CHAPTER 2

BASIC LAWS

QUESTION 2.1

A metal wire has a uniform cross-section A, length l, and resistance R between its two end points. It is uniformly stretched so that its length becomes αl. The new resistance is

(A) αR

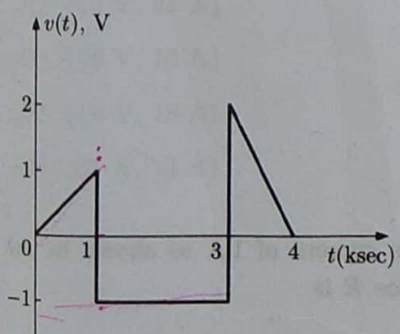
(B) $\alpha^2 R$

(C) $\sqrt{\alpha} R$

(D) $e^{\alpha} R$

QUESTION 2.2

The voltage across a 100 Ω resistor is sketched in the figure. The energy delivered to the resistor from $t = 0$ to $t = 2$ ksec will be



________ J

QUESTION 2.3

When a resistor R is connected to a current source it consumes a power of 18 W When the same R is connected to a voltage source having the same magnitude as the current source, the power absorbed by R is 45 W. The magnitude of the current source and the value of R are

(A) $\sqrt{18}$ A and 1 Ω

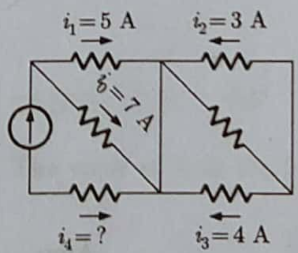
(B) 3 A and 2 Ω

(C) 1 A and 18 Ω

(D) 6 A and 0.5 Ω

QUESTION 2.4

The current i_4 in the circuit of the figure is equal to



(A) 12 A

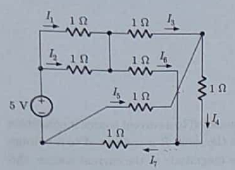
(B) -12 A

(C) 4 A

(D) None or these

QUESTION 2.5

Which one of the following equations is valid for the circuit shown below ?



(A) $I_3 + I_5 - I_6 + I_7 = 0$

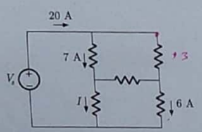
(B) $I_3 - I_5 + I_6 + I_7 = 0$

(C) $I_3 + I_5 + I_6 + I_7 = 0$

(D) $I_3 + I_5 + I_6 - I_7 = 0$

QUESTION 2.6

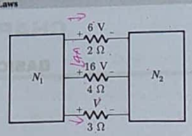
In the circuit shown in figure, unknown current I is



_______ Amp

QUESTION 2.7

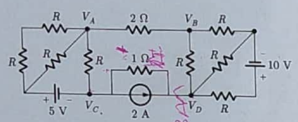
The two electrical networks N_1 and N_2 are connected through three resistors as shown in figure. The voltage across 3 Ω resistor is



_______ Volts

QUESTION 2.8

If $V_A - V_B = 6$ V then $V_C - V_D$ is



(A) −5 V

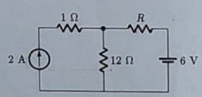
(B) 2 V

(C) 3 V

(D) 6 V

QUESTION 2.9

If the 12 Ω resistor draws a current of 1 A as shown in the figure, the value of resistance R is



(A) 4 Ω

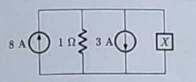
(B) 6 Ω

(C) 8 Ω

(D) 18 Ω

QUESTION 2.10

Consider the circuit shown in figure below. Let X be a 4 Ω resistor then power absorbed by X is P_1 and when X be a 6 V independent voltage source with positive terminal at top, then power absorbed by X is P_2. What is the value of P_1/P_2 ?



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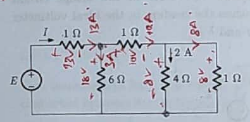
QUESTION 2.11

The values of E and I for the circuit shown in figure are



(A) (13 V, 31 A)

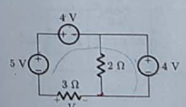
(B) (18 V, 13 A)

(C) (18 V, 18 A)

(D) (31 V, 13 A)

QUESTION 2.12

The voltage V in the figure equal to



−4 − 4 + 5 + V = 0

V = 3

(A) 3 V

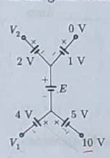
(B) −3 V

(C) 5 V

(D) None of these

QUESTION 2.13

In the given circuit, the value of the voltage source E is



10+5+E+1=0

E=-16 volts

(A) −16 V

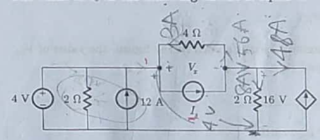
(B) 4 V

(C) −6 V

(D) 16 V

QUESTION 2.14

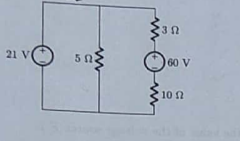
The value of I_x in the following circuit is equal to



_______ Amp

QUESTION 2.15

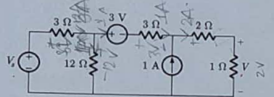
In the following circuit, what is the value of [redacted]ent I_1 ?



_______ Amp

QUESTION 2.16

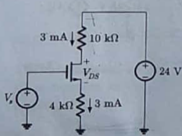
If $V = 2$ V in the circuit below, then value of V_s equals to



_______ Volt

QUESTION 2.17

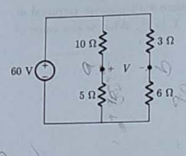
In the transistor circuit shown in the figure, the value of V_{DS} will be equal to



_______ Volt

QUESTION 2.18

The voltage V in the following circuit, equals to

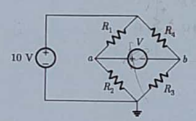


15 − 40 = −25

_______ Volt

QUESTION 2.19

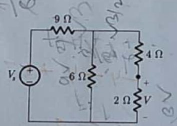
If $R_1 = R_2 = R_4 = R$ and $R_3 = 1.1R$ in the bridge circuit shown in the figure, then the reading in the ideal voltmeter connected between a and b is



_______ V

QUESTION 2.20

If $V = 3$ V in the circuit of figure, then V_s is equal to



_______ Volt

QUESTION 2.21

How many 200 W/220 V incandescent lamps connected in series would consume that same total power as a single 100 W/220 V incandescent lamp ?

