CLASS TEST

S.No.: 01_JP_ECEE_16062025

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NETWORK THEORY

EC-EE

Date of Test : 16/06/2025

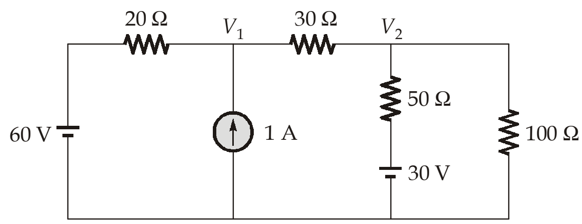
ANSWER KEY

1.	(c)	7.	(c)	13.	(a)	19.	(c)	25.	(d)
2.	(b)	8.	(c)	14.	(d)	20.	(a)	26.	(c)
3.	(b)	9.	(b)	15.	(d)	21.	(a)	27.	(d)
4.	(d)	10.	(d)	16.	(c)	22.	(a)	28.	(a)
5.	(a)	11.	(d)	17.	(b)	23.	(d)	29.	(a)
6.	(d)	12.	(b)	18.	(a)	24.	(c)	30.	(b)

DETAILED EXPLANATIONS

1. (c)

Given circuit is



Applying KCL at node 1,

$$\frac{V_1 - 60}{20} + \frac{V_1 - V_2}{30} = 1$$

$$\Rightarrow \quad \frac{3V_1 - 180 + 2V_1 - 2V_2}{60} = 1$$

$$\Rightarrow \quad 5V_1 - 2V_2 = 60 + 180$$

$$\Rightarrow \quad 5V_1 - 2V_2 = 240 \quad \text{...(i)}$$

$$\frac{V_2 - V_1}{30} + \frac{V_2 - 30}{50} + \frac{V_2}{100} = 0$$

$$\Rightarrow \quad \frac{10V_2 - 10V_1 + 6V_2 - 180 + 3V_2}{300} = 0$$

$$\Rightarrow \quad -10V_1 + 19V_2 = 180 \quad \text{...(ii)}$$

Solving equation (i) and (ii),

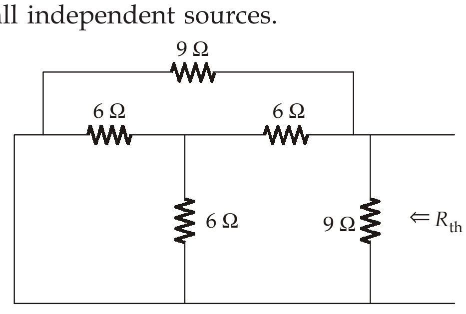
$$V_1 = 54.6 \text{ V}$$

$$V_2 = 44 \text{ V}$$

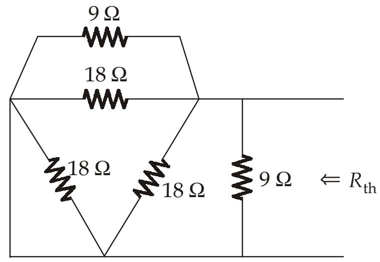
$$I_{100\ \Omega} = \frac{V_2}{100} = \frac{44}{100} = \frac{1.84}{5} = 0.44 \text{ A}$$

2. (b)

To calculate R_{th}, deactivate all independent sources.



Using star to delta transformation,



$$R_{th} = 9 \parallel [(9 \parallel 18) \parallel 18] = 9 \parallel \frac{9}{2} = \frac{9 \times \frac{9}{2}}{9 + \frac{9}{2}} = \frac{9 \times 9}{27} = 3\,\Omega$$

For maximum power transfer, $R_L = R_{th} = 3\ \Omega$

3. **(b)**

$$V(t) = 10 \sin \omega t \text{ V}$$
$$\text{B.W} = 400 \text{ rad/s}$$
$$V_{rms} = \frac{10}{\sqrt{2}} = 7.07 \text{ V}$$
$$\text{B.W} = \frac{R}{L}$$
$$400 = \frac{100}{L}$$
$$L = 0.25 \text{ H}$$
$$Q_0 = \frac{V_c}{V} = \frac{500}{7.07} = 70.72$$

We have, $$Q_0 = \frac{1}{R}\sqrt{\frac{L}{C}}$$

$$70.72 = \frac{1}{100}\sqrt{\frac{0.25}{C}}$$
$$(70.72 \times 100)^2 = \frac{0.25}{C}$$
$$C = \frac{0.25}{(7072)^2} = 4.99 \times 10^{-9} \text{F}$$

