}^2 R$ and V_L and V_C are out of phase. I_{max} is due to $Z_{min} = R$ which is due to out of phase of V_L and V_C.

LEVEL-I (C.W)

INSTANTANEOUS, PEAK,R.M.S & AVERAGE VALUES OF A.C AND A.V

1. **The r.m.s. value of an a.c. of 50 Hz is 10 A. The time taken by the alternating current in reaching from zero to maximum value and the peak value of current will be**
1) 2×10^{-2} sec and 14.14 A 2) 1×10^{-2} sec and 7.07 A
3) 5×10^{-3} sec and 7.07 A 4) 5×10^{-3} sec and 14.14 A

2. **An inductor has a resistance R and inductance L. It is connected to an A.C. source of e.m.f E_V and angular frequency ω, then the current I_v in the circuit is**
1) $\frac{E_V}{\omega L}$ 2) $\frac{E_V}{R}$ 3) $\frac{E_V}{\sqrt{R^2+\omega^2L^2}}$ 4) $\sqrt{\left(\frac{E_V}{R}\right)^2+\left(\frac{E_V}{\omega L}\right)^2}$

3. **The peak voltage of 220 Volt AC mains (in Volt) is**
1) 155.6 2) 220.0 3) 311 4) 440.0

4. **The peak value of A.C. is $2\sqrt{2}A$. It's apparent value will be**
1) 1A 2) 2A 3) 4A 4) zero

5. **Alternating current in circuit is given by $I = I_0 \sin 2\pi nt$. Then the time taken by the current to rise from zero to r.m.s. value is equal to**
1) 1/2n 2) 1/n 3) 1/4n 4) 1/8n

6. **Using an A.C. voltmeter the potential difference in the electrical line in a house is read to be 234 volt. If the line frequency is known to be 50 cycles/second, the equation for the line voltage is**
1) $V = 165 \sin(100\pi t)$ 2) $V = 331 \sin(100\pi t)$
3) $V = 220 \sin(100\pi t)$ 4) $V = 440 \sin(100\pi t)$

7. **A mixer of 100Ω resistance is connected to an A.C. source of 200V and 50 cycles/sec. The value of average potential difference across the mixer will be**
1) 308V 2) 264V 3) 220V 4) zero

A.C ACROSS PURE RESISTOR, INDUCTOR & CAPACITOR

8. **The equation of an alternating voltage is E=220 $\sin(\omega t+\pi/6)$ and the equation of the current in the circuit is I=10 $\sin(\omega t-\pi/6)$. Then the impedance of the circuit is**
1) 10 ohm 2) 22 ohm 3) 11 ohm 4) 17 ohm

9. **A steady P.D. of 10V produces heat at a rate 'x' in resistor. The peak value of A.C. voltage which will produce heat at rate of x/2 in same resistor is**
1) 5 V 2) $5\sqrt{2}$ V 3) 10 V 4) $10\sqrt{2}$ V

10. **An alternating voltage of $E = 200\sqrt{2}\sin(100t)V$ is connected to a condenser of 1 μF through an A.C. ammeter. The reading of the ammeter will be**
1) 10 mA 2) 40 mA 3) 80 mA 4) 20 mA

11. **The inductance of a coil is 0.70 henry. An A.C. source of 120 volt is connected in parallel with it. If the frequency of A.C. is 60Hz, then the current which is flowing in inductance will be**
1) 4.55 A 2) 0.355 A 3) 0.455 A 4) 3.55 A

TRANSFORMER

12. **A transformer steps up an A.C. voltage from 230 V to 2300 V. If the number of turns in the secondary coil is 1000, the number of turns in the primary coil will be**
1) 100 2) 10,000 3) 500 4) 1000

13. **The transformer ratio of a transformer is 5. If the primary voltage of the transformer is 400 V, 50 Hz, the secondary voltage will be**
1) 2000 V, 250 Hz 2) 80 V, 50 Hz
3) 80 V, 10 Hz 4) 2000 V, 50 Hz

14. **A step-up transformer works on 220V and gives 2 A to an external resistor. The turn ratio between the primary and secondary coils is 2:25. Assuming 100% efficiency, find the secondary voltage, primary current and power delivered respectively**
1) 2750 V, 25 A, 5500 W 2) 2750 V, 20 A, 5000 W
3) 2570 V, 25 A, 550 W 4) 2750 V, 20 A, 55 W