____

QUESTION 2.22

A 100 Ω, 1 W resistor and a 800 Ω, 2 W resistor are connected in series. The maximum dc voltage that can be applied continuously to the series circuit without exceeding the power limit of any of the resistors is

_______ V

QUESTION 2.23

Two incandescent light bulbs of 40 W and 60 W rating are connected in series across the mains. Then

(A) the bulbs together consume 100 W

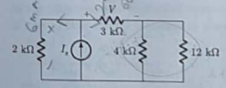
(B) the bulbs together consume 50 W

(C) the 60 W bulb glows brighter

(D) the 40 W bulb glows brighter

QUESTION 2.24

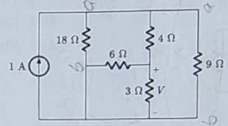
For the circuit shown below it is given that $V = 6$ volt, then what is the value of I_s ?



_______ mA

QUESTION 2.25

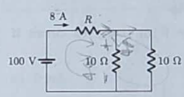
In the resistive network shown below the value of voltage V is



_______ Volt

QUESTION 2.26

In the figure given below the value of R is



(A) 2.5 Ω

(B) 5.0 Ω

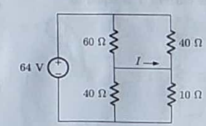
(C) 7.5 Ω

(D) 10.0 Ω

$-160 + 8R + 40 = 0$

QUESTION 2.27

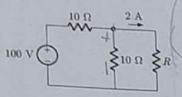
The value of current I in the circuit below is equal to



_______ Amp

QUESTION 2.28

In figure, the value of resistance R in Ω is



$\frac{V}{R} = 2$

$\frac{V-100}{10} + \frac{V}{10} + 2 = 0$

$V - 100 + V + 20 = 0$

$V = 40$

(A) 10

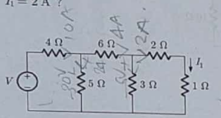
(B) 20

(C) 30

(D) 40

QUESTION 2.29

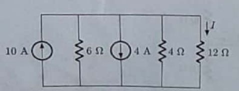
What is the value of voltage V in the given circuit if $I_1 = 2$ A ?



_______ Volt

QUESTION 2.30

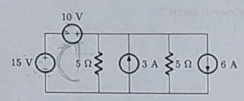
In the circuit shown below. the current I is equal to



_______ Amp

QUESTION 2.31

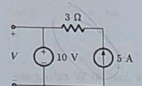
The power absorbed by each of 5 Ω resistor shown in figure, is



_______ Watts

QUESTION 2.32

The voltage V in the figure is



(A) 10 V

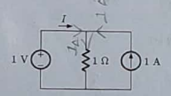
(B) 15 V

(C) 5 V

(D) None of the above

QUESTION 2.33

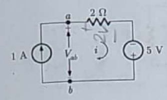
The current I supplied by the dc voltage source in the circuit shown below is



_______ A

QUESTION 2.34

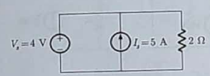
Assuming ideal elements in the circuit shown below, the voltage V_{ab} will be



_______ V

QUESTION 2.35

For the circuit shown, find out the current flowing through the 2 Ω resistance. Also identify the changes to be made to double the current through the 2 Ω resistance.



(A) (5 A; Put $V_s = 30$ V)

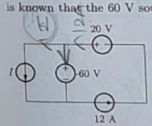
(B) (2 A; Put $V_s = 8$ V)

(C) (5 A; Put $I_s = 10$ A)

(D) (7 A; Put $I_s = 12$ A)

QUESTION 2.36

In the interconnection of ideal sources shown in the figure, it is known that the 60 V source is absorbing power.



Which of the following can be the value of the current source I?

(A) 10 A

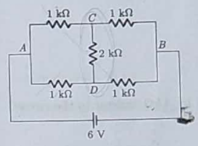
(B) 13 A

(C) 15 A

(D) 18 A

QUESTION 2.37

The current through the 2 kΩ resistance in the circuit shown is



(A) 0 mA

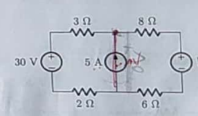
(B) 1 mA

(C) 2 mA

(D) 6 mA

QUESTION 2.38

In the circuit shown below the 5 A source supplies no power, the value of source V_s is



$\frac{0-30}{5} + 5 + \frac{-V_s}{14} = 0$

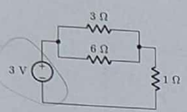
$-6-5 = \frac{V_s}{14}$

$V_s = 11 \times 19$

_______ Volts

QUESTION 2.39

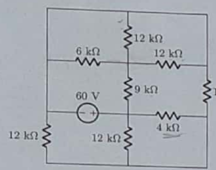
The power supplied by the *dc* voltage source in the circuit shown below is



_______ W

QUESTION 2.40

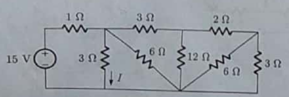
What is the power absorbed by 4 kΩ resistor in the circuit given below ?



_______ mW

QUESTION 2.41

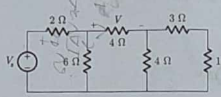
In the circuit shown below, current I is equal to



_______ Amp

QUESTION 2.42

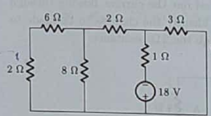
In the circuit below if $V = 4$ volt, then V_s is



_______ Volts

QUESTION 2.43

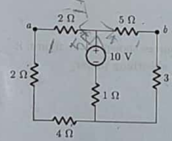
What is the value of current I in the circuit below ?