4. **(d)**

Given data, Power factor = 0.6 (lag)

$$\cos\theta = 0.6$$
$$\theta = \cos^{-1}(0.6) = 53.13°$$

According to given circuit,

$$Z_{eq} = \frac{R_2(1+2j)}{R_2 + 1 + j2}$$
$$\angle\theta = \tan^{-1} 2 - \tan^{-1}\frac{2}{R_2 + 1}$$

$$\angle 53.13° = \tan^{-1}\frac{2-\frac{2}{R_2+1}}{1+\frac{4}{R_2+1}}$$

$$\tan(53.13°) = \frac{2R_2+2-2}{R_2+5}$$

$$\frac{4}{3}(R_2+5) = 2R_2$$

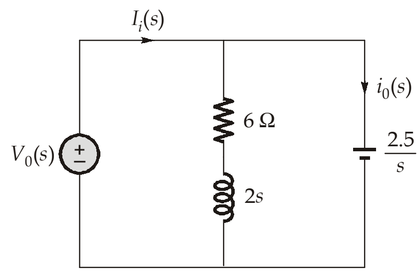
$$4R_2 + 20 = 6R_2$$

$$2R_2 = 20$$

$$R_2 = 10\ \Omega$$

5. (a)

In s-domain, the circuit can be drawn as below:



The admittance

$$Y(s) = \frac{1}{6+2s}+\frac{s}{2.5} = \frac{1}{2(s+3)}+\frac{2}{5}s = \frac{5+4s(s+3)}{10(s+3)}$$

$$Y(s) = \frac{4s^2+12s+5}{10(s+3)}$$

$$Z(s) = \frac{1}{Y(s)} = \frac{10(s+3)}{4s^2+12s+5}$$

Poles, $s = -0.5, -2.5$

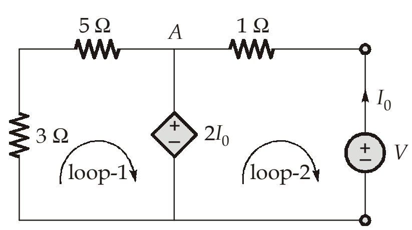
Zero $\Rightarrow$ $s = -3$

6. (d)

For the given tree, the possible fundamental cut-sets are {1, 6, 8}, {2, 6, 8, 3}, {8, 7, 5, 3} and {4, 7, 8}.

7. (c)

To calculate R_{th}, the equivalent circuit is



KVL in loop-1

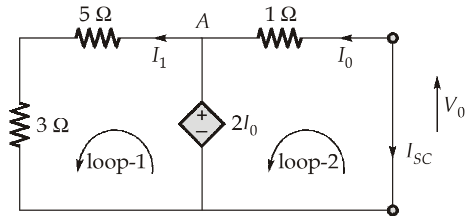
$$8I + 2I_0 = 0 \quad \text{...(i)}$$

KVL in loop-2

$$V = I_0 + 2I_0$$

$$\frac{V}{I_0} = 3\ \Omega = R_{th}$$

Calculate V_{th}



$$I_{sc} = -I_0$$

KVL in loop-1

$$2I_0 = 8I_1$$

$$I_1 = \frac{1}{4}I_0 \quad \text{...(ii)}$$

KVL in loop-2

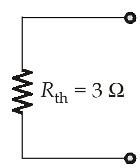
$$3I_0 = 0$$

$$I_0 = 0$$

Hence, $I_{sc} = 0$

∴ $V_{th} = R_{th}\, I_{sc} = 0\ \text{V}$

Thevenin equivalent circuit is



8. (c)

Whenever an ideal voltage source and ideal current source are connected in series, the current through the combination would be same as the current source. Hence, it will behave like an ideal current source alone and if they are connected in parallel, it will behave like an ideal voltage source alone.

9. (b)

10. (d)

Tie set matrix gives the relation between the tie set currents and branch currents. Thus, the order of B_f is $(b - n + 1) \times b$ and it's rank is $(b - n + 1)$. Further, the submatrix corresponding to twigs (B_t) is not an identity matrix and the submatrix corresponding to links (B_l) is a identity matrix of order $(b - n + 1)$.

11. (d)

According to given circuit

$$V_2 = -5I_2$$

Substituting the value of V_2 in the given equation,

$$V_1 = -25I_2 - 6I_2$$

$$V_1 = -31I_2$$
$$I_1 = 8 \times (-5I_2) - 3I_2$$
$$I_1 = (-40 - 3)I_2 = -43I_2$$

Input impedance

$$Z_i = \frac{V_1}{I_1} = \frac{-31}{-43} = \frac{31}{43}\,\Omega$$

12. (b)

