DPP - Daily Practice Problems

Chapter-wise Sheets

Date : | **Start Time :** | **End Time :**

PHYSICS

CP21

SYLLABUS : Alternating Current

Max. Marks : 180 **Marking Scheme :** (+4) for correct & (–1) for incorrect answer **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 45 MCQs. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. In a series resonant LCR circuit, the voltage across R is 100 volts and $R = 1$ kΩ with C = 2μF. The resonant frequency ω is 200 rad/s. At resonance, the voltage across L is

(a) 2.5×10^{-2} V (b) 40 V

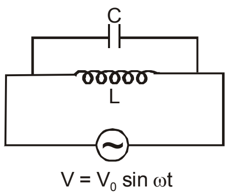
(c) 250 V (d) 4×10^{-3} V

2. An alternating voltage $V = V_0 \sin \omega t$ is applied across a circuit. As a result, a current $I = I_0 \sin(\omega t - \pi/2)$ flows in it. The power consumed per cycle is

(a) zero (b) $0.5\, V_0 I_0$

(c) $0.707\, V_0 I_0$ (d) $1.414\, V_0 I_0$

3. For the circuit shown in the fig., the current through the inductor is 0.9 A while the current through the condenser is 0.4 A. Then



(a) current drawn from generator I = 1.13 A

(b) $\omega = 1/(1.5\, LC)$

(c) I = 0.5 A

(d) I = 0.6 A

4. A capacitor has capacity C and reactance X. If capacitance and frequency become double, then reactance will be

(a) 4X (b) X/2 (c) X/4 (d) 2X

5. A coil of inductance 300 mH and resistance 2Ω is connected to a source of voltage 2V. The current reaches half of its steady state value in

(a) 0.1 s (b) 0.05 s (c) 0.3 s (d) 0.15 s

6. In an A.C. circuit, a resistance of R ohm is connected in series with an inductance L. If phase angle between voltage and current be 45°, the value of inductive reactance will be

(a) R/4 (b) R/2 (c) R (d) R/5

7. A bulb is rated at 100 V, 100 W, it can be treated as a resistor. Find out the inductance of an inductor (called choke coil) that should be connected in series with the bulb to operate the bulb at its rated power with the help of an ac source of 200 V and 50 Hz.

(a) $\frac{\pi}{\sqrt{3}}$ H (b) 100 H (c) $\frac{\sqrt{2}}{\pi}$ H (d) $\frac{\sqrt{3}}{\pi}$ H

8. An ac source of angular frequency ω is fed across a resistor r and a capacitor C in series. The current registered is I. If now the frequency of source is changed to $\omega/3$ (but maintaining the same voltage), the current in the circuit is found to be halved. The ratio of reactance to resistance at the original frequency ω is

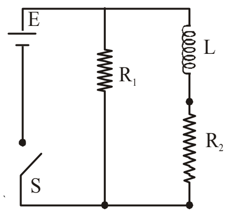
(a) $\sqrt{\frac{3}{5}}$ (b) $\sqrt{\frac{2}{5}}$ (c) $\sqrt{\frac{1}{5}}$ (d) $\sqrt{\frac{4}{5}}$

RESPONSE GRID					
	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ		

Space for Rough Work

9. Large transformers, when used for some time, become hot and are cooled by circulating oil. The heating of transformer is due to
(a) heating effect of current alone
(b) hysteresis loss alone
(c) both the hysteresis loss and heating effect of current
(d) none of the above

10. An inductor of inductance $L = 400$ mH and resistors of resistance $R_1 = 2\Omega$ and $R_2 = 2\Omega$ are connected to a battery of emf 12 V as shown in the figure. The internal resistance of the battery is negligible. The switch S is closed at $t = 0$. The potential drop across L as a function of time is



(a) $\frac{12}{t}e^{-3t}$ V (b) $6(1 - e^{-t/0.2})$V
(c) $12e^{-5t}$ V (d) $6e^{-5t}$ V

11. An ideal coil of 10H is connected in series with a resistance of 5Ω and a battery of 5V. 2second after the connection is made, the current flowing in ampere in the circuit is
(a) $(1 - e^{-1})$ (b) $(1 - e)$ (c) e (d) e^{-1}

