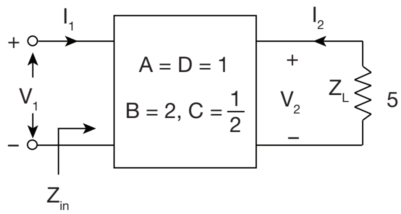
Networks Test 4

Number of Questions: 25 **Section Marks: 90**

Directions for questions 1 to 25: Select the correct alternative from the given choices.

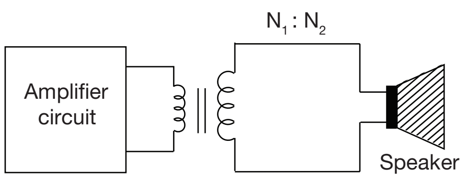
1. Consider the circuit shown in figure



The input impedance Z_{in} is ________.

(A) 3.5 Ω (B) 2 Ω
(C) 7 Ω (D) 5 Ω

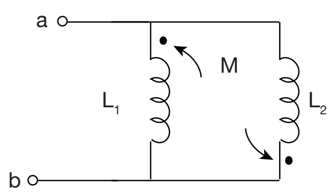
2. The ideal transformer in figure is used to match the amplifier circuit to the loud speaker to achieve maximum power transfer.



If the output impedance of the amplifier is 192 Ω and the internal impedance of the speaker is 48 Ω. Then the required turns ratio ($N_1 : N_2$) is ________

(A) 2 : 1 (B) 1 : 2
(C) 1 : 3 (D) 1 : 4

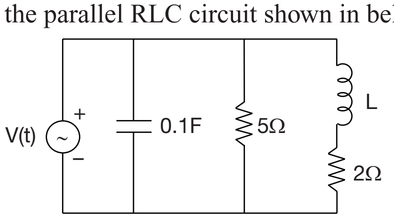
3.



Two coils are mutually coupled with L_1 = 10H and L_2 = 40H and k = 0.5. Then the maximum possible equivalent inductance in between the terminals '*a*' and '*b*' is ________

(A) 30 H (B) 4.28 H
(C) 5 H (D) 8 H

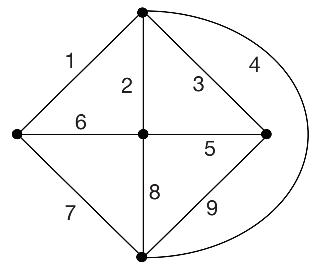
4. Consider the parallel RLC circuit shown in below.



If resonant frequency ω_o = 2 rad/sec, then the value of L is _______

(A) 0.5 H (B) 2 H
(C) A and B (D) 4 H

5. Consider the graph shown in below.

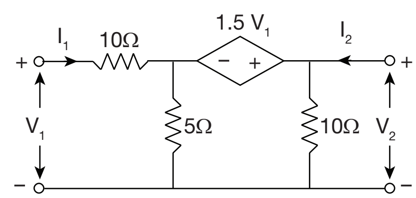


Match List – I with List – II:

List – I		**List – II**	
P	Links	a	2, 5, 6, 8
Q	f-loops	b	1, 4, 5, 9
R	twigs	c	1, 2, 3, 4
S	f-cut set	d	2, 3, 6, 7, 8
		e	3, 4, 9

(A) $P-d, Q-e, R-c, S-a$
(B) $P-c, Q-d, R-a, S-e$
(C) $P-c, Q-d, R-b, S-e$
(D) $P-d, Q-e, R-b, S-a$

6.

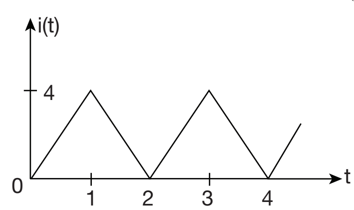


The h-parameters (h_{11} and h_{21}) of the circuit is ________

(A) 4 Ω and –2.2 (B) 4 Ω and $\frac{5}{11}$

(C) 2.5 Ω and –2.2 (D) $\frac{11}{5}$ Ω and 1.2

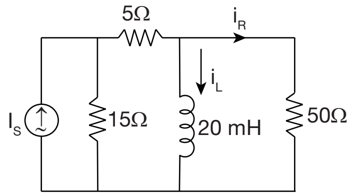
7. The RMS value of the current wave form $i(t)$ is _____.