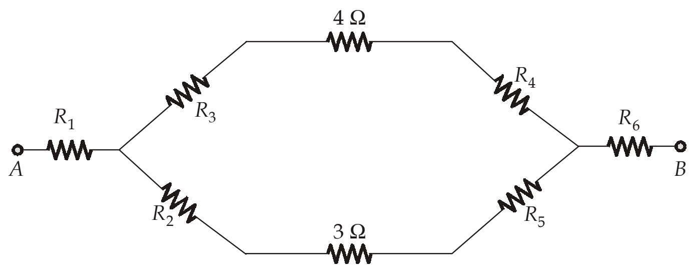
$$i(t) = \frac{-4\times10^{-3}}{8}[V(t)-8]$$
$$i(t) = -\frac{1}{2}\times10^{-3}[V(t)-8] = -\frac{1}{2}\times10^{-3}V(t)+4\times10^{-3}$$
$$V(t) = \frac{2i(t)-8\times10^{-3}}{-10^{-3}} = -2\times10^3 i(t) + 8$$

Hence, $R_{th} = 2\times10^3\ \Omega$

$$\text{Time constant} = \tau = \frac{L}{R_{th}} = \frac{8\times10^{-3}}{2\times10^3} = 4\ \mu s$$

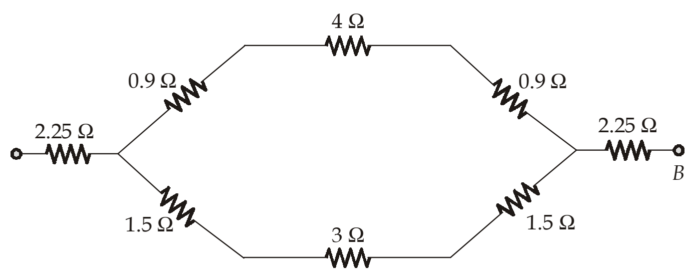
13. (a)

Converting the two delta network formed by resistors 4.5 Ω, 3 Ω and 7.5 Ω into equivalent star network, we have,

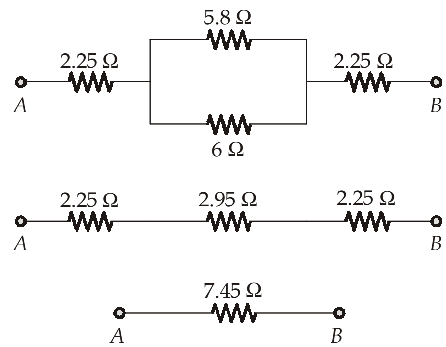


$$R_1 = R_6 = \frac{4.5\times7.5}{4.5+7.5+3} = 2.25\ \Omega$$
$$R_2 = R_5 = \frac{7.5\times3}{4.5+7.5+3} = 1.5\ \Omega$$
$$R_3 = R_4 = \frac{4.5\times3}{4.5+7.5+3} = 0.9\ \Omega$$

The simplified network is



The network can be simplified as follows:



$$R_{AB} = 7.45\ \Omega$$

14. **(d)**

From linearity,

$$V_{out} = K_1 V_{s1} + K_2 i_{s2}$$

For $V_{s1} = 6$ V, $i_{s2} = 0$, $V_{out} = 5$ V, hence

$$V_{out} = 6K_1$$

$$5 = 6K_1 \quad \Rightarrow \quad K_1 = \frac{5}{6}$$

For $V_{s1} = 0$, $i_{s2} = 3$ A, $V_{out} = 8$ V, hence

$$V_{out} = K_1 \times 0 + 3 \times K_2$$

$$8 = 3K_2$$

$$K_2 = \frac{8}{3}$$

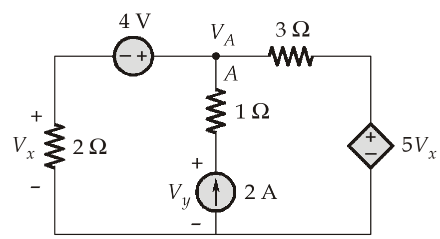
Therefore for $V_{s1} = 12$ V and $i_{s2} = 9$ A

$$V_{out} = \frac{5}{6}V_{s1} + \frac{8}{3}i_{s2} = \frac{5}{6}\times 12 + \frac{8}{3}\times 9$$