_______ Amp

QUESTION 2.44

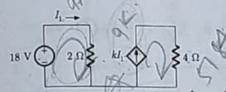
In the figure, the potential difference between point a and b is



_______ Volt

QUESTION 2.45

In the circuit of figure, the value of k such that power dissipated by 4 Ω resistor is 5184 W, will be



$81K^2 + A = 5184$

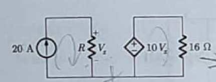
$K^2 = 16$

$K = 4$

____

QUESTION 2.46

In the following circuit, the value of R that is required to deliver a power of 160 kW to the 16 Ω resistor would be



$V = 20R$

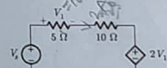
$\frac{(20 \times 20R)^2}{16} = 160 \times 1000$

$R = 8$

_______ Ω

QUESTION 2.47

In the following circuit, power dissipated by 5 Ω resistor is 20 W. What is the values of source voltage V_s ?



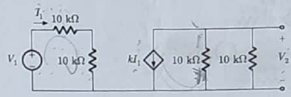
$-35 + 7 + V = 0$

$V = 28$

_______ Volt

QUESTION 2.48

For the given circuit , what value of k will produce voltage gain $\frac{V_2}{V_1} = -10$?



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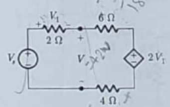
QUESTION 2.49

In the circuit shown in figure, if $V = 42$ V, then value of V_s is

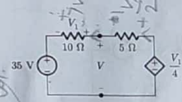


$V = 42$

_______ Volt

QUESTION 2.50

For the circuit shown in figure, what is the voltage V ?



$-35 - V_1 - V_1 \ldots = 0$

$-5V_1 = -35$

$V_1 = 7$

_______ Volt

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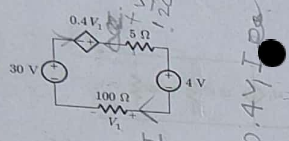
QUESTION 2.51

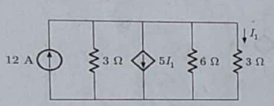
How much power is absorbed by the dependent source in the following circuit ?



_______ Watt

QUESTION 2.52

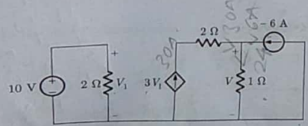
In the given circuit, the value of current I_1 through 3 Ω resistor is



_______ Amp

QUESTION 2.53

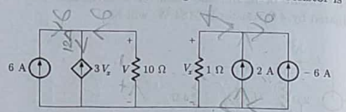
In the circuit shown in the figure, the value of voltage V, is



_______ Volt

QUESTION 2.54

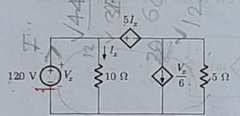
In the following circuit, voltage V across 10 Ω resistor is



_______ Volt

QUESTION 2.55

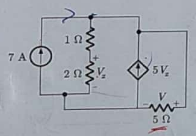
What is the power delivered by the 120 V source in the given circuit ?



_______ kJ

QUESTION 2.56

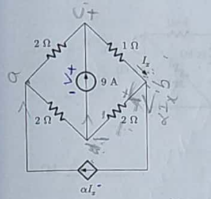
What is the voltage V across the 5 Ω resistor shown below ?



_______ Volt

QUESTION 2.57

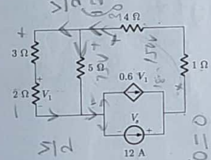
The value of α in the network such that power supplied by 9 A source is 180 W, will be equal to



____

QUESTION 2.58

In the given circuit voltage V_s across current source is



_______ Volts

QUESTION 2.59

A 3 V dc supply with an internal resistance of 2 Ω supplies a passive non-linear resistance characterized by the relation $V_{NL} = I_{NL}^2$. The power dissipated in the non linear resistance is

_______ W

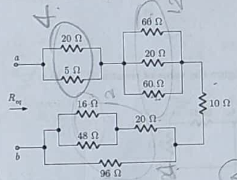
QUESTION 2.60

A 10 V battery with an internal resistance of 1 Ω is connected across a nonlinear load whose V-I characteristic is given by $7I = V^2 + 2V$. The current delivered by the battery is

_______ A

QUESTION 2.61

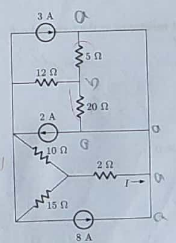
What is the equivalent resistance R_{eq} looking into terminal a-b of the following network ?



_______ Ω

QUESTION 2.62

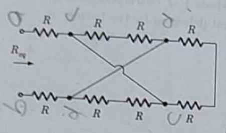
For the given circuit, the value of current I equals to



_______ Amp

QUESTION 2.63

In the following network $\frac{R_{eq}}{R}$ is equal to

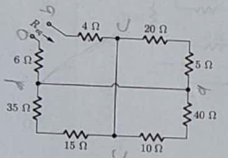


$\frac{2R + 2R}{3} = \frac{8R}{3}$

$R_{eq} = \frac{8}{3} = 2.66$

QUESTION 2.64

In the circuit of figure the value of resistor R_{eq} is

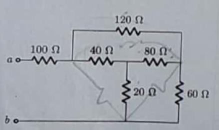


22.5

------- Ω

QUESTION 2.65

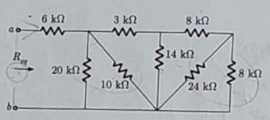
What is the value of equivalent resistance at the terminal a-b , for the circuit shown below ?



------- Ω

QUESTION 2.66

What is the value of equivalent resistance R_{eq} between terminal a-b in the following network ?