(A) $\frac{4}{\sqrt{3}A}$ (B) $\frac{2}{\sqrt{3}A}$

(C) $\frac{\sqrt{3}}{2A}$ (D) $4\sqrt{3}A$

8. If $I_S = 5 \cos 500t$ A, In the circuit shown in figure



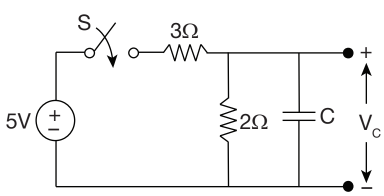
Then the circuit $i_L(t)$ is ______

(A) $2 \cos (500t - 26.56°)$ A
(B) $0.8 \sin (500t + 26°)$ A
(C) $5 \cos (500t + 30°)$ A
(D) None of these

9. The response of a network is $i(t) = 2t.e^{-5t}$ A for $t \geq 0$, the value of 't' at which the $i(t)$ will become maximum, is

(A) 0.2 sec
(B) 0.4 sec
(C) 0.25 sec
(D) 0.8 sec

10. In the network shown below, it is given that $V_c = 2.5$V and $\dfrac{dV_c}{dt} = -8$V/s at a time 't', where t is the time constant after the switch 'S' is closed. What is the value of 'C'?

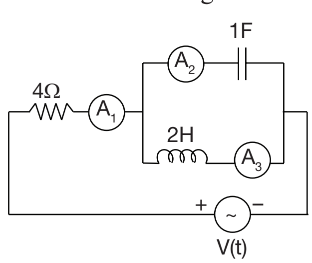


(A) 3.25 mF
(B) 1.25 mF
(C) 1 μF
(D) 0.052 F

11. In an AC series RLC circuit, the voltage across R and L is 20V, voltage across L and C is 9V and voltage across RLC is 15V. Then the ratio of $\dfrac{V_L}{V_C}$ is ______ [Assume $V_L > V_C$].

(A) 0.64
(B) 2.52
(C) 3.43
(D) 2.28

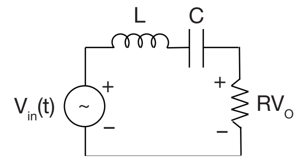
12. Consider the circuit shown in figure



If A_1, A_2 and A_3 are ideal ammeters. It A_1 and A_3 reads 8A and 3A respectively, then A_2 should read ______

(A) 5 A
(B) 11 A
(C) 8.66 A
(D) None

13. Consider the circuit shown in below.



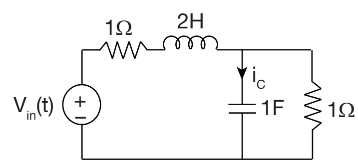
It is a

(A) BSF
(B) APF
(C) BPF
(D) HPF

14. The coil of a certain relay is operated by 15 V battery. If the coil has a resistance of 200 Ω and an inductance of 25 mH and the current needed to pull in is 40 mA, calculate the relay delay time.

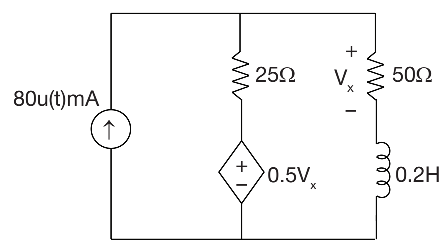
(A) 0.11 ms
(B) 0.15 ms
(C) 1.25 ms
(D) 0.5 ms

15. If $i_c(t) = -5.e^{-2.5t}$ A, the voltage of the source of the given circuit, $V_{in}(t)$ is given by



(A) $-16.e^{-2.5t}$ V
(B) $14.e^{-2.5t}$ V
(C) $8.e^{-2.5t}$ V
(D) $-10.e^{-2.5t}$ V

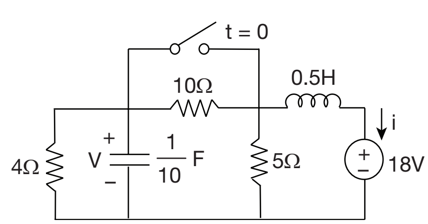
16.



Find $V_x(t)$ for all t?

(A) $1.6[1 - e^{-150t}]u(t)$ mV
(B) $80[1 - e^{-150t}]u(t)$mV
(C) $2.5[1 - e^{-75t}]u(t)$ V
(D) $1.6[1 - e^{-75t}]u(t)$ mV

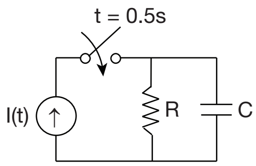
17. Consider the circuit shown in below figure



Find the steady state values of voltage and current

(A) 10V, 8.1 A
(B) 18V, –8.1 A
(C) 8V, 4.5 A
(D) 6V, 9 A

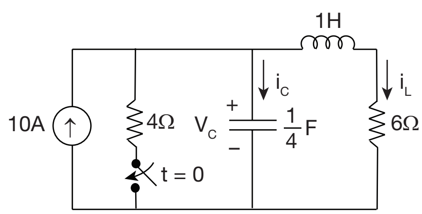
18. Consider the circuit shown in figure



If $i(t) = I_m.\cos(2t + f)$Amp and time constant of the circuit is ½ sec.
At what value of f, the circuit gives transient free response?