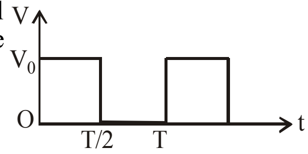
12. In an A.C. circuit, the current flowing in inductance is I = 5 sin (100 t – π/2) amperes and the potential difference is V = 200 sin (100 t) volts. The power consumption is equal to
(a) 1000 watt (b) 40 watt
(c) 20 watt (d) Zero

13. In an oscillating LC 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) $\frac{Q}{2}$ (b) $\frac{Q}{\sqrt{3}}$ (c) $\frac{Q}{\sqrt{2}}$ (d) Q

14. 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:
(a) $\frac{\pi}{4}\sqrt{LC}$ (b) $2\pi\sqrt{LC}$ (c) $\sqrt{LC}$ (d) $\pi\sqrt{LC}$

15. For an LCR series circuit with an A.C. source of angular frequency ω
(a) circuit will be capacitive if $\omega > \frac{1}{\sqrt{LC}}$
(b) circuit will be inductive if $\omega = \frac{1}{\sqrt{LC}}$
(c) power factor of circuit will be unity if capacitive reactance equals inductive reactance
(d) current will be leading voltage if $\omega > \frac{1}{\sqrt{LC}}$

16. The r.m.s. value of potential difference V shown in the figure is



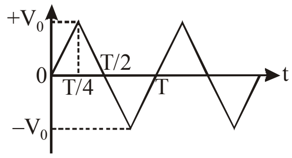
(a) V_0 (b) $V_0/\sqrt{2}$ (c) $V_0/2$ (d) $V_0/\sqrt{3}$

17. Which of the following statements is/are incorrect?
(a) If the resonance is less sharp, not only is the maximum current less, the circuit is close to resonance for a larger range Δω of frequencies and the tuning of the circuit will not be good.
(b) Less sharp the resonance less is the selectivity of the circuit or *vice–versa*.
(c) If quality factor is large, i.e., R is low or L is large, the circuit is more selective.
(d) Below resonance, voltage leads the current while above it, current leads the voltage.

18. A lamp consumes only 50% of peak power in an a.c. circuit. What is the phase difference between the applied voltage and the circuit current?
(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3}$ (c) $\frac{\pi}{4}$ (d) $\frac{\pi}{2}$

19. A step down transformer reduces 220 V to 110 V. The primary draws 5 ampere of current and secondary supplies 9 ampere. The efficiency of transformer is
(a) 20% (b) 44% (c) 90% (d) 100%

20. 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 T/4 is $\frac{V_0}{\sqrt{x}}$ then find the value of x.



(a) 5 (b) 4 (c) 7 (d) 3

21. The tuning circuit of a radio receiver has a resistance of 50 Ω, an inductor of 10 mH and a variable capacitor. A 1 MHz radio wave produces a potential difference of 0.1 mV. The values of the capacitor to produce resonance is (Take $\pi^2 = 10$)
(a) 2.5 pF (b) 5.0 pF (c) 25 pF (d) 50 pF

22. In an alternating current circuit in which an inductance and capacitance are joined in series, current is found to be maximum when the value of inductance is 0.5 henry and the value of capacitance is 8μF. The angular frequency of applied alternating voltage will be
(a) 5000 rad/sec (b) 4000 rad/sec
(c) 2×10^5 rad/sec (d) 500 rad/sec

23. 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) 4.0A (b) 8.0A (c) $\frac{20}{\sqrt{13}}$A (d) 2.0A

RESPONSE GRID					
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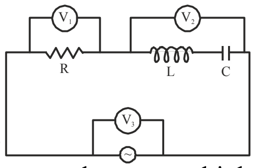
	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ
	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ

Space for Rough Work

24. In the figure shown, three AC voltmeters are connected. At resonance



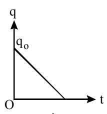
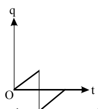
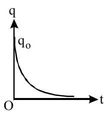
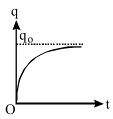
(a) $V_2 = 0$ (b) $V_1 = 0$
(c) $V_3 = 0$ (d) $V_1 = V_2 \neq 0$

25. A.C. power is transmitted from a power house at a high voltage as
(a) the rate of transmission is faster at high voltages
(b) it is more economical due to less power loss
(c) power cannot be transmitted at low voltages
(d) a precaution against theft of transmission lines