$$= 10 + 24 = 34 \text{ V}$$

15. **(d)**

16. **(c)**



The Node voltage $V_A = (4 + V_x)$ Volts.
Applying KCL at node *A*,

$$2 = \frac{V_x}{2} + \frac{V_A - 5V_x}{3}$$

$$2 = \frac{V_x}{2} + \frac{4 + V_x - 5V_x}{3}$$

$$2 = \frac{V_x}{2} + \frac{4}{3} - \frac{4V_x}{3}$$

$$2 - \frac{4}{3} = \frac{3V_x - 8V_x}{6}$$

$$-\frac{5V_x}{6} = \frac{2}{3}$$

$$V_x = -\frac{4}{5}\text{ Volt}$$

$$V_A = 4 + V_x = 4 - \frac{4}{5}$$

$$V_A = \frac{16}{5}\text{ Volt}$$

$$V_A = V_y - 1 \times 2$$

$$V_y = V_A + 2$$

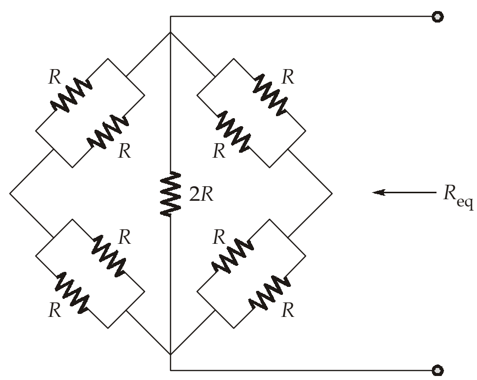
$$V_y = \frac{16}{5} + 2 = \frac{26}{5}\text{ Volts}$$

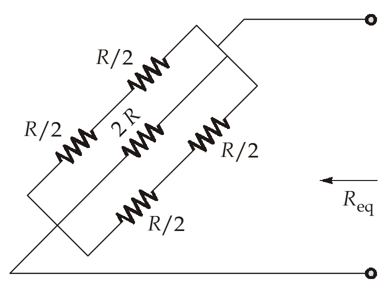
Power delivered by 2 A source = 2 V_y

$$= 2 \times \frac{26}{5} = \frac{52}{5}\text{ W} = 10.4\text{ W}$$

17. (b)

Simplifying the circuit, and calculating the equivalent resistance,





$$R_{eq} = 2R \| R \| R = 2R \| \frac{R}{2} = \frac{2R\left(\frac{R}{2}\right)}{2R + \frac{R}{2}} = \frac{R^2}{5R} \times 2$$

$$R_{eq} = \frac{2}{5}\text{R}$$

$$R = 2\ \text{k}\Omega$$

$$R_{eq} = \frac{4}{5}\ \text{k}\Omega$$

Maximum power transferred to load R_L

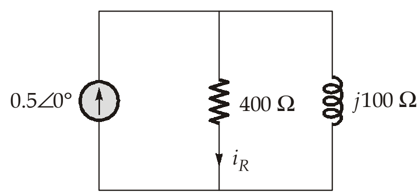
$$P_{max} = \frac{V_{Th}^2}{4R_{eq}} = \frac{V_{OC}^2}{4R_{eq}}$$

$$V_{OC} = V_s = 15\ \text{V}$$

$$P_{max} = \frac{V_{OC}^2}{4R_{eq}} = \frac{(15)^2}{4\times\frac{4}{5}\text{k}\Omega} = \frac{225\times 5}{16\ \text{k}\Omega}$$

$$P_{max} = 70.3125\ \text{mW}$$

18. (a)



Using current division rule,

$$i_R = \frac{j100}{(400+j100)}(0.5\angle 0°)\ \text{A}$$

$$i_R = \left(\frac{100\angle 90°}{412.31\angle 14.036°}\right)(0.5\angle 0°) = (121.26\angle 75.96°)\ \text{mA}$$

$$i_R = 121.26\cos(100t + 75.96°)\ \text{mA}$$

19. (c)

$$I(s) = \frac{V(s)}{R+sL+\frac{1}{sC}} = V(s)\frac{(sC)}{(s^2LC+sRC+1)}$$

$$= \frac{100}{s}\frac{sC}{(LC)\left(s^2+\frac{Rs}{L}+\frac{1}{LC}\right)} = \frac{100}{2}\frac{1}{\left(s^2+\frac{50}{2}s+\frac{200}{2}\right)}$$

$$I(s) = \frac{50}{s^2+25s+100} = \frac{50}{(s+5)(s+20)}$$

$$= \frac{50}{(20-5)(s+5)} + \frac{50}{(-20+5)(s+20)}$$

$$I(s) = \frac{50}{15(s+5)} - \frac{50}{15(s+20)}$$

Taking inverse Laplace transform,

$$L^{-1}[I(s)] = i(t) = \frac{10}{3}(e^{-5t} - e^{-20t})u(t)$$

At t = 200 msec

$$i(t)\big|_{t=200\times 10^{-3}\ \text{s}} = \frac{10}{3}(e^{-5\times 0.2} - e^{-20\times 0.2}) = \frac{10}{3}(e^{-1} - e^{-4})$$

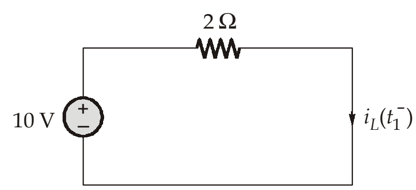
$$= \frac{10}{3}\times 0.3487 = 1.162\ \text{A}$$

20. (a)