(A) 135° (B) 1.356 rad
(C) 77.70° (D) B and C

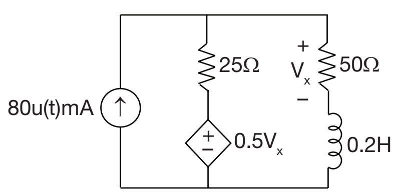
19. Consider the circuit shown in figure



Determine the values of $\dfrac{di_L(0^+)}{dt}$ and $\dfrac{dV_C(0^+)}{dt}$

(A) –10 A/sec and 0
(B) 10 A/sec and –60 V/sec
(C) 12.5 A/sec and 45 V/sec
(D) 0 and –60 V/sec

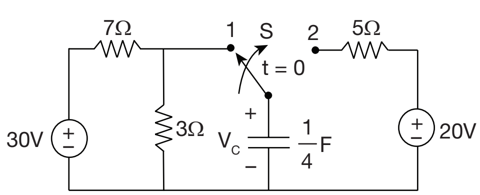
20.



Find the value of V_c at t = 2ms.

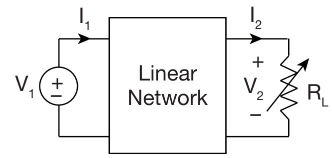
(A) 1.06 V (B) 0.75 V
(C) 3.5 V (D) 1.25 V

21. For the circuit shown in figure below, the switch has been in position 1 for a long time. At t = 0, the switch is moved to position 2. Then, the capacitor voltage $V_c(t)$ for $t > 0$ is ______



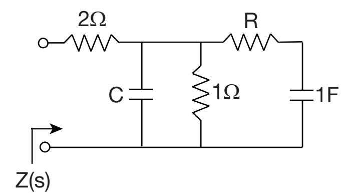
(A) $(9 + 11.e^{-4t/5})$ volts (B) $(20 - 11.e^{-4t/5})$ volts
(C) $(20 + 9.e^{-1.25t})$ volts (D) $(9 + 11\ e^{-1.25t})$ volts

22. In a linear network, a 1 Ω resistor consumes a power of 4 W, when voltage source of 4 V is applied to the circuit and 16 W when the voltage source is replaced by an 8 V source the power consumed by the 1 Ω resistor when 10 V is applied will be



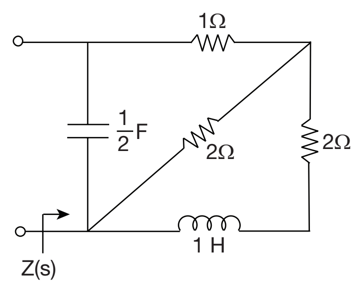
(A) 25 W (B) 20 W
(C) 18 W (D) 30 W

23. The network realization of RC impedance function, $Z(s) = \dfrac{2s^2 + 7s + 3}{s^2 + 3s + 1}$ is as shown below what are the values of R and C?



(A) 1 Ω, 1 F (B) 2 Ω, 0.5 F
(C) 1 Ω, 0.5 F (D) 2 Ω, 2 F

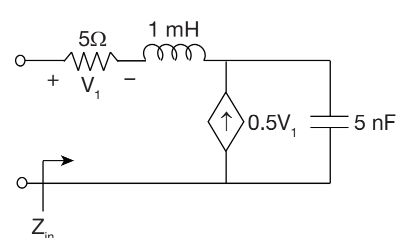
24. Consider the circuit shown in below.



The value of $Z(s)$ is ________

(A) $\dfrac{3(8+2s)}{3s^2+10s+8}$ (B) $\dfrac{(8+3s)}{s^2+10s+8}$
(C) $\dfrac{2(8+3s)}{3s^2+10s+8}$ (D) $\dfrac{2(8+3s)}{s^2+10s+8}$

25. For the circuit shown below the resonant frequency f_o is ______.



(A) 125 kHz (B) 150 kHz
(C) 830 kHz (D) 133 kHz

Answer Keys

1. B	2. A	3. B	4. C	5. D	6. A	7. A	8. A	9. A	10. D
11. D	12. B	13. C	14. A	15. B	16. A	17. B	18. D	19. D	20. A
21. B	22. A	23. A	24. C	25. D					