26. A transformer has an efficiency of 80%. It works at 4 kW and 100 V. If secondary voltage is 240 V, the current in primary coil is
(a) 0.4 A (b) 4 A (c) 10 A (d) 40 A

27. A 12 Ω resistor and a 0.21 henry inductor are connected in series to an a.c. source operating at 20 volt, 50 cycle. The phase angle between the current and source voltage is
(a) 30º (b) 40º (c) 80º (d) 90º

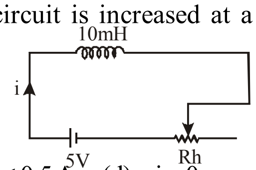
28. In LCR series circuit fed by a DC source, how does the amplitude of charge oscillations vary with time during discharge ?

(a)  (b)  (c)  (d) 

29. The primary and secondary coil of a transformer have 50 and 1500 turns respectively. If the magnetic flux ϕ linked with the primary coil is given by $\phi = \phi_0 + 4t$, where ϕ is in webers, t is time in seconds and ϕ_0 is a constant, the output voltage across the secondary coil is
(a) 120 volts (b) 220 volts
(c) 30 volts (d) 90 volts

30. The primary winding of a transformer has 100 turns and its secondary winding has 200 turns. The primary is connected to an A.C. supply of 120 V and the current flowing in it is 10 A. The voltage and the current in the secondary are
(a) 240 V, 5 A (b) 240 V, 10 A
(c) 60 V, 20 A (d) 120 V, 20 A

31. The resistance in the following circuit is increased at a particular instant. At this instant the value of resistance is 10Ω. The current in the circuit will be now



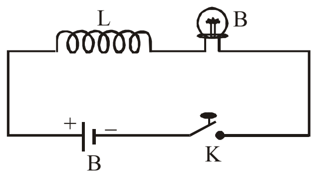
(a) i = 0.5 A (b) i > 0.5 A (c) i < 0.5 A (d) i = 0

32. The current in a *LR* circuit builds up to $\frac{3}{4}th$ of its steady state value in 4s. The time constant of this circuit is
(a) $\frac{1}{\ell n 2}s$ (b) $\frac{2}{\ell n 2}s$ (c) $\frac{3}{\ell n 2}s$ (d) $\frac{4}{\ell n 2}s$

33. An LCR series 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
(a) π (b) $\frac{\pi}{2}$ (c) $\frac{\pi}{4}$ (d) 0

34. What is the value of inductance L for which the current is maximum in a series LCR circuit with $C = 10\ \mu F$ and $\omega = 1000 s^{-1}$?
(a) 1 mH
(b) cannot be calculated unless R is known
(c) 10 mH
(d) 100 mH

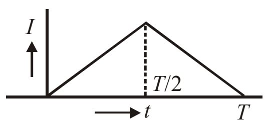
35. In the circuit of Fig, the bulb will become suddenly bright if



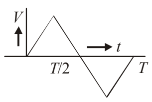
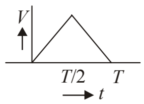
(a) contact is made or broken
(b) contact is made
(c) contact is broken
(d) won't become bright at all

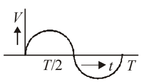
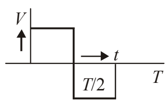
36. The voltage of an ac source varies with time according to the equation $V = 100 \sin 100\pi t \cos 100\pi t$ where t is in seconds and V is in volt. Then
(a) the peak voltage of the source is 100 volt
(b) the peak voltage of the source is 50 volt
(c) the peak voltage of the source is $100/\sqrt{2}$ volt
(d) the frequency of the source is 50 Hz

37. The current (I) in the inductance is varying with time according to the plot shown in figure.



Which one of the following is the correct variation of voltage with time in the coil?

(a)  (b) 

(c)  (d) 

RESPONSE GRID					
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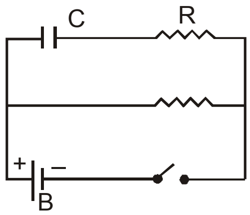
	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ	31. ⓐⓑⓒⓓ	32. ⓐⓑⓒⓓ	33. ⓐⓑⓒⓓ
	34. ⓐⓑⓒⓓ	35. ⓐⓑⓒⓓ	36. ⓐⓑⓒⓓ	37. ⓐⓑⓒⓓ	

Space for Rough Work

38. 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

(a) $V = 165 \sin(100\pi t)$ (b) $V = 331 \sin(100\pi t)$
(c) $V = 220 \sin(100\pi t)$ (d) $V = 440 \sin(100\pi t)$

39. In the circuit shown, when the switch is closed, the capacitor charges with a time constant



(a) RC
(b) 2RC
(c) $\frac{1}{2}$RC
(d) RC ln 2

40. A 100 μF capacitor in series with a 40Ω resistance is connected to a 110 V, 60 Hz supply.

What is the maximum current in the circuit?