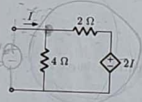


10

------- kΩ

QUESTION 2.67

The circuit shown in figure is equivalent to a load of



(A) $\frac{4}{3}$ ohms

(B) $\frac{8}{3}$ ohms

(C) 4 ohms

(D) 2 ohms

QUESTION 2.68

Twelve 1 Ω resistance are used as edges to form a cube. The resistance between two diagonally opposite corners of the cube is

(A) $\frac{5}{6}$ Ω

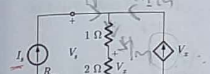
(B) 1 Ω

(C) $\frac{6}{5}$ Ω

(D) $\frac{3}{2}$ Ω

QUESTION 2.69

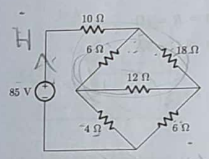
What is the equivalent resistance R_{eq} seen by the current source I_s in the circuit ?



------- Ω

QUESTION 2.70

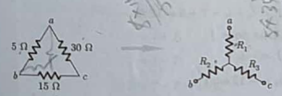
How much power is generated by the source in the given network ?



------- Watt

QUESTION 2.71

A Delta-connected network with its Wye-equivalent is shown in the given figure. The resistance R_1, R_2 and R_3 (in ohms) are respectively



(A) 1.5, 3 and 9

(B) 3, 9 and 1.5

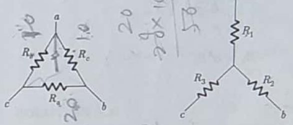
(C) 9, 3 and 1.5

(D) 3, 1.5 and 9

QUESTION 2.72

20, 10 and 10

In figure, R_a, R_b and R_c are 20 Ω, 20 Ω and 10 Ω respective[ly]. The resistances R_1, R_2 and R_3 in Ω of an equivalent sta[r] connection are



(A) 2.5, 5, 5

(B) 5, 2.5, 5

(C) 5, 5, 2.5

(D) 2.5, 5, 2.5

****

SOLUTIONS

ON 2.1

tion is (B).

$$R = \frac{\rho l}{A}$$

nt volume,

$$R = \frac{\rho l}{A} \times \frac{l}{l} = \frac{\rho l^2}{V}$$

$$R \propto l^2$$

$$R_2 = \alpha^2 R_1$$

ON 2.2

swer is 13.33 .

$$p(t) = \frac{v^2(t)}{R}$$

$$E[0,t] = \int_0^t p(t)\,dt = \frac{1}{100}\int_0^t v^2(t)\,dt$$

raph $v(t) = \begin{cases} t, & 0 \le t < 1\,\text{ksec} \\ -1, & 1 \le t < 2\,\text{ksec} \end{cases}$

$$,2] = \frac{1}{100}\int_0^2 v^2(t)\,dt$$

$$= \frac{1}{100}\int_0^1 v^2(t)\,dt + \frac{1}{100}\int_1^2 v^2(t)\,dt$$

$$= \frac{1}{100}\int_0^1 t^2\,dt + \frac{1}{100}\int_1^2 (-1)^2\,dt$$

$$= \frac{1}{100}\left[\frac{t^3}{3}\right]_0^1 + \frac{1}{100}[t]_1^2$$

$$= \frac{1}{100}\left[\frac{1\times 10^3}{3} - 0\right] + \frac{1}{100}[2\times 10^3 - 1\times 10^3]$$

$$= \frac{10}{3} + 10$$

$$= \frac{40}{3} = 13.33\,\text{Joule}$$

SOLUTION 2.3

Correct option is (B).
When R is connected to current source power absorbed by R is

$$P_1 = I_s^2 R = 18\,\text{W}, \qquad I_s \to \text{value of current source}$$

When R is connected to voltage source power absorbed is

$$P_2 = \frac{V_s^2}{R} = 4.5\,\text{W}, \qquad V_s \to \text{value of voltage source}$$

Given that I_s and V_s are same in magnitude, so dividing above two

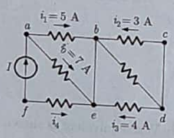
$$\frac{I_s^2 R}{V_s^2/R} = \frac{18}{4.5}$$

$$R^2 = 20 \Rightarrow R = 2\,\Omega$$

$$I_s^2 \times 2 = 18 \Rightarrow I_s = 3\,\text{A}$$

SOLUTION 2.4

Correct option is (B).
The given figure is shown below.



Applying KCL at node a we have

$$I = i_5 + i_1 = 7 + 5 = 12\,\text{A}$$

Applying KCL at node f

$$I = -i_4$$

So, $\quad i_4 = -12$ amp

SOLUTION 2.5

Correct option is (D).
Writing KCL at top right node

$$I_3 + I_5 = I_4 \qquad \text{...(i)}$$

KCL at bottom right node

$$I_4 + I_6 = I_7$$

$$I_4 = I_7 - I_6$$

Substituting I_4 into equation (i)

$$I_3 + I_5 = I_7 - I_6$$

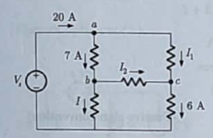
$$I_3 + I_5 + I_6 - I_7 = 0$$

NOTE :

The problem can be solved in a single step using KCL at bottom node.

SOLUTION 2.6

Correct answer is 14.
Consider the circuit with unknown current and reference direction as shown below



Applying KCL at node 'a'

$$\Sigma I_{entering} = \Sigma I_{leaving}$$

$$20 = 7 + I_1$$

$$I_1 = 20 - 7 = 13\,\text{A}$$

Applying KCL at node 'c'

$$\Sigma I_{entering} = \Sigma I_{leaving}$$

$$I_1 + I_2 = 6$$

$$I_2 = 6 - I_1 = 6 - 13$$

$$= -7\,\text{A}$$

Applying KCL at node 'b'

$$\Sigma I_{entering} = \Sigma I_{leaving}$$

$$7 = I + I_2$$

$$7 = I - 7$$

$$I = 7 + 7 = 14\,\text{A}$$

SOLUTION 2.7

Correct answer is -21.
Algebraic sum of the current entering or leaving a cutset is equal to 0.

