PRACTICE QUESTIONS

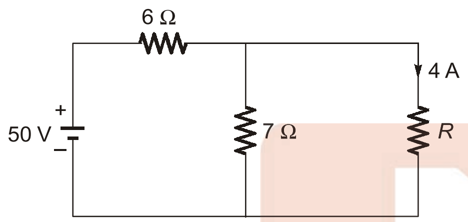
for SSC-JE : CBT-2

Electric Circuits and Magnetic Circuits

Electrical Engineering

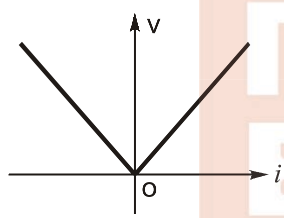
Electric Circuits and Magnetic Circuits

Q.1 The value of resistance 'R' shown in the given figure is



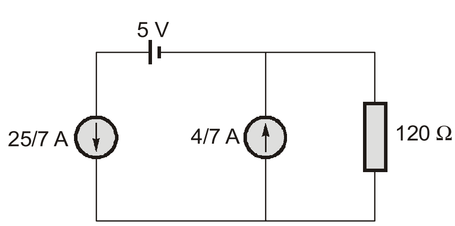
(a) 3.5 Ω (b) 2.5 Ω
(c) 1 Ω (d) 4.5 Ω

Q.2 The v-i characteristic of an element is shown in the figure given below. The element is



(a) non-linear, active, non-bilateral
(b) linear, active, non-bilateral
(c) non-linear, passive, non-bilateral
(d) non-linear, active, bilateral

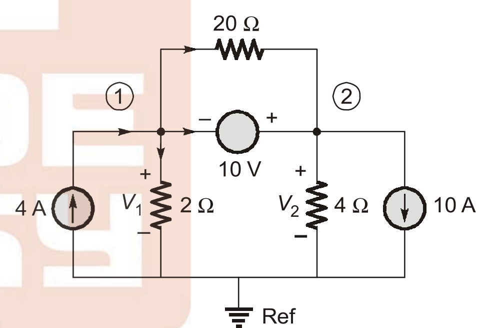
Q.3 The current through 120 ohm resistor in the circuit shown in the figure below is



(a) 1 A (b) 2 A
(c) 3 A (d) 4 A

Q.4 In a network made up of linear resistors and ideal voltage sources, values of all resistors are doubled. Then the voltage across each resistor is
(a) Doubled
(b) Halved
(c) Decreases four times
(d) Not changed

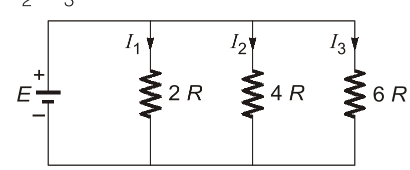
Q.5 When KCL is applied at the super node in the below circuit, the current equation in terms of node voltages V_1 and V_2 is



(a) $-6 = \frac{V_1}{2} + \frac{V_2}{4}$ (b) $4 = \frac{V_1 - V_2}{2} + \frac{V_1 - V_2}{20}$

(c) $4 = \frac{V_1}{2} + \frac{V_1 - V_2}{20}$ (d) $4 = \frac{V_1}{2} + \frac{V_2}{4}$

Q.6 Three parallel branches of resistors are connected across a d.c. source as shown in the figure. What is $I_1 : I_2 : I_3$?

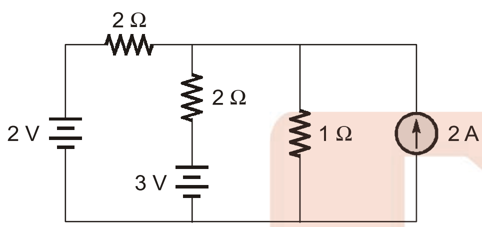


(a) 3 : 2 : 6 (b) 2 : 4 : 6
(c) 6 : 3 : 2 (d) 6 : 2 : 4

Q.7 If an ideal voltage source and ideal current source are connected in series, the combination

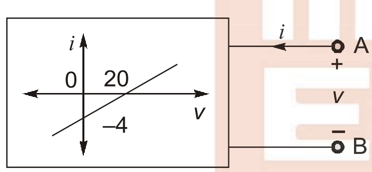
(a) has the same properties as a current source alone.
(b) has the same properties as a voltage source alone.
(c) has the same properties as the source which has a higher value.
(d) results in the branch being redundant.