At $t = t_1^-$

Switch S_1 closed, S_2 open

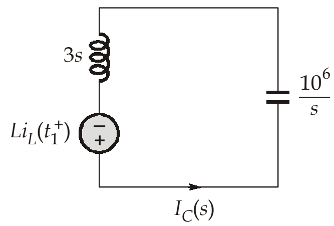
Inductor $\rightarrow$ Short circuit



$$i_L(t_1^-) = \frac{10}{2} = 5\text{ A}$$

At $t = t_1^+$

Switch S_1 – Open
S_2 – Closed



$$Li_L(t_1^+) = 3 \times 5 = 15\text{ Volt}$$

$$I_C(s) = \frac{Li_L(t_1^+)}{3s + \frac{10^6}{s}} = \frac{15s}{3s^2 + 10^6}$$

$$I_C(s) = \frac{5s}{s^2 + \frac{10^6}{3}} = 5\frac{s}{s^2 + \left(\frac{10^3}{\sqrt{3}}\right)^2}$$

Taking inverse Laplace of $I_C(s)$

$$L^{-1}[I_C(s)] = i_C(t) = 5\cos\left[\frac{10^3}{\sqrt{3}}(t - t_1)\right]\text{A}$$

$$i_C(t) = 5\cos\left[0.577 \times 10^3 (t - t_1)\right]\text{A} \quad \text{for } t \geq t_1$$

21. (a)

$$v(t) = \sin(2t) = (1\ \angle 0°)\text{ V}$$

$$i(t) = i_R + i_C + i_L$$

$$= v(t)\left(\frac{1}{R} + \frac{1}{j\omega L} + \frac{1}{-\frac{j}{\omega C}}\right)$$

$$i(t) = \frac{1\angle 0^\circ}{\frac{1}{3}} + \frac{1\angle 0^\circ}{j2\left(\frac{1}{4}\right)} - \frac{2(3)}{j}(1\angle 0^\circ)$$

$$i(t) = 3\angle 0^\circ + 2\angle -90^\circ + 6\angle 90^\circ$$

$$i(t) = 3\sin(2t) + 2\sin(2t - 90^\circ) + 6\sin(2t + 90^\circ)$$

$$= 3\sin(2t) - 2\cos(2t) + 6\cos(2t)$$

$$= 3\sin(2t) + 4\cos 2t$$

$$= \sqrt{3^2 + 4^2}\cos\left[2t - \tan^{-1}\left(\frac{3}{4}\right)\right]$$

$$i(t) = 5\cos(2t - 36.86^\circ)\text{ A} = 5\sin(2t - 36.86^\circ + 90^\circ)$$

$$i(t) = 5\sin(2t + 53.14^\circ)\text{ A}$$

22. **(a)**

For series RC circuit, $Z = R - \frac{j}{\omega C}$

$v(t)$ consists of two frequencies,

At $\omega = 0$ rad/sec, $i(t)_{DC} = \frac{50}{Z}$

At $\omega = 5 \times 10^3$ rad/sec, $i(t)_{AC} = \frac{50}{Z} = 11.2\angle 63.4^\circ$

$$|Z| = \frac{50}{11.2} = \sqrt{R^2 + \frac{1}{\omega^2 C^2}} \quad ...(i)$$

Also, $\tan^{-1}\left(\frac{1}{\omega RC}\right) = 63.4^\circ$

$$\frac{1}{\omega RC} = 2$$

$$2R = \frac{1}{\omega C} \quad \text{put in equation (i)}$$

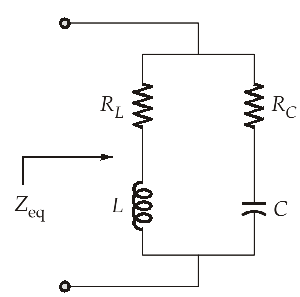
$$\sqrt{R^2 + (2R)^2} = 4.464$$

Squaring both sides, $5R^2 = 19.93$

$$R^2 = 3.985$$

$$R = 1.99\ \Omega \simeq 2\ \Omega$$

23. **(d)**



Equivalent impedance of the circuit is Z_{eq},

Admittance, $Y_{eq} = \frac{1}{Z_{eq}} = Y_1 + Y_2$

$$Y_1 = \frac{1}{R_L + sL}$$

$$Y_2 = \frac{1}{R_C + \frac{1}{sC}}$$

$$Y_1 = \frac{1}{(R_L + j\omega L)}\frac{(R_L - j\omega L)}{(R_L - j\omega L)} = \frac{R_L - j\omega L}{R_L^2 + \omega^2 L^2}\ \mho$$

$$Y_2 = \frac{1}{\left(R_C - \frac{j}{\omega C}\right)}\frac{\left(R_C + \frac{j}{\omega C}\right)}{\left(R_C + \frac{j}{\omega C}\right)} = \frac{R_C + \frac{j}{\omega C}}{R_C^2 + \frac{1}{\omega^2 C^2}}\ \mho$$

$$Y_{eq} = Y_1 + Y_2 = \frac{R_L - j\omega L}{R_L^2 + \omega^2 L^2} + \frac{R_C + j/\omega C}{R_C^2 + \frac{1}{\omega^2 C^2}}$$