$$I_{2\Omega} + I_{4\Omega} + I_{3\Omega} = 0$$

$$\frac{6}{2} + \frac{16}{4} + I_{3\Omega} = 0$$

$$I_{3\Omega} = -7\,\text{A}$$

$$V_{3\Omega} = -7 \times 3 = -21\,\text{V}$$

SOLUTION 2.8

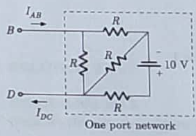
Correct option is (A).
In the given circuit

$$V_A - V_B = 6\,\text{V}$$

So current in the branch will be

$$I_{AB} = \frac{6}{2} = 3\,\text{A}$$

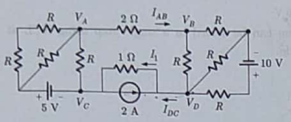
We can see, that the circuit is a one port circuit looking from terminal BD as shown below



One port network

For a one port network current entering one terminal, equals the current leaving the second terminal. Thus the outgoing current from A to B will be equal to the incoming current from D to C as shown

i.e. $\quad I_{DC} = I_{AB} = 3\,\text{A}$



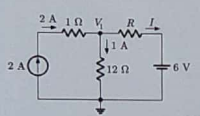
The total current in the resistor 1 Ω will be

$$I_1 = 2 + I_{DC} \qquad \text{(Writing KCL at node } D\text{)}$$
$$= 2 + 3 = 5\text{ A}$$

So, $\quad V_{CD} = 1 \times (-I_1) = -5\text{ V}$

SOLUTION 2.9

Correct option is (B).
The circuit is as given below.



Voltage across 12 Ω resistor

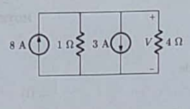
$$V_1 = 12 \times 1 = 12\text{ V}$$

Using KCL at top center node

$$2 = 1 + I$$
$$I = 1\text{ A}$$
$$I = \frac{V_1 - 6}{R} = 1$$
$$12 - 6 = R$$
$$R = 6\,\Omega$$

SOLUTION 2.10

Correct answer is −0.667.
X : 4 Ω resistance



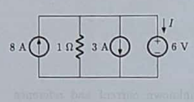
Applying KCL at the top node

$$8 = 3 + \frac{V}{1} + \frac{V}{4}$$
$$5 = \frac{5}{4}V \quad \Rightarrow \quad V = 4\text{ volt}$$

Power absorbed by X

$$P_1 = \frac{(V)^2}{4} = \frac{(4)^2}{4} = 4\text{ W}$$

X : 6 V independent source, with +ve terminal at top



Applying KCL at the top node

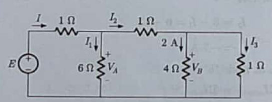
$$8 = \frac{6}{1} + 3 + I$$
$$I = -1\text{ A}$$

Power absorbed by 6 V source

$$P_2 = (-1) \times (6)$$
$$= -6\text{ W} \qquad \text{(Passive sign convention)}$$
$$\frac{P_1}{P_2} = \frac{4}{-6} = -\frac{2}{3} = -0.667$$

SOLUTION 2.11

Correct option is (D).
Solving the circuit



Voltage across 4 Ω,

$$V_B = 4 \times 2 = 8\text{ V}$$

Current in 1 Ω,

$$I_3 = \frac{V_B}{1\,\Omega} = \frac{8}{1} = 8 \text{ A}$$

Using KCL,

$$I_2 = I_3 + 2 = 8 + 2 = 10\text{ A}$$

So, $\quad V_A = I_2 \times 1 + V_B \qquad$ (KVL in the middle loop)

$$= 10 + 8 = 18\text{ V}$$

Current in 6 Ω,

$$I_1 = \frac{V_A}{6} = \frac{18}{6} = 3\text{ A}$$

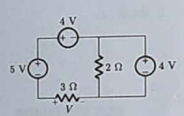
Using KCL, $I = I_1 + I_2 = 3 + 10 = 13\text{ A}$

Using Ohm's Law current in left most 1 Ω is given by

$$\frac{E - V_A}{1} = I$$
$$E - 18 = 13 \times 1$$
$$E = 31\text{ V}$$

SOLUTION 2.12

Correct option is (A).



Writing KVL in the left mesh

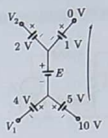
$$5 - 4 - 4 + V = 0$$
$$V = 3\text{ V}$$

SOLUTION 2.13

Correct option is (A).
Applying KVL in the right most loop starting from 10 V and going towards 0 V as shown in figure,

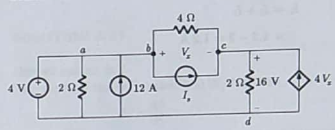
$$10 + 5 + E + 1 = 0$$

or $\quad E = -16\text{ V}$



SOLUTION 2.14

Correct answer is 59.



Applying KVL around the loop *abcda*

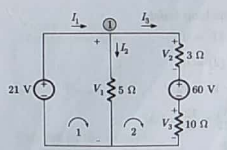
$$4 - V_x - 16 = 0$$
$$V_x = -12\text{ V}$$

Applying KCL at node c

$$4V_x + I_s + \frac{V_x}{4} = \frac{16}{2}$$
$$4(-12) + I_s + \frac{(-12)}{4} = 8$$
$$I_s - 48 - 3 = 8 \text{ or } I_s = 59\text{ A}$$

SOLUTION 2.15

Correct answer is 1.2.
Consider the circuit as shown below



Applying KVL around Loop 1

$$21 - V_1 = 0$$

$$V_1 = 21 \text{ volt}$$

Current $I_2 = \frac{V_1}{5} = \frac{21}{5} = 4.2 \text{ A}$ (Ohm's Law)