A.C ACROSS L-R, L-C & L-C-R SERIES CIRCUITS

15. **A coil of self - inductance $\left(\frac{1}{\pi}\right)$H is connected in series with a 300 Ω resistance. A voltage of 200V at frequency 200Hz is applied to this combination. The phase difference between the voltage and the current will be**
1) $\tan^{-1}\left(\frac{4}{3}\right)$ 2) $\tan^{-1}\left(\frac{3}{4}\right)$ 3) $\tan^{-1}\left(\frac{1}{4}\right)$ 4) $\tan^{-1}\left(\frac{5}{4}\right)$

16. **A condenser of $10\mu F$ and an inductor of 1H are connected in series with an A.C. source of frequency 50Hz. The impedance of the combination will be (take $\pi^2=10$)**
1) zero 2) Infinity 3) 44.7 Ω 4) 5.67 Ω

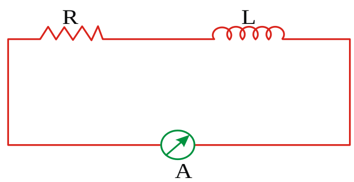
17. **A 100 km telegraph wire has capacity of 0.02 $\mu F/km$, if it carries an alternating current of frequency 5 kHZ. The value of an inductance required to be connected in series so that the impedence is minimum.**

1) 50.7mH 2) 5.07mH 3) 0.507mH 4) 507mH

18. **In an *LCR* series circuit the rms voltages across *R*, *L* and *C* are found to be 10 V, 10 V and 20 V respectively. The rms voltage across the entire combination is**

1) 30 V 2) 1 V 3) 20V 4) $10\sqrt{2}\,V$

19. **In the circuit shown, a 30V d.c. source gives a current 2.0 A as recorded in the ammeter A and 30V a.c. source of frequency 100Hz gives a current 1.2A. The inductive reactance is**



1) 10 ohm 2) 20 ohm 3) $5\sqrt{34}$ ohm 4) 40 ohm

20. **A choke coil has negligible resistance. The alternating potential drop across it is 220 volt and the current is 5mA. The power consumed is**

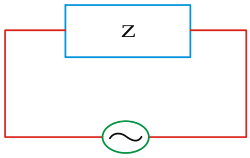
1) $220\times\frac{5}{1000}$ W 2) $\frac{220}{5}$ W

3) zero 4) 2.20 x 5W

21. **In an A.C. circuit, the instantaneous values of e.m.f. and current are E = 200 sin 314t volt and $I=\sin(314t+\pi/3)$ ampere then the average power consumed in watts is**

1) 200 2) 100 3) 0 4) 50

22. **In a black box of unkown elements (L, C or R or any other combination) an AC voltage $E = E_0\sin(\omega t+\phi)$ is applied and current in the circuit was found to be $i=i_0\sin(\omega t+\phi+\pi/4)$. Then the unknown elements in the box may be**

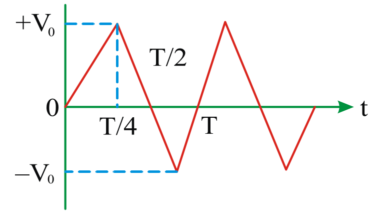


1) only capacitor 2) both inductor and resistor

3) either capacitor, resistor and inductor or only capacitor and resistor

4) only resistor

23. **The voltage time (V - t) graph for triangular wave having peak value V_0 is as shown in figure.**



The rms value of V in time interval from $t=0$ **to** $\frac{T}{4}$ **is**

1) $\frac{V_0}{\sqrt{3}}$ 2) $\frac{V_0}{2}$ 3) $\frac{V_0}{\sqrt{2}}$ 4) $2V_o$

LEVEL-I (C.W) - KEY

1) 4 2) 3 3) 3 4) 2 5) 4 6) 2 7) 4
8) 2 9) 3 10) 4 11) 3 12) 1 13) 4 14) 1
15) 1 16) 1 17) 3 18) 4 19) 2 20) 3 21) 4
22) 3 23) 1