Hints and Explanations

1. We know T-parameters are defined interms of

$V_1 = AV_2 - BI_2$

$I_1 = CV_2 - DI_2$

$$Z_{in} = \frac{V_1}{I_1} = \frac{AV_2 - BI_2}{CV_2 - DI_2}$$

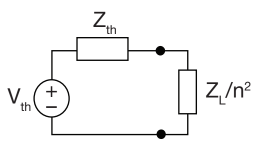
But $V_2 = -Z_L I_2$

$$\therefore \quad Z_{in} = \frac{AZ_L + B}{CZ_L + D}$$

$$= \frac{5+2}{2.5+1} = \frac{7}{3.5} = 2\ \Omega.$$

Choice (B)

2. Replace the amplifier circuit with the thevenins equivalent circuit.



$$\therefore \quad Z_{th} = 192\ \Omega \text{ and } \frac{Z_L}{n^2} = 48\,\Omega$$

$$Z_{th} = \frac{Z_L}{n^2} \text{ for max power}$$

$$\text{Where } n = \frac{N_2}{N_1}$$

$$\text{We know } R_s = \frac{R_L}{n^2}$$

$$n^2 = \frac{48}{192} = \frac{1}{4}$$

$N_1 : N_2 = 2:1$

Choice (A)

3. $M = K\sqrt{L_1 L_2} \;= 0.5\sqrt{10\times 40} \;= 10\text{H}$

For parallel opposing configuration

$$L_{eg} = \frac{L_1L_2 - M^2}{L_1 + L_2 + 2M} = \frac{400-100}{50+20}$$

$$= \frac{300}{70} = 4.28\,\text{H}$$

Choice (B)

4. $Y = 0.2 + j\omega(0.1) + \dfrac{1}{2+j\omega L}$

$$Y = 0.2 + j\omega(0.1) + \frac{2-j\omega L}{4+(\omega_0 L)^2}$$

At resonance Img $\{Y\} = 0$

$\omega = \omega_o$

$$\omega_o(0.1) = \frac{\omega_0 L}{4+(\omega_0\, L)^2}$$

$4 + (\omega_o L)^2 = 10\,L$

But given $\omega_o = 2$ r/s

$4L^2 = 10L - 4$

$2L^2 - 5L + 2 = 0$

$2L^2 - 4L - L + 2 = 0$

$2L\{L - 2\} - 1\,\{L - 2\} = 0$

$L = 2$ and $L = \dfrac{1}{2}$

Choice (C)

5. Tree branches are called twigs

$\therefore$ no. of twigs $= N - 1$

Here $N = 5$

$\therefore$ Twigs $= 4$

Select the twigs, without forming closed loop.

Co-tree branches are called links

$\therefore$ Total branches = Twigs + links

f – loops:- It consists only one link and one or more than one twigs

f-cut set:- It is a removal of one tree branch at a time.

It consists only one tree branch and others links.

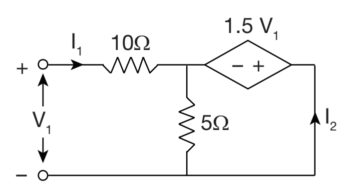
Choice (D)

6. h-parameters are defined interms of

$V_1 = h_{11}\, I_1 + h_{12}\, V_2$

$I_2 = h_{21}\, I_1 + h_{22}\, V_2$

Let $V_2 = 0$



$$h_{11} = \frac{V_1}{I_1}$$

$V_1 = 10\, I_1 - 1.5\, V_1$

$2.5\, V_1 = 10\, I_1$

$V_1/I_1 = 4\ \Omega$

$$I_1 + I_2 = \frac{-1.5V_1}{5}$$

But $V_1 = 4I_1$

$I_1 + I_2 = -0.3 \times 4I_1$

$2.2\, I_1 = -I_2$

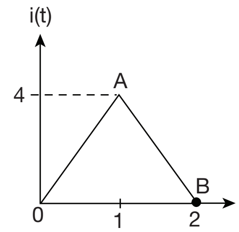
$$\frac{I_2}{I_1} = -2.2$$

Choice (A)

7. $I_{\text{rms}} = \sqrt{\dfrac{1}{T}\displaystyle\int_0^T i^2\,(t).dt}$

Consider one period of $i(t)$

$T = 2$



$0(0, 0)\ A(1, 4)$

$$i(t) = \left(\frac{4-0}{1-0}\right)(t-0)$$

$i(t) = 4t$; for $0 < t < 1$

for A to B straight line $A(1, 4)B(2, 0)$

$$i(t) - 4 = \left(\frac{0-4}{2-1}\right)(t-1)$$

$i(t) = -4t + 8;\ 1 < t < 2$

$$\therefore \quad I_{rms}^2 = \frac{1}{2}\left[\int_0^1 i^2(t)\,dt + \int_1^2 i^2(t).dt\right]$$