At resonant frequency $\omega = \omega_o$,
Imaginary part of admittance is zero.

$$\therefore \qquad \frac{-\omega_o L}{R_L^2 + \omega_o^2 L^2} + \frac{\frac{1}{\omega_o C}}{R_C^2 + \frac{1}{\omega_o^2 C^2}} = 0$$

$$\frac{\omega_o C}{1 + R_C^2 \omega_o^2 C^2} = \frac{\omega_o L}{R_L^2 + \omega_o^2 L^2}$$

$$\frac{L}{C} + \omega_o^2 R_C^2 LC = R_L^2 + \omega_o^2 L^2$$

$$\omega_o^2 (R_C^2 LC - L^2) = R_L^2 - \frac{L}{C}$$

$$\omega_o^2 = \frac{R_L^2 - \frac{L}{C}}{LC\left(R_C^2 - \frac{L}{C}\right)}$$

$$\omega_o = \frac{1}{\sqrt{LC}}\sqrt{\frac{R_L^2 - \frac{L}{C}}{R_C^2 - \frac{L}{C}}}\ \text{rad/sec}$$

Puttting the values of R_L, R_C, L and C

$$\omega_o = \frac{1}{\sqrt{2}}\sqrt{\frac{100-2}{25-2}} = \sqrt{\frac{98}{46}} = 1.46\ \text{rad/sec}$$

24. (c)

$$f_r = 2\ \text{MHz}$$

$$Q = \frac{\text{Resonant frequency}}{\text{Bandwidth}}$$

$$= \frac{f_r}{\text{BW}} = \frac{2\times10^6}{20\times10^3} = \frac{10^5}{10^3} = 100$$

Resonance frequency, $$f_r = \frac{1}{2\pi\sqrt{LC}}$$

Quality factor for series *RLC* circuit,

$$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

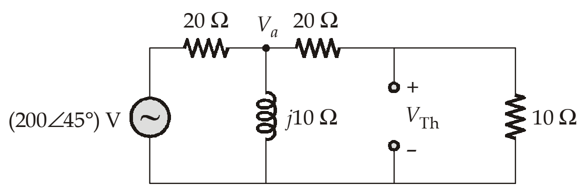
$$100 = \frac{1}{R}\sqrt{\frac{1}{(2\pi f_r)^2 C^2}}$$

$$R = \frac{1}{100(2\pi f_r)C} = \frac{1}{100\times 2\pi\times 2\times 10^6\times 0.5\times 10^{-9}}$$

$$R = \frac{1000}{200\pi} = \frac{5}{\pi} = 1.59\ \Omega$$

25. (d)

Using Thevenin's theorem,



Using KCL, $$\frac{(200\angle 45^\circ) - V_a}{20} = \frac{V_a}{j10} + \frac{V_a}{30}$$

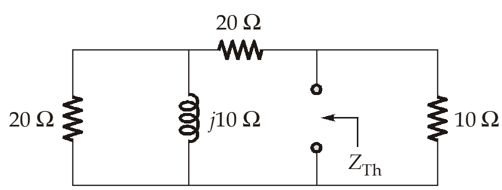
$$10\angle 45^\circ = V_a\left(\frac{1}{20} + \frac{1}{j10} + \frac{1}{30}\right) = V_a\left(\frac{j3 + 6 + j2}{j60}\right)$$

$$V_a = \frac{(10\angle 45^\circ)(60\angle 90^\circ)}{7.81\angle 39.8^\circ} = (76.8\angle 95.2^\circ)\ \text{V}$$

Thevenin voltage, $$V_{Th} = V_a\left(\frac{10}{30}\right) = \frac{V_a}{3}$$

$$V_{Th} = (25.6\angle 95.2^\circ)\ \text{Volt}$$

Finding Thevenin's equivalent impedance, Z_{Th}



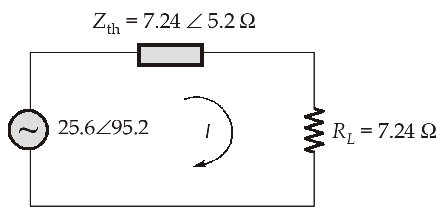
$$Z' = j10 \| 20 = \frac{20(j10)}{20 + j10}$$