LEVEL-I (C.W) - HINTS

1. $i_0=\sqrt{2}i_{rms}\quad ,T=\frac{1}{f},t=\frac{T}{4}$

2. $i=\frac{E_0}{\sqrt{R^2+X_L^2}},\ X_L=L\omega$

3. $V_0=\sqrt{2}.V_{r.m.s.}=\sqrt{2}\times200=311\,volt$

4. $I_{rms}=\frac{I_0}{\sqrt{2}}$

5. $t=\frac{T}{4}=\frac{1}{4f}$

6. $E=E_0\sin\omega$ t ; voltage read is r.m.s. value

$E_0=\sqrt{2}\times234V=331$ volt

and $\omega\,\mathrm{t}=2\pi\,nt=2\pi\times50\times t=100\,\pi\,t$

Thus, the eqn of line voltage is given by

V = 331 sin(100π t)

7. For one complete rotation, average voltage is zero

8. $Z=\frac{E_0}{I_0}$

9. $\frac{v^2}{R}=x,\ \frac{v_1^2}{R}=\frac{x}{2}\Rightarrow v_1=\frac{v}{\sqrt{2}}$

$\therefore$ in the second case $V_{rms}=V_1$ $\quad\therefore$ $V_0=\sqrt{2}V_1$

10. $I_{rms} = \frac{E_{rms}}{X_C} = \frac{E_0 \omega C}{\sqrt{2}}$

11. $X_L = 2\pi fl = 6.28 \times 60 \times 0.70 = 263.76\Omega$

$I = \frac{V}{X_L} = \frac{120}{263.76} = 0.455A$

12. $\frac{n_s}{n_p} = \frac{V_s}{V_p}$

13. Frequency remains same. $\frac{V_s}{V_p} = 5$

14. $\frac{E_s}{E_p} = \frac{N_s}{N_p} = \frac{i_p}{i_s}$, $P = E_s i_s$

15. $\tan\theta = \frac{2\pi fL}{R}$, $f = \frac{1}{2\pi\sqrt{LC}}$

16. $Z = \left(2\pi fL - \frac{1}{2\pi fC}\right)$

17. $\omega = \frac{1}{\sqrt{LC}} \Rightarrow L = \frac{1}{\omega^2 C} = \frac{1}{(2\pi n)^2 C}$

18. $V = \sqrt{V_R^2 + (V_L - V_C)^2}$

19. When d.c. source, $R = \frac{V}{I} = \frac{30}{2} = 15\Omega$

When a.c. source, $Z = \frac{30}{1.2} = 25\Omega$

$X_L = \sqrt{(25)^2 - (15)^2} = \sqrt{625 - 225} = 20\Omega$

20. Average power is zero

21. $P_{avg} = I_{rms} E_{rms} \cos\phi = \frac{1}{\sqrt{2}} \times \frac{200}{\sqrt{2}} \cos 60°$

50W

22. Here current leads the voltage. So, there is reactance which is capacitive

$\Rightarrow X = X_C - X_L$ or $X = X_C$ alone besides R

23. Ans : (a)

$V = \frac{V_0 t}{T/4} = \frac{4V_0 t}{T}$

$$V_{rms} = \sqrt{\langle V^2 \rangle} = \frac{4V_0}{T}\left\{\frac{\int_0^{T/4} t^2 dt}{\int_0^{T/4} dt}\right\} = \frac{V_0}{\sqrt{3}}$$

LEVEL-I (H.W)

INSTANTANEOUS, PEAK,R.M.S & AVERAGE VALUES OF A.C AND A.V

1. For a given AC source the average emf during the positive half cycle

1) depends on E_0
2) depends on shape of wave
3) both 1 and 2
4) depends only on peak value of E_0

2. An alternating emf given by $V = V_0 \, Sin\,\omega t$ has peak value 10 volt and frequency 50 Hz. The instantaneous emf at $t = \frac{1}{600} s$ is

1) 10 V 2) $5\sqrt{3}V$ 3) 5 V 4) 1V

3. The equation of A.C. of frequency 75Hz, if it's RMS value is 20A is

1) $I = 20 Sin(150\pi t)$ 2) $I = 20\sqrt{2} Sin(150\pi t)$
3) $I = \frac{20}{\sqrt{2}} Sin(150\pi t)$ 4) $I = 20\sqrt{2} Sin(75\pi t)$

4. The voltage of an A.C. source varies with time according to the equation $V = 50 \sin 100\pi t \cos 100\pi t$, where 't' is in sec and 'V' is in volt. Then

1) The peak voltage of the source is 100 V
2) The peak voltage of the source is $100/\sqrt{2}V$
3) The peak voltage of the source is 25 V
4) The frequency of the source is 50 Hz