(a) 3.24 A (b) 4.25 A (c) 2.25 A (d) 5.20 A

41. The core of any transformer is laminated so as to

(a) reduce the energy loss due to eddy currents
(b) make it light weight
(c) make it robust and strong
(d) increase the secondary voltage

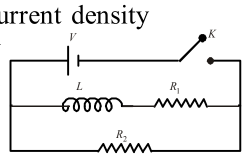
42. An AC generator of 220 V having internal resistance r = 10Ω and external resistance R = 100Ω. What is the power developed in the external circuit?

(a) 484 W (b) 400 W (c) 441 W (d) 369 W

43. What is increased in step-down transformer?

(a) Voltage (b) Current
(c) Power (d) Current density

44. In the circuit shown below, the key K is closed at t = 0. The current through the battery is



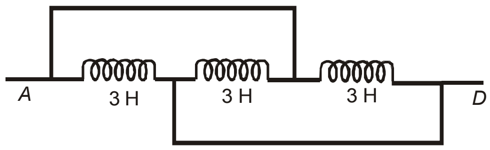
(a) $\frac{VR_1R_2}{\sqrt{R_1^2+R_2^2}}$ at $t = 0$ and $\frac{V}{R_2}$ at $t = \infty$

(b) $\frac{V}{R_2}$ at $t = 0$ and $\frac{V(R_1+R_2)}{R_1R_2}$ at $t = \infty$

(c) $\frac{V}{R_2}$ at $t = 0$ and $\frac{VR_1R_2}{\sqrt{R_1^2+R_2^2}}$ at $t = \infty$

(d) $\frac{V(R_1+R_2)}{R_1R_2}$ at $t = 0$ and $\frac{V}{R_2}$ at $t = \infty$

45. The inductance between A and D is



(a) 3.66 H (b) 9 H (c) 0.66 H (d) 1 H

RESPONSE GRID	
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	43. ⓐⓑⓒⓓ 44. ⓐⓑⓒⓓ 45. ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM DPP CHAPTERWISE CP21 - PHYSICS			
Total Questions	45	Total Marks	180
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	50	Qualifying Score	70
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS

PHYSICS SOLUTIONS

DPP/CP21

1. (c) Across resistor, $I = \frac{V}{R} = \frac{100}{1000} = 0.1\ A$

At resonance,

$$X_L = X_C = \frac{1}{\omega C} = \frac{1}{200 \times 2 \times 10^{-6}} = 2500$$

Voltage across L is

$$I X_L = 0.1 \times 2500 = 250\,\text{V}$$

2. (a) The phase angle between voltage V and current I is $\pi/2$. Therefore, power factor $\cos\phi = \cos(\pi/2) = 0$. Hence the power consumed is zero.

3. (c) The current drawn by inductor and capacitor will be in opposite phase. Hence net current drawn from generator $= I_L - I_C = 0.9 - 0.4 = 0.5$ amp.

4. (c) Capacitive reactance, $X = \frac{1}{\omega C} = \frac{1}{2\pi f C}$

$$\Rightarrow X \propto \frac{1}{fC}$$

$$\therefore \frac{X'}{X} = \frac{f}{f'} \times \frac{C}{C'} = \frac{f}{2f} \times \frac{C}{2C} = \frac{1}{4} \Rightarrow X' = \frac{X}{4}$$

5. (a) The charging of inductance given by,

$$i = i_0\left(1 - e^{-\frac{Rt}{L}}\right)$$

$$\frac{i_0}{2} = i_0(1 - e^{-\frac{Rt}{L}}) \Rightarrow e^{-\frac{Rt}{L}} = \frac{1}{2}$$

Taking log on both the sides,

$$-\frac{Rt}{L} = \log 1 - \log 2$$

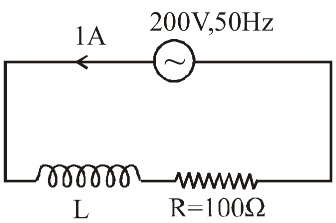
$$\Rightarrow t = \frac{L}{R}\log 2 = \frac{300 \times 10^{-3}}{2} \times 0.69$$

$$\Rightarrow t = 0.1 \text{ sec.}$$

6. (c) $\tan\phi = \frac{\omega L}{R} = \frac{X_L}{R}$

Given $\phi = 45°$. Hence $X_L = R$.