$$Z_{Th} = 10 \| (Z' + 20)$$

$$20 + Z' = 20 + \frac{j200}{(20 + j10)} = \frac{400 + j400}{20 + j10}$$

$$Z_{Th} = \frac{\left(\frac{400+j400}{20+j10}\right)10}{\frac{400+j400}{(20+j10)}+10} = \frac{4000(1+j)}{600+j500} = \frac{4000\sqrt{2}\angle 45°}{781.02\angle 39.8°}$$

$$Z_{Th} = (7.24\angle 5.2°)\ \Omega$$

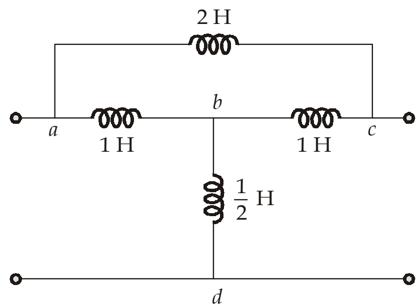


$$I = \frac{25.6\angle 95.2}{7.24\angle 5.2 + 7.24}$$

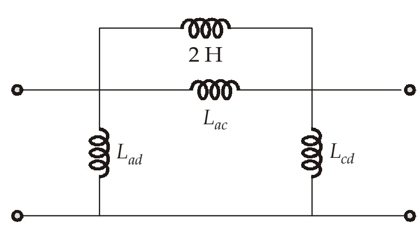
$$P = I^2R_L = I^2(7.24) = 22.67 \text{ Watt}$$

26. (c)

The given circuit can be drawn as,



Converting '*Y*' '*acd*' to 'Δ', we get



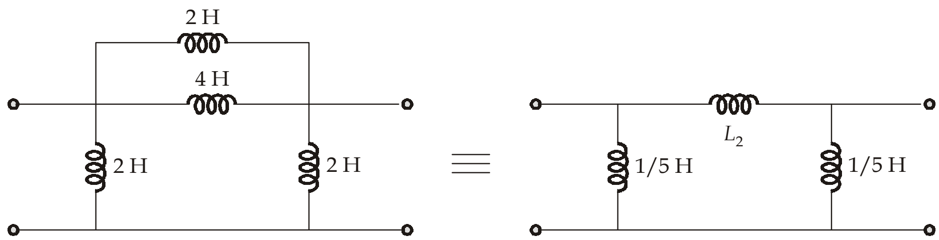
Here,

$$L_{cd} = \frac{1\times\frac{1}{2}+1\times\frac{1}{2}+1\times 1}{1} = 2\text{ H}$$

$$L_{ad} = \frac{1\times\frac{1}{2}+1\times\frac{1}{2}+1\times 1}{1} = 2\text{ H}$$

$$L_{ac} = \frac{1\times 1+1\times\frac{1}{2}+1\times\frac{1}{2}}{\frac{1}{2}} = 4\text{ H}$$

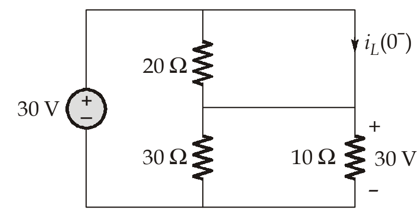
∴ The circuit can be redrawn as



where, $$L_2 = \frac{2\times 4}{2+4} = \frac{8}{6} = \frac{4}{3}\text{ H}$$

27. (d)

At $t = 0^-$, switch is closed, circuit is in steady state, inductor acts as short circuit

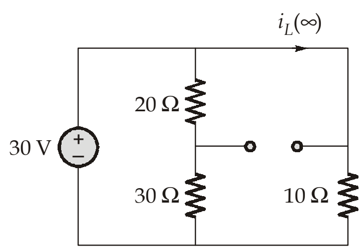


$$i_L(0^-) = \frac{30}{30} + \frac{30}{10} = 3 + 1 = 4\text{ A}$$

At $t = 0^+$ switch is opened

$$i_L(0^+) = i_L(0^-) = 4\text{ A}$$

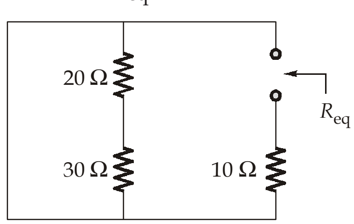
At $t \to \infty$, switch is open, circuit is in steady state, inductor acts as short circuit



$$i_L(\infty) = \frac{30}{10} = 3\text{ A}$$

$$i_L(t) = i_L(\infty) + \left[i_L(0^+) - i_L(\infty)\right]e^{-t/\tau}$$

Time constant, $$\tau = \frac{L}{R_{eq}}$$



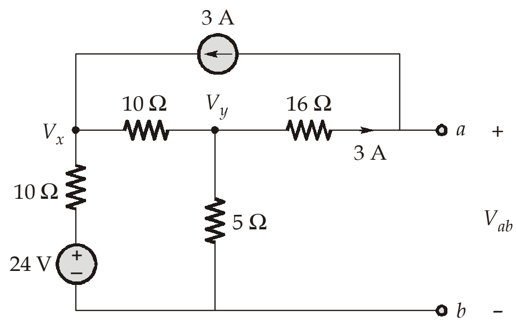
$$R_{eq} = 10\ \Omega$$

$$\tau = \frac{0.5}{10} = \frac{1}{20}\text{ sec}$$

$$i_L(t) = 3 + (4 - 3)e^{-20t} \qquad t \geq 0$$
$$= (3 + e^{-20t}) \qquad t \geq 0$$