5. The form factor for a sinusoidal A.C. is

1) $2\sqrt{2} : \pi$ 2) $\pi : 2\sqrt{2}$ 3) $\sqrt{2} : 1$ 4) $1 : \sqrt{2}$

6. At resonance the peak value of current in L-C-R series circuit is

1) E_0/R 2) $\frac{E_0}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$

3) $\frac{E_0}{\sqrt{2}\sqrt{R^2 + \left(\omega^2 L - \frac{1}{\omega^2 C^2}\right)^2}}$ 4) $\frac{E_0}{\sqrt{2}R}$

7. In an AC circuit, the rms value of the current, I_{rms} is related to the peak current I_0 as

1) $I_{rms} = \frac{1}{\pi} I_0$ 2) $I_{rms} = \frac{1}{\sqrt{2}} I_0$
3) $I_{rms} = \sqrt{2} I_0$ 4) $I_{rms} = \pi I_0$

8. **A voltmeter connected in an A.C circuit reads 220V. It represents,**
1) peak voltage 2) RMS voltage
3) Average voltage 4) Mean square voltage

9. **If the instantaneous current in a circuit is given by $I = 2\cos(\omega t + \phi)$ A, the rms value of the current is**
1) $2\,A$ 2) $\sqrt{2}\,A$ 3) $2\sqrt{2}\,A$ 4) zero

10. **The time taken by an AC of 50 Hz in reaching from zero to its maximum value will be**
1) 0.5 s 2) 0.005 s 3) 0.05 s 4) 5s

11. **A generator produces a voltage that is given by V=240 sin 120t V, where t is in second. The frequency and r.m.s. voltage are respectively**
1) 60Hz and 240V 2) 19Hz and 120V
3) 19Hz and 170V 4) 754Hz and 170V

A.C ACROSS PURE RESISTOR, INDUCTOR & CAPACITOR

12. **A 220 V, 50 Hz AC supply is connected across a resistor of 50 $k\Omega$. The current at time t second, assuming that it is zero at $t = 0$, is**
1) $4.4\sin(314t)\,mA$ 2) $6.2\sin(314t)\,mA$
3) $4.4\sin(157t)\,mA$ 4) $6.2\sin(157t)\,mA$

13. **A resistance of 20Ω is connected to a source of alternating current rated 110 V, 50 Hz. Then the time taken by the current to change from its maximum value to the r.m.s. value is**
1) 2.5×10^{-3} sec 2) 2.5×10^{-2} sec
3) 5×10^{-3} sec 4) 25×10^{-3} sec

14. **A condenser of capacity 1pF is connected to an A.C source of 220V and 50Hz frequency. The current flowing in the circuit will be**
1) 6.9×10^{-8}A 2) 6.9A 3) 6.9×10^{-6}A 4) zero

15. **In a circuit, the frequency is $f = \frac{1000}{2\pi}$ Hz and the inductance is 2 henry, then the reactance will be**
1) 200Ω 2) $200\mu\Omega$ 3) 2000Ω 4) $2000\mu\Omega$

TRANSFORMER

16. **The transformer ratio of a transformer is 10:1. The current in the primary circuit if the secondary current required is 100 A assuming the transformer be ideal, is**
1) 500 A 2) 200 A 3) 1000 A 4) 2000 A

17. **The transformer ratio of a transformer is 10:1. If the primary voltage is 440V, secondary emf is**
1) 44 V 2) 440V 3) 4400 V 4) 44000 V

A.C ACROSS L-R, L-C & L-C-R SERIES CIRCUITS

18. **The frequency at which the inductive reactance of 2H inductance will be equal to the capacitive reactance of 2μF capacitance (nearly)**
1) 80Hz 2) 40 Hz 3) 60Hz 4) 20Hz

19. **In a series LCR circuit $R = 10\Omega$ and the impedance $Z = 20\Omega$. Then the phase difference between the current and the voltage is**
1) 60^o 2) 30^o 3) 45^o 4) 90^o

20. **In an L-C-R series circuit,**
$R = \sqrt{5}\Omega,\ X_L = 9\Omega,\ X_C = 7\Omega$. **If applied voltage in the circuit is 50V then impedance of the circuit in ohm will be**
1) 2 2) 3 3) $2\sqrt{5}$ 4) $3\sqrt{5}$

21. **In an AC circuit the potential differences across an inductance and resistance joined in series are respectively 16 V and 20 V. The total potential difference across the circuit is**
1) 20 V 2) 25.6 V 3) 31.9 V 4) 53.5 V