Applying KVL around Loop 2

$$V_1 - V_2 - 60 - V_3 = 0 \qquad ...(1)$$

$$V_2 = 3I_3, \; V_3 = 10I_3 \qquad \text{(Ohm's low)}$$

Substituting V_1, V_2 and V_3 into equation (1), we get

$$21 - 3I_3 - 60 - 10I_3 = 0$$

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

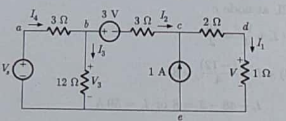
Applying KCL at node 1,

$$I_1 = I_2 + I_3$$

$$= 4.2 - 3 = 1.2 \text{ A}$$

SOLUTION 2.16

Correct answer is 18.
Consider the following currents and voltages in the circuit



$$I_1 = \frac{V}{1} = 2 \text{ A}$$

Applying KCL at node c

$$I_2 + 1 = I_1$$

$$I_2 + 1 = 2$$

$$I_2 = 2 - 1 = 1 \text{ A}$$

Applying KVL around the loop $bcdeb$

$$V_3 - 3 - 3I_2 - 2I_1 - 1I_1 = 0$$

$$V_3 - 3 - 3(1) - 2(2) - 1(2) = 0$$

$$V_3 - 12 = 0 \Rightarrow V_3 = 12 \text{ V}$$

$$I_3 = \frac{V_3}{12} = \frac{12}{12} = 1 \text{ A}$$

Applying KCL at node b

$$I_4 = I_2 + I_3$$

$$I_4 = 1 + 1 = 2 \text{ A}$$

Applying KVL around the loop $abea$

$$V_s - 3I_4 - V_3 = 0$$

$$V_s = 3(2) + 12 = 18 \text{ V}$$

$$((I_4 = 2 \text{ A}, \; V_3 = 12 \text{ V}))$$

SOLUTION 2.17

Correct answer is 18.
In the given circuit we do not know the current voltage characteristic of the transistor, but it still obeys both KCL and KVL. Applying KVL around the outer loop,

$$24 - (10 \times 10^3)(3 \times 10^{-3}) - V_{DS}$$

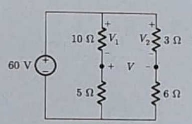
$$-(4 \times 10^3)(3 \times 10^{-3}) = 0$$

$$24 - 30 - V_{DS} - 12 = 0$$

$$V_{DS} = 18 \text{ V}$$

SOLUTION 2.18

Correct answer is -20.



Using voltage division

$$V_1 = \frac{10}{10+5}(60) = 40 \text{ V}$$

$$V_2 = \frac{3}{(6+3)}(60) = 20 \text{ V}$$

Applying KVL

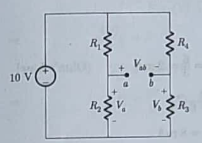
$$V + V_1 - V_2 = 0$$

$$V = -V_1 + V_2 = -40 + 20$$

$$= -20 \text{ V}$$

SOLUTION 2.19

Correct answer is -0.238 V.
The circuit can be redrawn in a simpler way as shown below



$$V_a = \frac{R_2}{R_1 + R_2}(10) \qquad \text{(Using voltage division)}$$

$$V_a = 5 \text{ V} \qquad (R_1 = R_2)$$

Now, $V_b = \frac{R_3}{R_3 + R_4}(10)$ (Using voltage division)

$$= \frac{1.1}{2.1} \times 10 = 5.238 \text{ V}$$

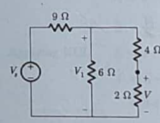
$$V = V_{ab} = V_a - V_b$$

$$= 5 - 5.238$$

$$= -0.238 \text{ V}$$

SOLUTION 2.20

Correct answer is 36.
Let voltage across parallel branches is V_1, as shown in figure

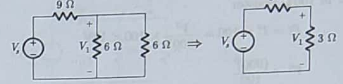


Using voltage division

$$V = \frac{2}{2+4}(V_1) = \frac{V_1}{3}$$

$$V_1 = 3 \times 3 = 9 \text{ V} \qquad (V = 3 \text{ volt})$$

Combining resistances



Using voltage division

$$V_1 = \frac{3}{9+3}(V_s) = \frac{V_s}{4}$$

$$V_s = 4V_1 = 4 \times 9 = 36 \text{ V} \qquad (V_1 = 9 \text{ volt})$$

SOLUTION 2.21

Correct answer is 2.
Resistance of the bulb rated 200 W/220 V is

$$R_1 = \frac{V^2}{P_1}$$

$$= \frac{(220)^2}{200} = 242 \, \Omega$$

Resistance of 100 W/220 V lamp is

$$R_T = \frac{V^2}{P_2}$$

$$= \frac{(220)^2}{100} = 484 \, \Omega$$

To connect in series

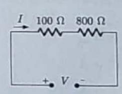
$$R_T = n \times R_1$$

$$484 = n \times 242$$

$$n = 2$$

SOLUTION 2.22

Correct answer is 45 V.



Current in the resistors

$$I = \frac{V}{100 + 800} = \frac{V}{900}$$

Power in 100 Ω resistor

$$P_1 = I^2 \times 100 = \frac{V^2}{(900)^2} \times 100 < 1\ \text{W}$$

$$V^2 < \frac{(900)^2}{100}$$

$$V^2 = 8100$$

$$V < 90\ \text{V}$$

Power in 800 Ω resistor

$$P_2 = I^2 \times 800 = \frac{V^2}{(900)^2} \times 800 < 2\ \text{W}$$

$$V^2 < \frac{2 \times (900)^2}{800}$$

$$V^2 < 2025$$

$$V < 45\ \text{V}$$

The maximum voltage the can be applied will be 45 V.

SOLUTION 2.23

Correct option is (D).
Let resistance of 40 W and 60 W lamps are R_1 and R_2 respectively

$\because$

$$P \propto \frac{1}{R^2}$$

$$\frac{P_1}{P_2} = \frac{R_2^2}{R_1^2}$$

$$\frac{R_2^2}{R_1^2} = \frac{40}{60}$$

$$R_2 < R_1$$

40 W bulb has high resistance than 60 W bulb, when connected in series power is

$$P_1 = I^2 R_1$$

$$P_2 = I^2 R_2$$

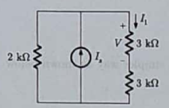
$\because R_1 > R_2$, So, $\quad P_1 > P_2$

therefore, 40 W bulb glows brighter.