7. (d)



From the rating of the bulb, the resistance of the bulb can be calculated.

$$R = \frac{V_{rms}^2}{P} = 100\Omega$$

For the bulb to be operated at its rated value the rms current through it should be 1A

Also, $I_{rms} = \frac{V_{rms}}{Z}$

$$\therefore \quad 1 = \frac{200}{\sqrt{100^2 + (2\pi 50.L)^2}}$$

$$L = \frac{\sqrt{3}}{\pi} H$$

8. (a) At angular frequency ω, the current in RC circuit is given by

$$i_{max} = \frac{V_{max}}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}} \quad ....(i)$$

$$\text{Also} \quad \frac{i_{rms}}{2} = \frac{V_{rms}}{\sqrt{R^2 + \left(\frac{1}{\frac{\omega}{3}C}\right)^2}} = \frac{V_{max}}{\sqrt{R^2 + \frac{9}{\omega^2 C^2}}} \quad .....(ii)$$

From equation (i) and (ii) we get

$$3R^2 = \frac{5}{\omega^2 C^2} \Rightarrow \frac{\frac{1}{\omega C}}{R} = \sqrt{\frac{3}{5}} \Rightarrow \frac{X_C}{R} = \sqrt{\frac{3}{5}}$$

9. (c)

10. (c) Growth in current in LR_2 branch when switch is closed is given by

$$i = \frac{E}{R_2}[1 - e^{-R_2 t/L}]$$

$$\Rightarrow \frac{di}{dt} = \frac{E}{R_2} \cdot \frac{R_2}{L} . e^{-R_2 t/L} = \frac{E}{L} e^{-\frac{R_2 t}{L}}$$

Hence, potential drop across L

$$= \left(\frac{E}{L} e^{-R_2 t/L}\right) L = E e^{-R_2 t/L}$$

$$= 12 e^{-\frac{2t}{400 \times 10^{-3}}} = 12 e^{-5t} V$$

11. (a) $I = I_o\left(1 - e^{-\frac{R}{L}t}\right)$

(When current is in growth in LR circuit)

$$= \frac{E}{R}\left(1 - e^{-\frac{R}{L}t}\right) = \frac{5}{5}\left(1 - e^{-\frac{5}{10} \times 2}\right)$$

$$= (1 - e^{-1})$$

12. (d) Power, $P = \mathbf{I}_{r.m.s} \times V_{r.m.s} \times \cos\phi$

In the given problem, the phase difference between voltage and current is $\pi/2$. Hence

$$P = \mathbf{I}_{r.m.s} \times V_{r.m.s} \times \cos(\pi/2) = 0.$$

13. (c) When the capacitor is completely charged, the total energy in the LC circuit is with the capacitor and that energy is $E = \frac{1}{2}\frac{Q^2}{C}$

When half energy is with the capacitor in the form of electric field between the plates of the capacitor we get

$\frac{E}{2} = \frac{1}{2}\frac{Q'^2}{C}$ where Q' is the charge on one plate of the capacitor

$\therefore \frac{1}{2} \times \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}\frac{Q'^2}{C} \Rightarrow Q' = \frac{Q}{\sqrt{2}}$

14. (a) Energy stored in magnetic field $= \frac{1}{2} Li^2$

Energy stored in electric field $= \frac{1}{2}\frac{q^2}{C}$

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

Also $q = q_0 \cos \omega t$ and $\omega = \frac{1}{\sqrt{LC}}$

On solving $t = \frac{\pi}{4}\sqrt{LC}$

15. (c) The circuit will have inductive nature if

$\omega > \frac{1}{\sqrt{LC}} \left(\omega L > \frac{1}{\sqrt{LC}}\right)$

Hence (a) is false. Also if circuit has inductive nature the current will lag behind voltage. Hence (d) is also false.