$$= \frac{1}{2}\left[\int_0^1 16t^2\,dt + \int_1^2 (-4t+8)^2\,dt\right]$$

$$= \frac{1}{2}\times\frac{16}{3}[1] + \frac{16}{2}\left[\int_1^2 (t^2 - 4t + 4)\,dt\right]$$

$$I_{rms}^2 = 2.666 + 8\left[\frac{t^2}{3} - 2t^2 + 4t\right]_1^2$$

$$= 2.666 + 8\left[\frac{7}{3} - 2(3) + 4\right]$$

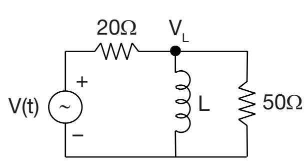
$$= \left(\frac{8}{3} + \frac{8}{3}\right)\text{Amp}$$

$$I_{rms}^2 = \frac{16}{3}$$

$$I_{rms} = \frac{4}{\sqrt{3}}\text{Amp}$$

Choice (A)

8.



$V(t) = 15\ i(t) = 75 \cos 500t$ V.

$\omega = 500$

$$\frac{V_L - V(t)}{20} + \frac{V_L}{j\omega L} + \frac{V(t)}{50} = 0$$

$5[V_L - V(t)] + (-j10V_L) + 2V(t) = 0$

$5V_L - 5V(t) - j10\ V_L + 2\ V(t) = 0$

$V_L\ (5 - j10) = 3V(t)$

$$V_L = \frac{3}{5}\frac{V(t)}{(1-j2)}$$

$$i_L(t) = \frac{V_L}{X_L} = \frac{3}{5}\times\frac{75\ \cos\ 500t}{(1-j2)(j10)}$$

$$i_L(t) = \frac{4.5\ \cos\ 500t}{(2+j1)}$$

$i_L(t) = 2 \cos(500t - 26.56^\circ)$ Amp

Choice (A)

9. For $i(t)$ to be maximum only when

$$\frac{di(t)}{dt} = 0 \text{ and } \frac{d^2\,i(t)}{dt^2} < 0$$

Given $i(t) = 2t.e^{-5t}\ A$

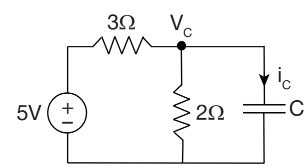
$$\frac{di}{dt} = 2\{e^{-5t} + t.(-5).e^{-5t}\} = 0$$

$1 - 5t = 0$

$$t = \frac{1}{5}\ \text{sec}$$

Choice (A)

10. After closing the switch the given circuit becomes



$$\frac{V_C - 5}{3} + \frac{V_C}{2} + C.\frac{dV_c}{dt} = 0$$

$$2V_C - 10 + 3V_C + 6C\frac{dV_C}{dt} = 0$$

Given $V_C = 2.5$ volts

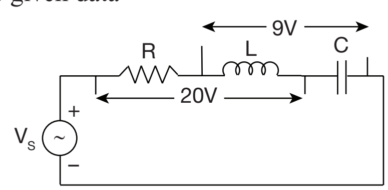
$$\frac{dV_C}{dt} = -8\ \text{V/sec}$$

$5V_C - 10 = 6 \times 8\text{V}$

$$C = \frac{2.5}{48}\ \text{F} = 0.052\ \text{Farads}$$

Choice (D)

11. From the given data



$V_L - V_C = 9\text{V}$

$V_S = 15$ V

$(15)^2 = V_R^2 + (9)^2$

$V_R = 12\text{V}$ and $V_x = \sqrt{V_R^2 + V_L^2}$

$(20)^2 = (12)^2 + V_L^2$

$V_L = 16\text{V}$

$V_L - V_C = 9\text{V}$

$V_C = 16 - 9 = 7$ volts

$$\therefore \quad \frac{V_L}{V_C} = 2.28$$

Choice (D)

12. From the given circuit

$I_1 = I_s = 8\text{A}$

$I_3 = I_L = 3\text{A}$

$\therefore$ we know $I_S = \sqrt{I_R^2 + (I_L - I_C)^2}$

But $I_R = 0$

$I_S = (I_L - I_C)$ or $I_C - I_L$

$\therefore$ $I_C = I_L + I_S = 11$ Amp Choice (B)

13. At low frequencies $f \to 0$ Hz

$L \to$ short circuit

$C \to$ open circuit

$I_R = 0$ Amp

$\therefore$ $V_o = 0$ volts at high frequencies

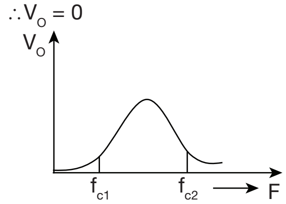
$f \to \infty$

$L \to$ open circuit

$C \to$ short circuit

$I_R = 0$

$\therefore$ $V_o = 0$



BPF Choice (C)