Q.8 The current in the 1 Ω resistor in the network as shown is



(a) 2.00 A (b) 2.25 A
(c) 2.50 A (d) 2.75 A

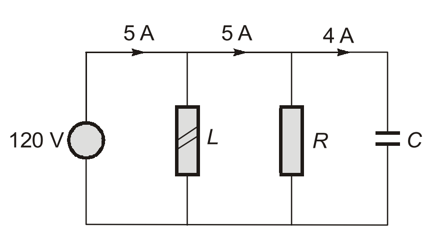
Q.9 The resistance seen from the terminals A and B of the device whose characteristic is shown in the figure below is



(a) –5 Ω (b) $-\frac{1}{5}\Omega$

(c) $\frac{1}{5}\Omega$ (d) 5 Ω

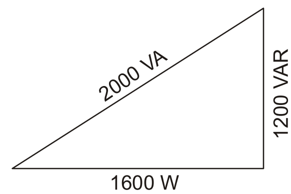
Q.10 In the circuit shown in the given figure,

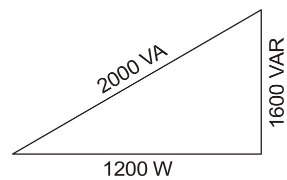


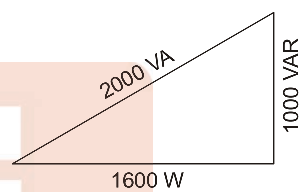
The current through the inductor L is

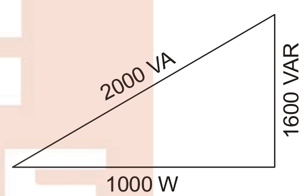
(a) 0 A (b) 3 A
(c) 4 A (d) 8 A

Q.11 A voltage of $V = 100\angle 30°$ is applied to an impedance $Z = 3 + j4$. Which one of the following is the power triangle?

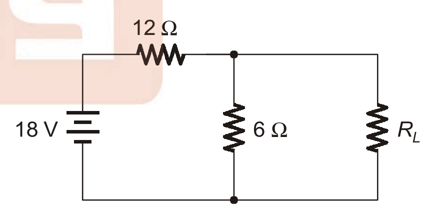
(a)


(b)


(c)


(d)


Q.12 In the circuit shown below, the maximum power absorbed by the load resistance R_L is

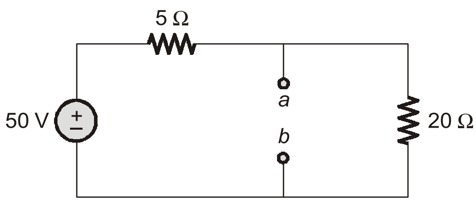


(a) 1.5 W (b) 2.25 W
(c) 2.5 W (d) 5 W

Q.13 A battery charger can drive a current of 5 A into a 1 Ω resistance connected at its output terminals. If it is able to charge an ideal 2 V battery at 7 A rate, then Thevenin's equivalent will be

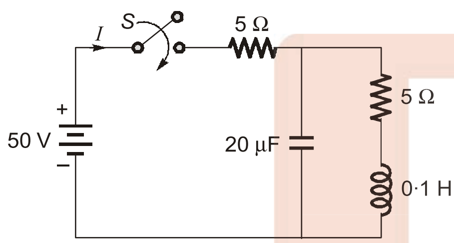
(a) 7.5 V in series with 0.5 Ω
(b) 12.5 V in series with 1.5 Ω
(c) 7.5 V in parallel with 0.5 Ω
(d) 12.5 V in parallel with 1.5 Ω

Q.14 The Thevenin voltage and resistance across the terminal *a*-*b* of the circuit in the figure respectively are



(a) 40 V, 4 Ω (b) 20 V, 8 Ω
(c) 40 V, 8 Ω (d) 20 V, 4 Ω

Q.15 The network shown below is initially at rest. What is the initial current *I* when the switch *S* is closed at $t = 0$?