If $\omega = \frac{1}{\sqrt{LC}}\left(\omega L = \frac{1}{\omega C}\right)$ the circuit will have resistance nature. Hence (b) is false.

Power factor

$$\cos\phi = \frac{R}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}} = 1 \text{ if } \omega L = \frac{1}{\omega C}$$

16. (b) $V_{rms} = \sqrt{\frac{(T/2)V_0^2 + 0}{T}} = \frac{V_0}{\sqrt{2}}$.

17. (d) Option (d) is false because the reason why the voltage leads the current is because $\frac{1}{C\omega} > L\omega$ and if the voltage lags, the inductive reactance is greater than the capacitive reactance.

18. (b) $P = \frac{1}{2}V_0 i_0 \cos\phi \Rightarrow P = P_{peak} . \cos\phi$

$\Rightarrow \frac{1}{2}(P_{peak}) = P_{peak}\cos\phi \Rightarrow \cos\phi = \frac{1}{2} \Rightarrow \phi = \frac{\pi}{3}$

19. (c) $\eta = \frac{E_s I_s}{E_p I_p}$ $\therefore \eta = \frac{110 \times 9}{220 \times 5} = 0.9 \times 100\% = 90\%$

20. (d) $V = \frac{V_0}{T/4}t \Rightarrow V = \frac{4V_0}{T}t$

$$\Rightarrow V_{rms} = \sqrt{<V^2>} = \frac{4V_0}{T}\sqrt{<t^2>} = \frac{4V_0}{T}\left\{\frac{\int_0^{T/4} t^2 dt}{\int_0^{T/4} dt}\right\}^{1/2} = \frac{V_0}{\sqrt{3}}$$

21. (a) $L = 10\text{ mHz} = 10^{-2}\text{ Hz}$

$f = 1\text{MHz} = 10^6\text{ Hz}$

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

$f^2 = \frac{1}{4\pi^2 LC}$

$$\Rightarrow C = \frac{1}{4\pi^2 f^2 L} = \frac{1}{4 \times 10 \times 10^{-2} \times 10^{12}} = \frac{10^{-12}}{0.4} = 2.5\ pF$$

22. (d) Current is maximum when $X_L = X_C$

$$\Rightarrow \omega L = \frac{1}{\omega C} \Rightarrow \omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.5 \times 8 \times 10^{-6}}}$$

$= \frac{1}{2 \times 10^{-3}} = 500$ rad/s.

23. (a) If $\omega = 50 \times 2\pi$ then $\omega L = 20\Omega$

If $\omega' = 100 \times 2\pi$ then $\omega' L = 40\Omega$

Current flowing in the coil is

$$I = \frac{200}{Z} = \frac{200}{\sqrt{R^2 + (\omega' L)^2}} = \frac{200}{\sqrt{(30)^2 + (40)^2}}$$

$I = 4A$.

24. (a) At resonance impedance is minimum ($\therefore X_L = X_C$) current is maximum, because V_L and V_C are equal in magnitude

$\therefore V_{LC} = V_L - V_C = 0$

Hence, voltmeter V_2 read 0 volt.

25. (b)

26. (d) As $E_p I_p = P_i$ $\therefore I_p = \frac{P_i}{E_p} = \frac{4000}{100} = 40$ A.

27. (c) The phase angle is given by

$\tan\phi = \frac{\omega L}{R} = \frac{2\pi \times 50 \times 0.21}{12} = 5.5$

$\phi = \tan^{-1} 5.5 = 80°$

28. (c)

29. (a) Since $\frac{V_s}{V_p} = \frac{N_s}{N_p}$

Where

N_s = No. of turns across primary coil = 50

N_p = No. of turns across secondary coil = 1500

and $V_p = \frac{d\phi}{dt} = \frac{d}{dt}(\phi_0 + 4t) = 4$

$\Rightarrow V_s = \frac{1500}{50} \times 4 = 120$ V

30. (a) $\frac{E_s}{E_p} = \frac{n_s}{n_p}$ or $E_s = E_p \times \left(\frac{n_s}{n_p}\right)$

$\therefore\ E_s = 120 \times \left(\frac{200}{100}\right) = 240\,V$

$\frac{I_p}{I_s} = \frac{n_s}{n_p}$ or $I_s = I_p\left(\frac{n_p}{n_s}\right)$ $\therefore\ I_s = 10\left(\frac{100}{200}\right) = 5$ amp