14. The current through the coil is given by

$$i(t) = i(\infty) + \{i(0) - i(\infty)\}.e^{\frac{-t}{\tau}}$$

$$i(0) = 0,\ i(\infty) = \frac{15}{200} = 75 \text{ mA}$$

$$\tau = \frac{L}{R} = \frac{30\times10^{-3}}{200} = 0.15\text{ms}$$

$i(t) = 75[1 - e^{-t/\tau}]$ mA

If $i(td) = 40$ mA, then $t_d = ?$

$40 = 75[1 - e^{-t/\tau}]$

$e^{-t/\tau} = 0.466$

$$-\frac{t_d}{\tau} = \ln(0.466)$$

$t_d = 0.7621\tau = 0.11$ msec Choice (A)

15. We know

$$i_c = C.\frac{dv_c}{dt}$$

$$V_c = \frac{1}{c}\int i_c(t).dt$$

$$= \frac{1}{1}\int -5.e^{-2.5}.dt$$

$$V_c = \frac{-5}{-2.5}.e^{-2.5t} = 2.e^{-2.5t} \text{ volts}$$

$$I_R = \frac{V_C}{R} = 2.e^{-2.5t}\text{Amp}$$

$I_{in} = I_C + I_R = -3.e^{-2.5t}$

$$V_{in} - I_{in} \times 1 - L.\frac{dI_{in}}{dt} - V_C = 0$$

$V_{in} = I_{in} + V_C + V_L$

$$V_L = 2.\frac{d}{dt}\{-3.e^{-2.5t}\}$$

$V_L = 6 \times 2.5.e^{-2.5t}$ volts

$V_{in} = -3.e^{-2.5t} + 2.e^{-2.5t} + 15.e^{-2.5t}$

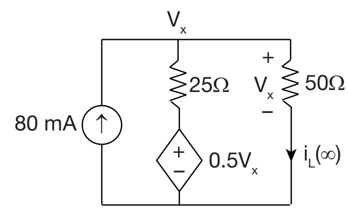
$V_{in} = 14.e^{-2.5t}$ volts Choice (B)

16. For $t < 0$:–

The independent current source deactivates (open circuit)

$\therefore$ $i_L(0^-) = 0$ Amp $= i_L(0^+)$

For $t > 0$:–



If $t \to \infty$, the circuit is in steady state

$L \to$ short circuit

$$-80\text{mA} + \frac{0.5V_x}{25} + i_L(\infty) = 0$$

$$V_x = \frac{i_L(\infty)}{50}$$

$$80 \times 10^{-3} = \frac{i_L(\infty)}{50} \times \frac{1}{50} + i_L(\infty)$$

$$i_L(\infty)\left[1 + \frac{1}{25\times10^2}\right] = 80 \times 10^{-3}$$

$i_L(\infty) = 79.96$ mA

$\therefore$ $i_L(t) = i(\infty) + [i(0^-) - i(\infty)].e^{-t/\tau}$

$i_L(t) = i(\infty)[1 - e^{-t/\tau}]\ u(t)$

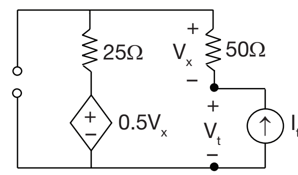
$$\tau = \frac{L_{eq}}{R_{eq}}$$

Res:–

(i) Deactivate all the independent sources.

(ii) Connect one test source

(iii) Find the equivalent resistance



$$\therefore \quad R_{th} = \frac{V_t}{I_t}$$

$V_t + V_x - 25\,I_t - 0.5V_x = 0$

$V_t = 25\,I_t + 50\,I_t$

$$\frac{V_t}{I_t} = R_{th} = 75\ \Omega$$

$$\tau = \frac{0.5}{75} = \frac{1}{150}\text{sec}$$

$\therefore\quad i_L(t) = 79.96[1 - e^{-150t}].u(t)$ mA

$\therefore\quad V_x = \dfrac{i_L(t)}{50}$

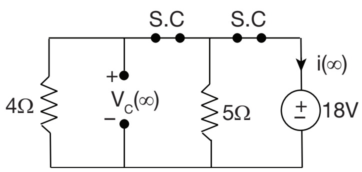
$V_x(t) \approx 1.6[1 - e^{-150t}].u(t)$ mV Choice (A)

17. In steady state

$C \rightarrow$ open circuit

$L \rightarrow$ short circuit

The equivalent circuit is



$V_C(\infty) = 18$V

$$\frac{18}{4} + \frac{18}{5} + i(\infty) = 0$$

$18 \times 9 = -20\ i(\infty)$

$i(\infty) = -8.1$ Amp Choice (B)