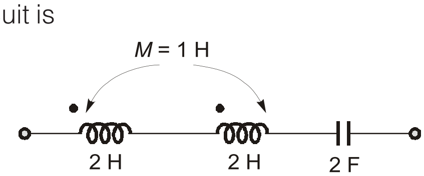


(a) 0 A (b) 5 A
(c) 10 A (d) 20 A

Q.16 In a series resonance circuit, at resonance, selectivity *Q* is equal to

(a) $\frac{1}{R\sqrt{LC}}$ (b) $\frac{1}{R}\sqrt{\frac{C}{L}}$
(c) $\frac{1}{R}\sqrt{\frac{L}{C}}$ (d) $\frac{1}{R}\sqrt{LC}$

Q.17 The resonant frequency of the given series circuit is



(a) $1/2\pi\sqrt{3}$ Hz (b) $1/4\pi\sqrt{3}$ Hz
(c) $1/4\pi\sqrt{2}$ Hz (d) $1/\pi\sqrt{2}$ Hz

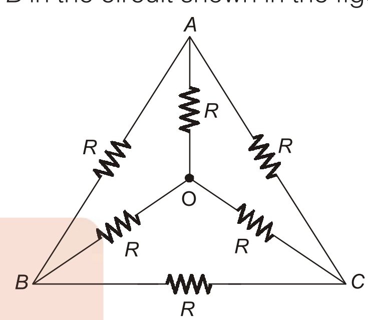
Q.18 A balanced load of $5 + j4$ is connected in delta. What is the impedance per phase of the equivalent star connection?

(a) $5 + j4$ (b) $1.66 + j1.33$
(c) $15 + j12$ (d) $2.5 + j2$

Q.19 A three-phase star-connected load is operating at a power factor angle ϕ, with ϕ being the angle between

(a) line voltage and line current
(b) phase voltage and phase current
(c) line voltage and phase current
(d) phase voltage and line current

Q.20 The effective resistance between the terminals *A* and *B* in the circuit shown in the figure is

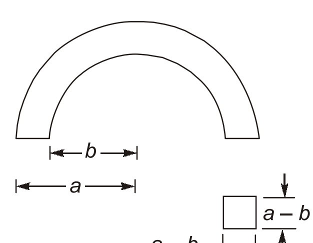


(a) *R* (b) $R - 1$
(c) $\frac{R}{2}$ (d) $\frac{6}{11}R$

Q.21 A practical current source is usually represented by

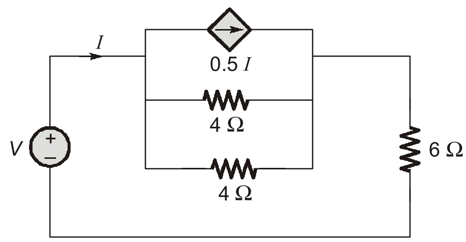
(a) a resistance in series with an ideal current source.
(b) a resistance in parallel with an ideal current source.
(c) a resistance in parallel with an ideal voltage source.
(d) none of these

Q.22 The resistance measured between the two ends of the toroid shown in the below figure is *R*. What would be the resistance if both *a* and *b* are doubled?