SOLUTION 2.24

Correct answer is 8.
By combining 4 kΩ and 12 kΩ

$$4\ \text{k}\Omega \,||\, 12\ \text{k}\Omega = 3\ \text{k}\Omega$$



$$I_1 = \frac{V}{3} = \frac{6}{3} = 2\ \text{mA} \qquad \text{(Ohm's Law)}$$

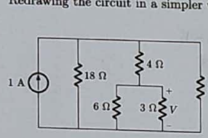
$$I_1 = \frac{2}{2+6}(I_s)$$

or

$$I_s = 4I_1 = 8\ \text{mA}$$

SOLUTION 2.25

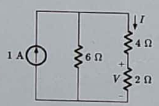
Correct answer is 1.
Redrawing the circuit in a simpler way, as shown



Combining the resistor combination

$$18\ \Omega \,||\, 9\ \Omega = 6\ \Omega$$

$$6\ \Omega \,||\, 3\ \Omega = 2\ \Omega$$



Using current division

$$I = \frac{6}{6+6}(1) = 0.5\ \text{A}$$

$$V = I \times 2 = 0.5 \times 2 = 1\ \text{V} \qquad \text{(Ohm's Law)}$$

SOLUTION 2.26

Correct option is (C).
Current in the circuit

$$I = \frac{100}{R + (10\,||\,10)} = 8\ \text{A}$$

$$\Rightarrow \quad \frac{100}{R+5} = 8$$

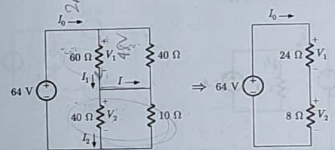
$$100 = 8R + 40$$

$$\Rightarrow \quad R = \frac{60}{8} = 7.5\ \Omega$$

SOLUTION 2.27

Correct answer is 0.4.

0.6



$$I_0 = \frac{64}{24+8} = 2\ \text{A}$$

$$V_1 = 2 \times 24 = 48\ \text{V}$$

$$I_1 = \frac{V_1}{60} = \frac{48}{60} = 0.8\ \text{A}$$

$$V_2 = 2 \times 8 = 16\ \text{V}$$

$$I_2 = \frac{V_2}{40} = \frac{16}{40} = 0.4\ \text{A}$$

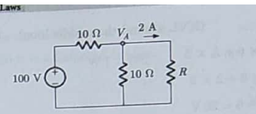
Applying KCL, $\quad I_1 = I + I_2$

$$I = I_1 - I_2 = 0.8 - 0.4$$

$$= 0.4\ \text{A}$$

SOLUTION 2.28

Correct option is (B).
In the circuit



Voltage $\quad V_A = \frac{(10\,||\,R)}{10 + (10\,||\,R)}(100)$

$$= \frac{100}{10 + \frac{10R}{10+R}} \times \frac{10R}{10+R}$$

$$= \frac{1000R}{100 + 20R}$$

$$= \frac{50R}{5+R}$$

Current in $R\ \Omega$ resistor

$$2 = \frac{V_A}{R}$$

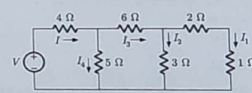
$$2 = \frac{50R}{R(5+R)}$$

$$10 + 2R = 50$$

$$R = \frac{40}{2} = 20\ \Omega$$

SOLUTION 2.29

Correct answer is 70.
We assume currents in each branch of the circuit as shown below.



We can see that I_3 is divided into two equal parallel resistances 3 Ω each.

$$I_3 = I_1 + I_2$$

$$I_3 = 2I_1 = 2I_2 \qquad (I_1 = I_2)$$

$$I_3 = 2 \times 2 = 4\ \text{A} \qquad (I_1 = 2\ \text{A})$$

and $\quad I_2 = \frac{I_3}{2} = \frac{4}{2} = 2\ \text{A}$

$$V_{5\Omega} = V_{6\Omega} + V_{3\Omega}$$

(KVL around the middle loop)

$$= I_3 \times 6 + I_2 \times 3$$
$$= 4 \times 6 + 2 \times 3$$
$$= 24 + 6 = 30 \text{ V}$$

So $I_4 = \frac{V_{5\Omega}}{5} = \frac{30}{5} = 6 \text{ A}$

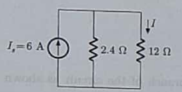
$$I = I_4 + I_3$$
$$= 6 + 4 = 10 \text{ A} \qquad \text{(KCL)}$$
$$V = 4I + 5I_4$$

(KVL around the left most loop)

$$= 4(10) + 5(6)$$
$$= 40 + 30 = 70 \text{ V}$$

SOLUTION 2.30

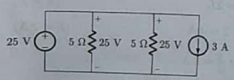
Correct answer is 1.
Current sources are in parallel which is equivalent to $I_s = 10 - 4 = 6$ A source. 6 Ω and 4 Ω resistors are in parallel, which is equivalent to 2.4 Ω.



$$I = \frac{2.4}{2.4 + 12}(6) = 1 \text{ A}$$

SOLUTION 2.31

Correct answer is 125.
10 V and 15 V voltage source are in series which is equivalent to 15 + 10 = 25 V. 3 A and 6 A current sources are in parallel and equivalent to 6 − 3 = 3 A



Power absorbed by each of the 5 Ω resistor

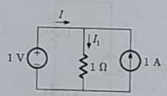
$$P = \frac{(V)^2}{R} = \frac{(25)^2}{5} = 125 \text{ W}$$

SOLUTION 2.32

Correct option is (A).
The voltage V is the voltage across voltage source and that is 10 V.

SOLUTION 2.33

Correct answer is 0 A.