18. We know, the transient free conditions

$\omega t_o + \phi = \tan^{-1}(\omega\tau + p/2)$ [for cosinusoidal input]

$$2\ t_o + \phi = \left\{\tan^{-1}\left[2 \times \frac{1}{2}\right] + \frac{\pi}{2}\right\}$$

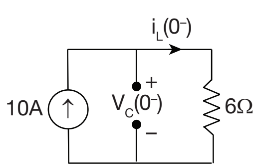
$t_o = 1$ sec

$$\phi = \frac{\pi}{4} + \frac{\pi}{2} -$$

$$\phi = \frac{3\pi}{4} - 2 = 1.356 \text{ rad or } 77.70°.$$ Choice (D)

19. For $t < 0$:

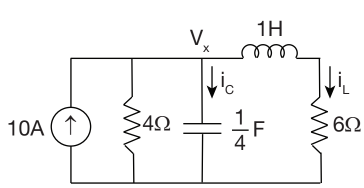
In steady state the equivalent circuit becomes



$i_L(0^-) = 10$ A $= i_L(0^+)$

$V_C(0^-) = 60$V $= V_C(0^+)$

For $t > 0$:–



$$-10 + \frac{V_x}{4} + i_c + i_L = 0$$

$$i_c = \frac{CdV_c}{dt}$$

$$V_L = L.\frac{di_L}{dt}$$

But $V_x = V_C$

$$-10 + \frac{V_C}{4} + C.\frac{dV_c}{dt} + i_L = 0$$

at $t = 0^+$

$$C\frac{dV_c(0^+)}{dt} = 10 - \frac{V_c(0^+)}{4} - i_L(0^+) = 10 - 15 - 10$$

$$\frac{dV_c(0^+)}{dt} = \frac{-15}{\frac{1}{4}}$$

$$\frac{dV_c(0^+)}{dt} = -60 \text{ V/sec}$$

$V_x = V_L + 6i_L$

$V_x = V_C$

$$V_C(0^+) = L\frac{di_L(0^+)}{dt} + 6i_L(0^+)$$

$$60 - 6 \times 10 = \frac{L\,di_L}{dt}$$

$$\frac{di_L}{dt} = 0\text{A/sec}$$ Choice (D)

20. For $t < 0$:–

Switch opened;

$\therefore\quad V_c(0^-) = 0 = V_C(0^+)$

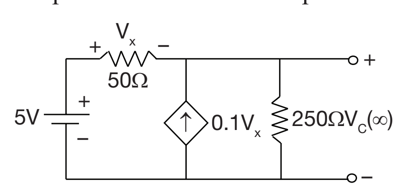
For $t > 0$:–

At $t = 0^+$ switch closed

$V_C(0^+) = 0$V

$\therefore\quad$ As $t \rightarrow \infty$; circuit is in steady state

In $S.S$ capacitor behaves like a open circuit.



$$\frac{V_C(\infty) - 5}{50} + \frac{V_C(\infty)}{250} = 0.1V_x$$

but $5 - V_x - V_x(\infty) = 0$

$V_x = 5 - V_c(\infty)$

$6V_c(\infty) - 25 = 25[5 - V_c(\infty)]$

$31V_c(\infty) = 150$

$V_c(\infty) = 4.83$ volts

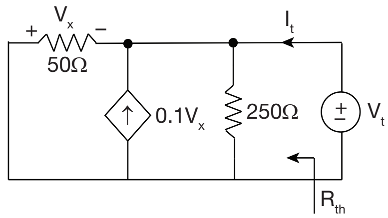
$\therefore\quad V_c(t) = V_c(\infty) + \{V_c(0^+) - V_c(\infty)\}.e^{-t/\tau}$

$\therefore \quad V_c(t) = 4.83[1 - e^{-t/\tau}\}.u(t)$

τ:–

$\tau = RC$

$\boldsymbol{R = R_{th}}$**:–**



$$-I_t + \frac{V_t}{250} + \frac{V_t}{50} - 0.1V_x = 0$$

$V_t + V_x = 0$

$V_x = -V_t$

$$\frac{6V_t}{250} = I_t - 0.1V_t$$

$6V_t = 250\ I_t - 25\ V_t$

$31V_t = 250\ I_t$

$$R_{th} = \frac{V_t}{I_t} = \frac{250}{31} = 8.064\ \Omega$$

$\tau = 8.064 \times 1$ m sec

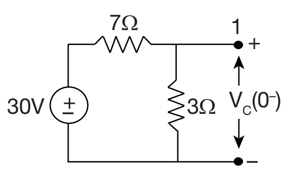
$\tau = 8.064$ m sec

$V_c(t) = 4.83[1 - e^{-124t}]u(t)$ at $t = 2$ m sec

$V_c(2\text{m}) = 1.06$ volts Choice (A)