22. **Current in an ac circuit is given by**
$i = 3\sin\omega t + 4\cos\omega t$ **then**
1) rms value of current is 5 A
2) mean value of this current in one half period will be $6/\pi$
3) if voltage applied is $V = V_m \sin\omega t$ then the circuit must be containing resistance and capacitance
4) if voltage applied is $V = V_m \sin\omega t$, the circuit may contain resistance and inductance

23. **A fully charged capacitor C with initial charge q_0 is connected to a coil of self inductance L at $t = 0$. The time at which the energy is stored equally between the electric and the magnetic fields is**
1) $\frac{\pi}{4}\sqrt{LC}$ 2) $2\pi\sqrt{LC}$ 3) $\sqrt{LC}$ 4) $\pi\sqrt{LC}$

LEVEL-I (H.W) - KEY

1) 3 2) 3 3) 2 4) 3 5) 2 6) 1 7) 2
8) 2 9) 2 10) 2 11) 3 12) 2 13) 1 14) 1
15) 3 16) 3 17) 3 18) 1 19) 1 20) 2 21) 2
22) 3 23) 1

LEVEL-I (H.W) - HINTS

1. $E_{av} = \frac{2E_0}{T}\int_0^{T/2} \sin(\omega t)\,dt = \frac{2E_0}{\pi}$

2. $V = 10\sin(100\pi t);\quad t = \frac{1}{600}s$

3. $i = i_0 \sin\omega t = \sqrt{2}\, i_{rms} \sin(2\pi ft)$

4. $V_0 = \sqrt{2}.V_{r.m.s.}$

5. $\text{Form factor} = \frac{\text{rms value}}{\text{avg value over half a cycle}}$

9. $I_{rms} = \frac{I_0}{\sqrt{2}}$

10. $t = \frac{T}{4} = \frac{1}{4f}$

11. $V = V_m \sin\omega t$ compare to given equation, we get $V_m = 240$ and $\omega = 120$

$f = \frac{\omega}{2\pi} = \frac{120}{6.28} = 19H_2$ and

$\text{voltage} = \frac{V_m}{\sqrt{2}} = \frac{240}{\sqrt{2}} = 170V$

12. $i = i_0 \sin\omega t$

$\omega = 2\pi f;\; i_0 = \frac{E_0}{R} = \frac{\sqrt{2}\times E_{rms}}{R}$

13. $E = E_0\cos\omega t$, $i = i_0\cos(2\pi ft)$ but $i = \frac{i_0}{\sqrt{2}}$

14. $i_{rms} = \frac{E_{rms}}{X_c}$

15. $X_L = \omega L = 2\pi fl = 2\pi\times\frac{1000}{2\pi}\times 2 = 2000\Omega$

16. $\frac{N_S}{N_p} = \frac{I_p}{I_S}$

17. $\frac{N_S}{N_p} = \frac{V_S}{V_p}$

18. $f = \frac{1}{2\pi\sqrt{LC}}$

19. $\cos\phi = \frac{R}{Z}$

20. Impedance, $Z = R + X_C + X_L$

$= \left(\sqrt{5}i - 7j + 9j\right) = \sqrt{5}i + 2j$

$|Z| = \sqrt{5+4} = \sqrt{9} = 3$

21. $V_{rms} = \sqrt{16^2 + 20^2} = \sqrt{656} \approx 25.6V$

22.. Ans : (c)

$i = 5\left(\frac{3}{5}\sin\omega t + \frac{4}{5}\cos\omega t\right) = 5\sin(\omega t + \delta)$

rms value is $\frac{5}{\sqrt{2}}$

Mean value can not be decided.

Here current leads voltage so, it is RC circuit

23. As initially charge is maximum

$q = q_0\cos\omega t$

$\Rightarrow i = \frac{dq}{dt} = -\omega q_0 \sin\omega t$

Given $\frac{1}{2}Li^2 = \frac{q^2}{2C}$

$\Rightarrow \frac{1}{2}L(\omega q_0\sin\omega t)^2 = \frac{(q_0\cos\omega t)^2}{2C}$

But, $\omega = \frac{1}{\sqrt{LC}} \quad \Rightarrow \tan\omega t = 1$

$\omega t = \frac{\pi}{4} \qquad \Rightarrow t = \frac{\pi}{4\omega} = \frac{\pi}{4}\sqrt{LC}$

LEVEL-I (H.W)