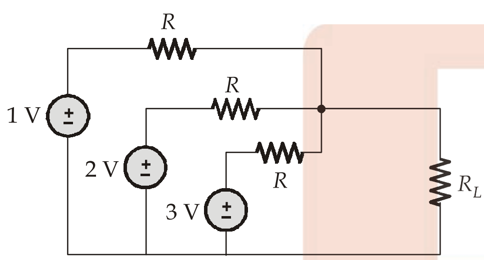
(a) 2*R* (b) *R*
(c) *R*/2 (d) *R*/4

Q.23 Calculate the voltage V in the circuit shown below:



(a) $6I$ (b) $4.5I$
(c) $4I$ (d) $7I$

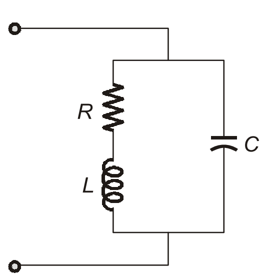
Q.24 For the circuit shown in the figure below, the value of 'R' such that the maximum power delivered to the load is 5 mW will be



(a) 400 Ω (b) 500 Ω
(c) 600 Ω (d) 700 Ω

Q.25 A series *RLC* circuit draws current at leading power factor at
(a) the resonant frequency
(b) frequencies less than the resonant frequency
(c) frequencies more than the resonant frequency
(d) frequencies both less and more than the resonant frequency

Q.26 The circuit given below is constituted by an iron-cored coil and a capacitor. At resonance, the circuit behaves like



(a) an open circuit
(b) a short circuit
(c) a pure resistor of value R
(d) a pure resistor of value much higher than R

Q.27 The dielectric strength and dielectric constant of a ceramic should be
(a) high and low respectively
(b) low
(c) low and high respectively
(d) high

Q.28 The unit of relative dielectric constant is
(a) Fm^{-1}
(b) CV^{-1}
(c) dimensionless
(d) FC^{-1}

Q.29 Ferrites have
(a) low copper loss
(b) low eddy current loss
(c) low resistivity
(d) high specific gravity compared to iron

Q.30 Magnetic susceptibility is
(a) inversely proportional to both temperature and magnetizing field.
(b) inversely proportional to temperature but independent of magnetizing field.
(c) proportional to temperature but inversely proportional to magnetizing field.
(d) proportional to temperature but independent of magnetizing field.

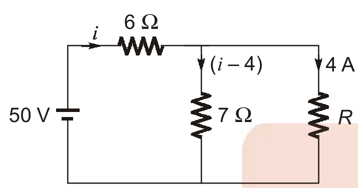
■■■■

Answer Keys

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

Detailed Solutions

1. (a)



By applying KVL in 1st loop

$$50 = 6i + 7(i - 4)$$

$$\Rightarrow \quad 13i = 78$$

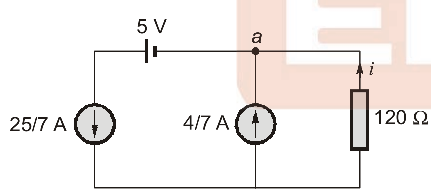
$$\Rightarrow \quad i = 6 \text{ A}$$

Now, by applying KVL in 2nd loop

$$7 \times 2 = 4 \times R$$

$$R = 3.5\ \Omega$$

3. (c)



By applying KCL at node a

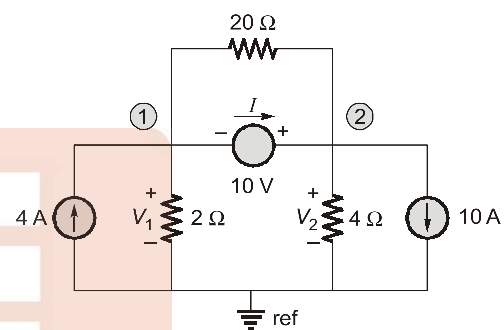
$$i = \frac{25}{7} - \frac{4}{7} = 3 \text{ A}$$

Voltage source in series with constant current source will behave like short circuit.

4. (d)

Ideal voltage source keeps the terminal voltage constant so accordingly current will change and the voltage across each resistor is unchanged following superposition principle.