21. For $t < 0$:– The switch connected to position 1.

at $t = 0^-$

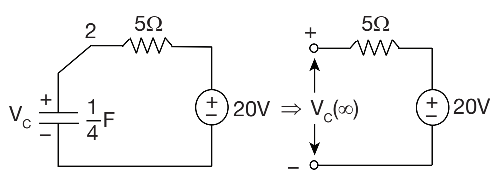


ckt is in *S.S*

$$\therefore \quad V_C(0^-) = \frac{3}{10} \times 30 = 9\text{V} = V_C(0^+)$$

For $t > 0$:– Switch $\rightarrow$ position 2.

The circuit becomes of $t \rightarrow \infty$ (in steady state)



$\therefore \quad V_C(\infty) = 20\text{V}$

$\therefore \quad V_c(t) = V_c(\infty) + \{V_c(0^+) - V_c(\infty)\}.e^{-t/\tau}$

$$\tau = RC = 5 \times \frac{1}{4} = 1.25 \text{ sec}$$

$V_C(t) = 20 + \{9 - 20\}.e^{-t/1.25}$ volts

$V_C(t) = 20 - 11.e^{-4t/5}$ volts Choice (B)

22. $V_1 = AV_2 + BI_2$

$I_1 = CV_2 + D\,I_2$

When $V_1 = 4V$ and $P = 4\text{W}$

$\therefore \quad P = I_2^2 R_L$

$$I_2 = \sqrt{\frac{P}{R_L}} \text{ and } P = \frac{V_2^2}{R_L}$$

$$V_2 = \sqrt{P.R_L} \text{ as } R_L = 2$$

$$4 = A\sqrt{P.R_L} + B.\sqrt{\frac{P}{R}}$$

$$4 = A\sqrt{4} + B\sqrt{4}$$

$2A + 2B = 4$

$A + B = 2$ ------(i)

$$8 = A\sqrt{16} + B\sqrt{16}$$

$8 = 4\text{A} + 4\text{B}$

$\therefore \quad A + B = 2$

$V_1 = 10$

$10 = 5\text{A} + 5\text{B}$

$\therefore \quad V_2 = 5$ and $I_2 = 5$

$P = I_2^2.R_L$

$= 25 \times 1 = 25\text{W}$ Choice (A)

23. $$Z(S) = 2 + \left[\frac{1}{SC} \,||\, \left\{1 \,||\, \left(R + \frac{1}{S}\right)\right\}\right]$$

$\therefore$ By comparison we can get

$R = 1\ \Omega$ and $C = 1\text{F}$ Choice (A)

24. $$Z(s) = \left(\frac{2}{s}\right) || \left[1 + (2+s)\,||\,2\right]$$

$$= \frac{2}{s} \,||\, \left[1 + \frac{4+2s}{4+s}\right]$$

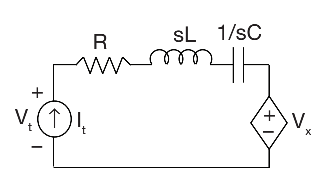
$$= \left(\frac{2}{s}\right) || \left[1 + \frac{4+2s}{4+s}\right]$$

$$= \frac{\left(\frac{2}{s}\right)\left(\frac{8+3s}{4+s}\right)}{\frac{2}{s} + \frac{8+3s}{4+s}}$$

$$= \frac{2(8+3s)}{8+2s+8s+3s^2}$$

$$Z(s) = \frac{2(8+3s)}{3s^2+10s+8}$$ Choice (C)

25.



$$V_t - V_x = RI_t + SLI_t + \frac{I_t}{sC}$$

But $V_x = 0.5V_1 \times 1/sc$

$V_1 = 5\ I_t$

$$V_x = \frac{2.5I_t}{sC}$$

$$V_t = I_t\left[5 + sL + \frac{1}{sc} + \frac{2.5}{sc}\right]$$

$$\frac{V_t}{I_t} = Z(s)$$

$$Z(s) = 5 + j\omega\ 1 \times 10^{-3} - \frac{j3.5}{\omega \times 5 \times 10^{-9}}$$

at resonance image $Z(s) = 0$

$$\therefore \quad \omega^2 = \frac{3.5}{5 \times 10^{-9} \times 10^{-3}}$$

$$w^2 = \frac{3.5}{5} \times 10^{12}$$

$\omega = 836.66 \times 10^3$ rad/sec

$f_o = 133.158$ kHz Choice (D)