INSTANTANEOUS, PEAK,R.M.S & AVERAGE VALUES OF A.C AND A.V

1. **The average current of a sinusoidally varying alternating current of peak value 5A with initial phase zero, between the instants t = T/8 to t = T/4 is (Where 'T' is time period)**

1) $\frac{10}{\pi}\sqrt{2}A$ 2) $\frac{5}{\pi}\sqrt{2}A$ 3) $\frac{20\sqrt{2}}{\pi}A$ 4) $\frac{10}{\pi}A$

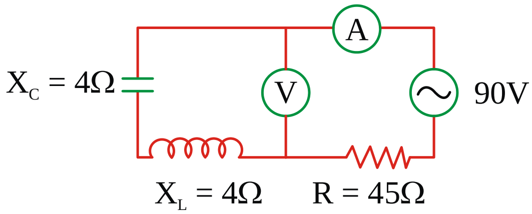
A.C ACROSS L-R, L-C & L-C-R SERIES CIRCUITS

2. **A 100Ω resistance is connected in series with a 4H inductor. The voltage across the resistor is $V_R = 2\sin(1000t)V$. The voltage across the inductor is**

1) $80\sin\left(1000t + \frac{\pi}{2}\right)$ 2) $40\sin\left(1000t + \frac{\pi}{2}\right)$

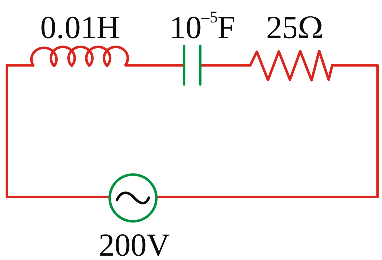
3) $80\sin\left(1000t - \frac{\pi}{2}\right)$ 4) $40\sin\left(1000t - \frac{\pi}{2}\right)$

3. **The reading of voltmeter and ammeter in the following figure will respectively be**



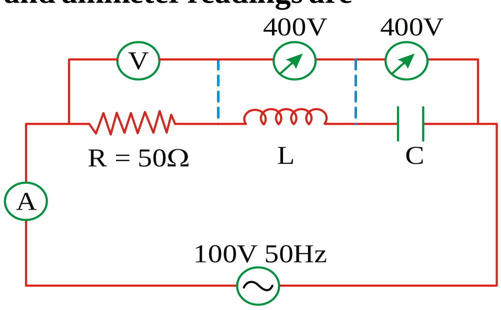
1) 0 and 2A 2) 2A and 0V
3) 2V and 2A 4) 0V and 0A

4. **In the following circuit, the values of current flowing in the circuit at f = 0 and f = ∞ will respectively be**



1) 8A and 0A 2) 0A and 0A
3) 8A and 8A 4) 0A and 8A

5. **In the series L-C-R circuit figure the voltmeter and ammeter readings are**



1) V=100 volt, I=2A 2) V=100 volt, I = 5 A
3) V=1000 volt, I=2A 4) V=300 volt, I = 1 A

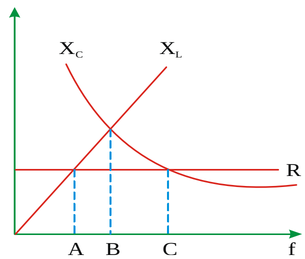
6. **The potential difference between the ends of a resistance R is V_R, between the ends of capacitor is $V_C = 2V_R$ and between the ends of inductance is $V_L = 3V_R$. Then the alternating potential of the source in terms of V_R will be**

1) $\sqrt{2}V_R$ 2) V_R 3) $\frac{V_R}{\sqrt{2}}$ 4) $5V_R$

7. **A 220V, 50Hz a.c. generator is connected to an inductor and a 50Ω resistance in series. The current in the circuit is 1.0A. The P.D. across inductor is**

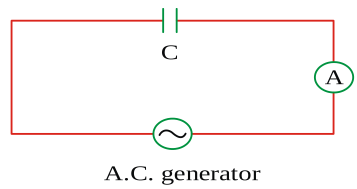
1) 102.2V 2) 186.4V 3) 213.6V 4) 302V

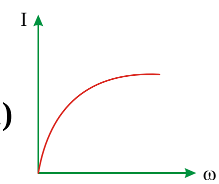
8. **The figure shows variation of R, X_L and X_C with frequenc *f* in a series L, C, R circuit. Then for what frequency point, the circuit is inductive**