5. (a)



Let current through 10 V source is I.

Applying KCL at node 1,

$$-4 + \frac{V_1}{2} + \frac{V_1 - V_2}{20} + I = 0 \quad \ldots(i)$$

Applying KCL at node 2,

$$-I + \frac{V_2}{4} + \frac{V_2 - V_1}{20} + 10 = 0 \quad \ldots(ii)$$

Adding equation (i) and (ii) we get,

$$-6 = \frac{V_1}{2} + \frac{V_2}{4}$$

Hence, option (a) is correct.

6. (c)

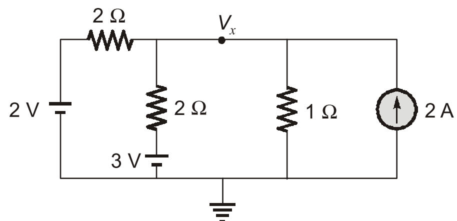
$$I_1 = \frac{E}{2R};\ I_2 = \frac{E}{4R};\ I_3 = \frac{E}{6R}$$

$$I_1 : I_2 : I_3 = \frac{E}{2R} : \frac{E}{4R} : \frac{E}{6R} = 6 : 3 : 2$$

7. (a)

Whenever an ideal voltage source and ideal current source are connected in series, they will behave like an ideal current source alone and if they are connected in parallel, they will have an ideal voltage source alone.

8. (b)



$$\frac{V_x-2}{2}+\frac{V_x-3}{2}+\frac{V_x}{1} = 2$$

$$4V_x = 9$$

$$\Rightarrow \quad V_x = \frac{9}{4}$$

$$I = \frac{V_x}{1}=\frac{9}{4}=2.25 \text{ A}$$

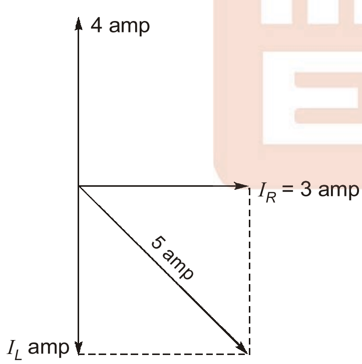
9. (d)

v-i characteristic is $i=\frac{1}{5}v-4$

$$\therefore \quad R_{AB} = \frac{dv}{di}=5\ \Omega$$

10. (d)

$$I_R = \sqrt{5^2-4^2} = 3 \text{ Amp}$$



$$(I_L-4)^2+3^2 = 5^2$$

$$I_L = 8 \text{ amp}$$

11. (b)

$$I = \frac{V}{|Z|}=\frac{100}{5}$$

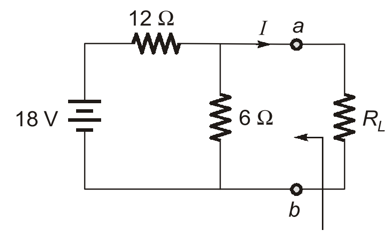
$$\text{p.f. of circuit} = \frac{3}{\sqrt{(3)^2+(4)^2}}=\frac{3}{5} = \cos\phi$$

$$\text{and, } \sin\phi = \frac{4}{5}$$

$$\text{So, real power} = 100\times\frac{100}{5}\times\frac{3}{5}=1200 \text{ W}$$

$$\text{Reactive Power} = 100\times\frac{100}{5}\times\frac{4}{5}=1600 \text{ VAR}$$

12. (b)



Resistance seen across the terminal *ab* is

$$= \frac{12\times 6}{12+6}=4\ \Omega$$

For maximum power transfer,

$$R_L = 4\ \Omega$$

Now, current passing through R_L,

$$I = \frac{18}{(6\|4+12)}\times\frac{6}{6+4}$$

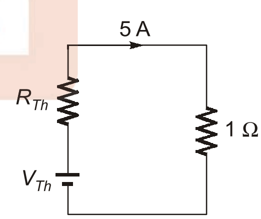
$$= \frac{18}{2.4+12}\times\frac{6}{10}=0.75 \text{ A}$$