31. (b) $R\uparrow \Rightarrow I\downarrow \Rightarrow \frac{dI}{dt} \to (-ve) \to e = (+ve)$

$\left[\text{As } e = -L\frac{dI}{dt}\right]$

Supporting $\to I_{net}\uparrow$

32. (b) We know that, $i = i_0(1-e^{-t/\tau})$

or $\frac{3}{4}i_0 = i_0(1-e^{-4/\tau})$

or $e^{-4/\tau} = \frac{1}{4}$

or $e^{4/\tau} = 4$

$\therefore\ \frac{4}{\tau} = \ln 4$

or $\tau = \frac{2}{\ln 2}s$

33. (d) At resonance, $\omega L = \frac{1}{\omega C}$. The circuit behaves as if it contains R only. So, phase difference = 0

At resonance, impedance is minimum $Z_{min} = R$ and current is maximum, given by

$I_{max} = \frac{E}{Z_{min}} = \frac{E}{R}$

It is interesting to note that before resonance the current leads the applied emf, at resonance it is in phase, and after resonance it lags behind the emf. LCR series circuit is also called as acceptor circuit and parallel LCR circuit is called rejector circuit.

34. (d) Condition for which the current is maximum in a series LCR circuit is,

$\omega = \frac{1}{\sqrt{LC}}$

$1000 = \frac{1}{\sqrt{L(10\times10^{-6})}}$

$\Rightarrow = L = 100$ mH

35. (c) When a circuit is broken, the induced e.m.f. is largest. So the answer is (c).

36. (b) $V = 50 \times 2 \sin 100\pi \cos 100\pi t = 50 \sin 200\pi t$

$\Rightarrow V_0 = 50\,Volts$ and $\nu = 100\,Hz$

37. (d) $V = -L\frac{di}{dt}$

Here $\frac{di}{dt}$ is + ve for $\frac{T}{2}$ time and

$\frac{di}{dt}$ is – ve for next $\frac{T}{2}$ time

38. (b) $V = V_0 \sin \omega t$

Voltage in r.m.s. value

$V_0 = \sqrt{2} \times 234\,V = 331$ volt

and $\omega t = 2\pi n t = 2\pi \times 50 \times t = 100\pi t$

Thus, the equation of line voltage is given by

$V = 331 \sin(100\pi t)$

39. (a) The resistance in the middle plays no part in the charging process of C, as it does not alter either the potential difference across the RC combination or the current through it.

40. (a) Here, $C = 100\ \mu F = 100 \times 10^{-6} F, R = 40\,\Omega$, $V_{rms} = 110\,V, f = 60\,Hz$

Peak voltage,

$V_0 = \sqrt{2}\ .\ V_{rms} = 100\sqrt{2} = 155.54\,V$

Circuit impedance,

$Z = \sqrt{R^2 + \frac{1}{\omega^2 C^2}}$

$= \sqrt{40^2 + \frac{1}{(2\times\pi\times60\times100\times10^{-6})^2}}$

$= \sqrt{1600 + 703.60} = \sqrt{2303.60} = 48\,\Omega$

hence, maximum current in coil,

$I_0 = \frac{V_0}{Z} = \frac{155.54}{48} = 3.24\,A$

41. (a) Laminated core provide less area of cross-section for the current to flow. Because of this, resistance of the core increases and current decreases thereby decreasing the eddy current losses.

42. (b) $V = 200V;\ r = 10\Omega$

$R' = 10 + 100\Omega = 110\Omega$

$I = \frac{V}{R'} = \frac{220}{100} = 2A$

$P = I^2R = 4 \times 100 = 400\,W$

43. (b) For step-down transformer,

$\frac{V_P}{V_S} = \frac{I_S}{I_P}$ $\because V_P > V_S$ $\therefore I_S > I_P$

44. (b) At $t = 0$, no current will flow through L and R_1

$\therefore$ Current through battery $= \frac{V}{R_2}$

At $t = \infty$,

effective resistance, $R_{eff} = \frac{R_1R_2}{R_1+R_2}$

$\therefore$ Current through battery $= \frac{V}{R_{eff}}$

$= \frac{V(R_1+R_2)}{R_1R_2}$

45. (d) These three inductors are connected in parallel. The equivalent inductance L_p is given by

$\frac{1}{L_p} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = \frac{3}{3} = 1$

$\therefore L_p = 1$