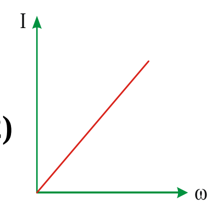


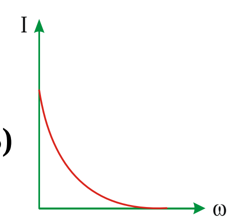
1) A 2) B 3) C 4) All points

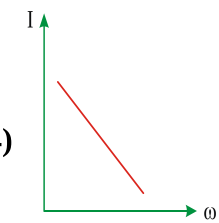
9. **A constant voltage at different frequencies is applied across a capacitance C as shown in the figure. Which of the following graphs correctly depicts the variation of current with frequency**



1) 

2) 

3) 

4) 

10. **In a series $L-C-R$ circuit $R = 200\Omega$ and the voltage and the frequency of the main supply is 220 V and 50Hz respectively. On taking out the capacitance from the circuit the current lags behind the voltage by 30^0. On taking out the inductor from the circuit the current leads the voltage by 30^0. The power dissipated in the $L-C-R$ circuit is**

1) 305 W 2) 210 W 3) zero 4) 242 W

11. **In a series resonant LCR circuit, the voltage across R is 100V and $R = 1k\Omega$ with $C = 2\mu F$. The resonant frequency ω is 200 rad/s. At resonance the voltage across L is**

1) $2.5\times10^{-2}V$ 2) 40 V 3) 250 V 4) $4\times10^{-3}V$

LEVEL-II (C.W) - KEY

1) 1 2) 1 3) 1 4) 2 5) 1 6) 1 7) 3
8) 3 9) 2 10) 4 11) 2

LEVEL-II (C.W) - HINTS

1. $<i> = \dfrac{\int_{T/8}^{T/4} i\,dt}{\int_{T/8}^{T/4} dt}$

2. $i = \dfrac{(V_0)_R}{R}, V_L = (V_0)_L \sin\left(\omega t + \dfrac{\pi}{2}\right) and (V_0)_L = X_L i$

3. $I_{rms} = \dfrac{E_{rms}}{R} = 2A$; $V_{rms} = I_{rms}(X_L - X_C) = 0$

$\therefore$ circuit is at resonance

4. $I = \dfrac{E}{Z} = \dfrac{E}{\sqrt{R^2 + \left[2\pi f L - \dfrac{1}{2\pi f C}\right]^2}}$

5. $I_{r.m.s.} = \dfrac{V_{r.m.s.}}{Z} = \dfrac{V_{r.m.s.}}{R} = \dfrac{100}{50} = 2A$

$V = \sqrt{V_R^2 + (V_L - V_C)^2}$

6. $\overline{V}_S = \overline{V_B} + \overline{V_C} + \overline{V_L} = V_R\hat{i} - 2V_R\hat{j} + 3V_R\hat{j}$

$= V_R\hat{i} + V_R\hat{j}$, $|\overline{V}| = \sqrt{2}V_R$

7. $I = \dfrac{E}{Z}$, $\therefore I = \dfrac{220}{Z}$, $Z = 220\Omega$

$Z^2 = R^2 + X_L^2 \quad \therefore \quad X_L = \sqrt{Z^2 - R^2}$

$L = \dfrac{1}{\omega}\sqrt{Z^2 - R^2} \qquad \therefore L = \dfrac{1}{2\pi f}\sqrt{Z^2 - R^2} = 0.68H$

$\therefore V_L = \omega L I = 2\pi \times 0.5 \times 0.68 \times 1 = 213.6\text{V}$

8. At A : $X_C > X_L$; At B : $X_C = X_L$; At C : $X_C < X_L$

9. For capacitive circuits $X_C = \dfrac{1}{\omega C}$

$\therefore i = \dfrac{V}{X_C} V\omega C \Rightarrow i \propto \omega$

10. The given circuit is under resonance as $X_L = X_C$
Hence, power dissipated in the circuit is

$P = \dfrac{V^2}{R} = 242W$

11. At resonance, $\omega L = \dfrac{1}{\omega C}$
current flowing through the circuit

$I = \dfrac{V_R}{R} = \dfrac{100}{1000} = 0.1A$

So, voltage across L is given by

$V_L = I X_L = I\omega L \qquad$ but $\omega L = \dfrac{I}{\omega}$

$V_I = \dfrac{I}{\omega C} = \dfrac{0.1}{200 \times 2 \times 10^{-6}} = 250V$