Now maximum power absorbed by R_L is

$$= I^2R_L = (0.75)^2\times 4$$

$$= 2.25 \text{ W}$$

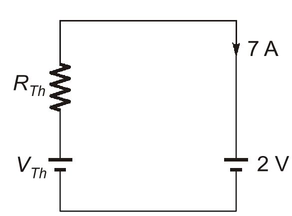
13. (b)



$$I = \frac{V_{Th}}{R_{Th}+1} \Rightarrow 5 = \frac{V_{Th}}{R_{Th}+1}$$

$$\Rightarrow \quad 5R_{Th}+5 = V_{Th}$$

$$\Rightarrow \quad \boxed{V_{Th}-5R_{Th}=5}$$



$$7 = \left(\frac{V_{Th} - 2}{R_{Th}}\right)$$

$$7R_{Th} = V_{Th} - 2$$

$$\boxed{V_{Th} - 7R_{Th} = 2}$$

$$V_{Th} - 5R_{Th} = 5$$

$$\underline{V_{Th} - 7R_{Th} = 2}$$

$$- \quad + \qquad -$$

$$2R_{Th} = 3$$

$$\boxed{R_{Th} = 1.5\ \Omega}$$

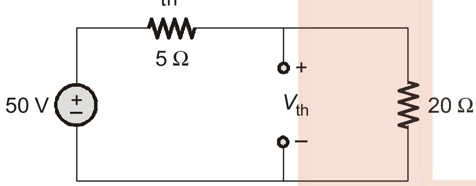
$$V_{Th} - (1.5) = 5$$

$$V_{Th} - 7.5 = 5$$

$$\boxed{V_{Th} = 12.5\text{ V}}$$

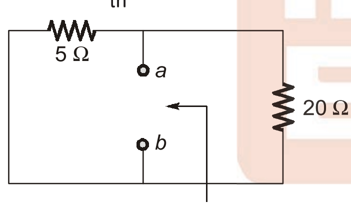
14. (a)

Case-I : V_{th}



$$V_{th} = 50 \times \frac{20}{20+5} = 40\text{ V}$$

Case-II : R_{th}



$$R_{th} = \frac{5 \times 20}{5 + 20} = 4\ \Omega$$

15. (c)

When system is initially at rest: Inductor will behave as open circuit and capacitor act as short circuit

$$\therefore \qquad I = \frac{50}{5} = 10\text{ A}$$

16. (c)

In a series resonance circuit,

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

17. (b)

$$L_{equivalent} = L_1 + L_2 + 2M$$

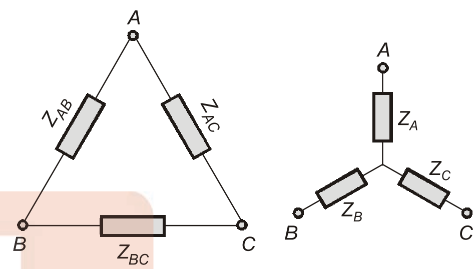
$$= 2 + 2 + 2 \times 1 = 6\text{ H}$$

Resonant frequency

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

$$= \frac{1}{2\pi\sqrt{6 \times 2}} = \frac{1}{4\pi\sqrt{3}}\text{ Hz}$$

18. (b)