At t = 40 ms, $\quad i_L(t)\big|_{t = 40\times10^{-3}\text{ s}} = 3 + e^{-\frac{20\times40}{1000}} = 3 + e^{-0.8} = 3.449 \text{ A}$

28. **(a)**



Using KCL, $\quad \frac{V_x - 24}{10} + \frac{V_x - V_y}{10} = 3$

$$30 + 24 - V_x = V_x - V_y$$
$$2V_x - V_y = 54 \qquad \text{...(i)}$$

Using KCL, $\quad \frac{V_x - V_y}{10} = \frac{V_y}{5} + 3$

$$\frac{V_x - V_y}{10} = \frac{V_y + 15}{5}$$
$$V_x - V_y = 2V_y + 30$$
$$V_x - 3V_y = 30$$
$$2V_x - 6V_y = 60 \qquad \text{...(ii)}$$

From equation (i) and (ii),

$$5V_y = -6$$
$$V_y = -\frac{6}{5}\text{ Volt}$$

Using KVL, $\quad V_y = 3 \times 16 + V_{ab}$

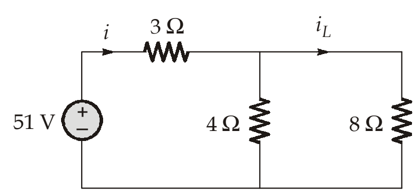
$$V_{ab} = V_y - 48 = -1.2 - 48 = -49.2 \text{ V}$$

29. **(a)**

At $t = 0^-$ switch closed.

Circuit is in steady state,

Inductor acts as short circuit



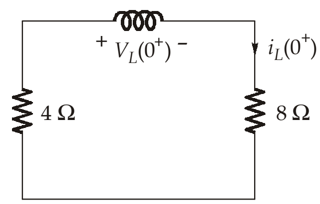
$$8\|4 = \frac{8\times4}{12} = \frac{8}{3}\,\Omega$$
$$R_{eq} = \frac{8}{3} + 3 = \frac{17}{3}\,\Omega$$

$$i = \frac{51}{R_{eq}} = \frac{51}{17} \times 3 = 3 \times 3 = 9 \text{ A}$$

$$i_L(0^-) = i \times \frac{4}{12} = \frac{9}{3} = 3 \text{ A}$$

At $t = 0^+$

Switch is open.



Using KVL at $t = 0^+$,

$$V_L(0^+) + i_L(0^+)\,(8 + 4) = 0$$

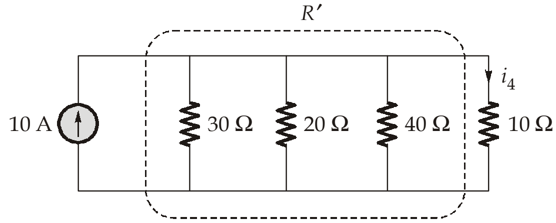
$$V_L(0^+) = -i_L(0^+)\,12$$

$$i_L(0^+) = i_L(0^-) = 3 \text{ A}$$

$$V_L(0^+) = \frac{L\,di_L(0^+)}{dt} = -12 \times 3$$

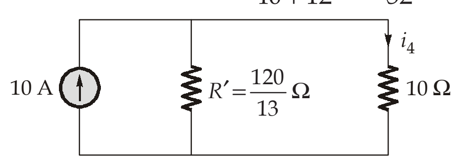
$$\frac{di_L(0^+)}{dt} = -\frac{36}{4} = -9 \text{ A/s}$$

30. (b)



$$30 \| 20 = \frac{30 \times 20}{50} = 12\ \Omega$$

$$R' = 12 \| 40 = \frac{12 \times 40}{40 + 12} = \frac{12 \times 40}{52} = \frac{120}{13}\ \Omega$$



Using current division rule,

$$i_4 = 10\frac{R'}{R' + 10} = 10 \times \frac{\frac{120}{13}}{\frac{120}{13} + 10} = 10 \times \frac{120}{120 + 130}$$

$$= 10 \times \frac{120}{250} = \frac{24}{5} = 4.8 \text{ A}$$

■■■■