If

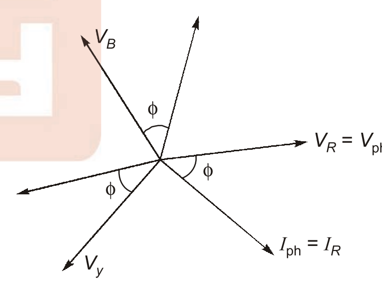
$$Z_{AB} = Z_{AC} = Z_{BC} = Z$$

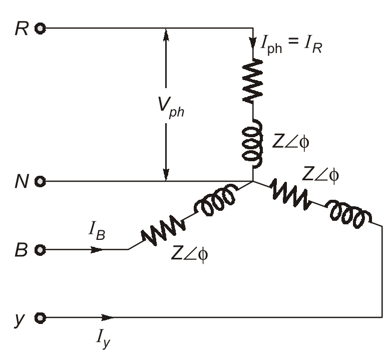
$$Z_A = Z_B = Z_C = \frac{Z}{3}$$

$$Z_A = Z_B = Z_c = \left(\frac{5 + j4}{3}\right)$$

$$Z = 1.66 + j\,1.33\ \Omega$$

19. (b)

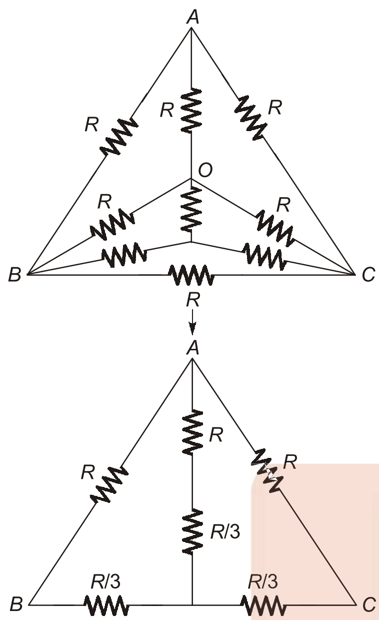




A load is connected between phase to neutral.

The power factor (ϕ) of load is the angle between phase voltage and phase current.

20. (c)



$$R_{AB} = R \left\| \left(\frac{R}{3} + \left(\frac{4R}{3} \middle\| \frac{4R}{3} \right) \right) \right. = \frac{R}{2}$$

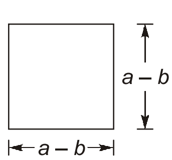
21. (b)

A practical current source is usually represented by a resistance in parallel with an ideal current source and a practical voltage source is usually represented by a resistance in series with an ideal voltage source.

22. (c)

$$\text{Mean length of toroid} = \pi\left(b + \left(\frac{a-b}{2}\right)\right)$$

$$\text{Where mean radius} = b + \left(\frac{a-b}{2}\right) = \frac{a+b}{2}$$



Area of cross section $= \pi(a-b)^2$

$$R = \frac{\rho l}{A} = \frac{\pi\rho\left(\frac{a+b}{2}\right)}{\pi(a-b)^2} = \frac{\rho}{2}\frac{(a+b)}{(a-b)^2}$$

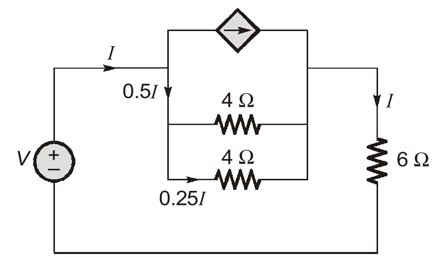
with 'a' and 'b' doubled,

$$R' = \frac{\rho}{2}\frac{(2a+2b)}{(2a-2b)^2}$$

$$= \frac{\rho}{4}\frac{a+b}{(a-b)^2} = \frac{R}{2}$$

23. (d)

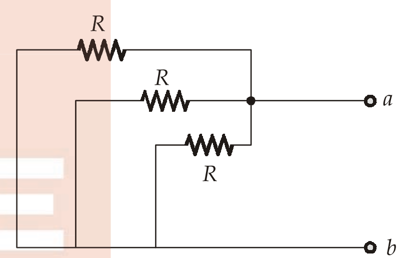
Applying KVL,



$$V = 4 \times 0.25I + 6I = 7I$$

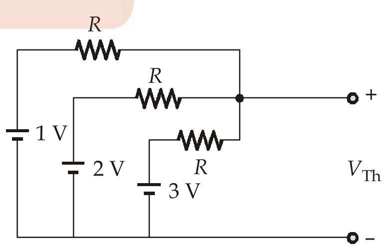
24. (c)

For finding R_{Th} across terminal a and b:



$$R_{Th} = \frac{R}{3}\ \Omega$$

For finding V_{Th}:



Using KCL, we get,

$$\frac{V_{Th}-1}{R} + \frac{V_{Th}-2}{R} + \frac{V_{Th}-3}{R} = 0$$

$$3V_{Th} = 6$$

$$V_{Th} = 2\text{ V}$$

$\therefore$ Maximum power transferred will be given by

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

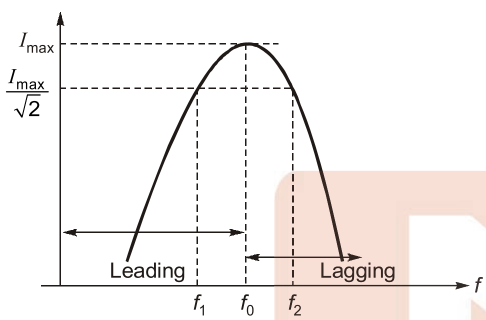
$$5 \times 10^{-3} = \frac{2 \times 2}{4 \times \frac{R}{3}}$$

$$\frac{R}{3} = \frac{10^3}{5}$$

or $$R = \frac{3}{5} \times 10^3 = 600\ \Omega$$

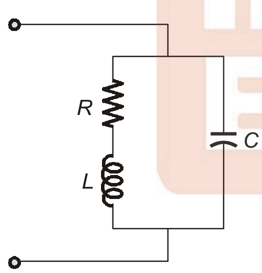
25. (b)

Consider the resonance curve for series *RLC* circuit as shown below.



From above curve it is clear that series *RLC* circuit draws maximum current at leading power factor at frequencies below f_0 (resonance frequency).

26. (d)



$$Y = j\omega C + \frac{1}{R + j\omega L}$$

$$Y = j\omega C + \frac{R - j\omega L}{R^2 + \omega^2 L^2}$$

At resonance imaginary part of Y is equal to zero hence

$$\omega C = \frac{\omega L}{R^2 + \omega^2 L^2}$$

$$\omega C(R^2 + \omega^2 L^2) = \omega L$$

$$\omega^2 L^2 C = L - CR^2$$

$$\omega^2 LC = 1 - \frac{CR^2}{L}$$

$$\omega_0 = \frac{1}{\sqrt{LC}}\sqrt{1 - \frac{R^2 C}{L}}$$

for positive ω_0, $R < \sqrt{\frac{L}{C}}$

At resonance, $$Z = (Y)^{-1} = \frac{R^2 + \omega_0^2 L^2}{R}$$

$$= R + \frac{1}{RLC}\left(1 - \frac{R^2 C}{L}\right)L^2$$

$$= R + \frac{1}{RC}[L - R^2 C]$$

$$= R + \frac{L}{RC} - R$$

At resonance, $$Z_{in} = \frac{L}{RC}\Omega$$

As $$R^2 < \frac{L}{C} \Rightarrow R < \frac{L}{RC}$$

Circuit behaves like a pure resistor of much higher value than *R*.

27. (d)

Ceramics have high values of dielectric constant e_r (8 for mica, 7 for soda-lime glass, and 6 for porcelain). Dielectric strength of ceramic is high.

28. (c)

Relative dielectric constant is

$$e_r = \frac{\varepsilon}{\varepsilon_0}$$

which is a dimensionless quantity.

29. (b)

Ferrites have high resistivity due to which eddy current loss is reduced.

30. (b)

Magnetic susceptibility,

$$\chi_m \propto \frac{1}{T}$$

or, $$\chi_m = \frac{C_c}{T}$$

Where, C_c = Curie constant and

T = Absolute temperature

Thus, χ_m is inversely proportional to temperature but independent of magnetizing field.

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