Current in 1 Ω resistor

$$I_1 = \frac{1}{1} = 1 \text{ A}$$
$$I + 1 = I_1 \qquad \text{(Using KCL)}$$
$$I = I_1 - 1 = 1 - 1 = 0 \text{ A}$$

SOLUTION 2.34

Correct answer is −3 Volt.
Applying KVL in the circuit

$$V_{ab} - 2i + 5 = 0$$
$$V_{ab} = 2 \times 1 - 5$$
$$= -3 \text{ Volt} \qquad i = 1 \text{ A}$$

SOLUTION 2.35

Correct option is (B).
Voltage across 2 Ω resistor,

$$V_s = 2 \text{ V}$$

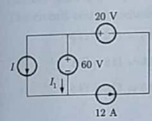
Current, $I_{2\Omega} = \frac{V_s}{2} = \frac{4}{2} = 2 \text{ A}$

To make the current double we have to take

$$V_s = 8 \text{ V}$$

SOLUTION 2.36

Correct option is (A).
Circuit is as shown below



Since 60 V source is absorbing power. So, in 60 V source current flows from +ve to −ve direction

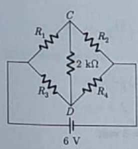
So, $I + I_1 = 12$ (KCL at the bottom left node)

$$I = 12 - I_1$$

I is always less then 12 A So, only option (A) satisfies this conditions.

SOLUTION 2.37

Correct option is (A).

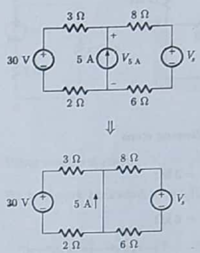


In the bridge, $R_1 R_4 = R_2 R_3 = 1$

So it is a balanced bridge,

SOLUTION 2.38

Correct answer is −154.



$$P_{5\,A} = 0 = V_{5\,A} \times 6 = 0 \Rightarrow V_{5\,A} = 0$$

So voltage across 5 A source is zero.
Applying KCL at the top center node

$$\frac{30}{3+2} + 5 + \frac{V_s}{8+6} = 0$$
$$\frac{30}{5} + 5 + \frac{V_s}{14} = 0 \text{ or } V_s = -154 \text{ V}$$
$$I = 0 \text{ mA}$$

SOLUTION 2.39

Correct answer is 3 W.
Total resistance seen by source

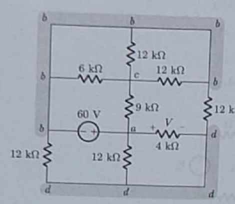
$$R = (3\,\Omega \,||\, 6\,\Omega) + 1\,\Omega$$
$$= 2\,\Omega + 1\,\Omega = 3\,\Omega$$

Power supplied by source,

$$P_s = \frac{(3)^2}{R} = \frac{(3)^2}{3} = 3 \text{ W}$$

SOLUTION 2.40

Correct answer is 100.
We assign nodes a, b, c and d as shown below



Simplifying the circuit in following steps
Between nodes c and b

$$6\text{ k}\Omega \,||\, 12\text{ k}\Omega \,||\, 12\text{ k}\Omega = 3\text{ k}\Omega$$

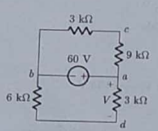
Between nodes b and d

$$12\text{ k}\Omega \,||\, 12\text{ k}\Omega = 6\text{ k}\Omega$$

Between nodes a and d

$$4\text{ k}\Omega \,||\, 12\text{ k}\Omega = 3\text{ k}\Omega$$

Between node c and a, 9 kΩ resistor is connected.



Using voltage division

$$V = \frac{3}{3+6}(60) = 20\text{ V}$$

Power absorbed by 4 kΩ resistor

$$P = \frac{V^2}{4\times 10^3} = \frac{(20)^2}{4\times 10^3}$$

$$= 100\text{ mW}$$

SOLUTION 2.41

Correct answer is 3.
Simplifying the resistor combination as shown below. Starting from the right most resistors

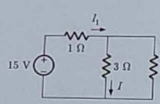
$$6\,\Omega \,||\, 3\,\Omega = 2\,\Omega$$

$$2\,\Omega \,||\, 2\,\Omega = 4\,\Omega$$

$$12\,\Omega \,||\, 4\,\Omega = 3\,\Omega$$

$$3\,\Omega + 3\,\Omega = 6\,\Omega$$

$$6\,\Omega \,||\, 6\,\Omega = 3\,\Omega$$



$$I_1 = \frac{15}{1 + 3\,\Omega \,||\, 3\,\Omega}$$

$$= \frac{15}{1+1.5} = 6\text{ A}$$

Using current division

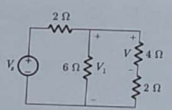
$$I = \frac{3}{3+3}(I_1) = 3\text{ A}$$

SOLUTION 2.42

Correct answer is 10.
The circuit can be simplified as

$$3\,\Omega + 1\,\Omega = 4\,\Omega$$

$$4\,\Omega \,||\, 4\,\Omega = 2\,\Omega$$



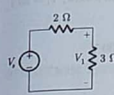
Using voltage division

$$V = \frac{4}{4+2}(V_1)$$

or

$$4 = V_1\left(\frac{4}{6}\right) \Rightarrow V_1 = 6\text{ volt}$$

Simplifying further we have



Using voltage division

$$V_1 = \frac{3}{3+2}(V_s) \Rightarrow V_s = \frac{5}{3}\times V_1 = 10\text{ volt}$$

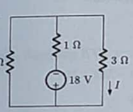
SOLUTION 2.43

Correct answer is -4.
The circuit can be reduced as shown below

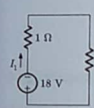
$$6\,\Omega + 2\,\Omega = 8\,\Omega$$

$$8\,\Omega \,||\, 8\,\Omega = 4\,\Omega$$

$$4\,\Omega + 2\,\Omega = 6\,\Omega$$



Further simplifying $\quad 6\,\Omega \,||\, 3\,\Omega = 2\,\Omega$



$$I_1 = -\frac{18}{2+1} = -6\text{ A}$$

By current division

$$I = \frac{6}{6+3}(-6) = \frac{6}{9}(-6)$$

$$= -4\text{ A}$$

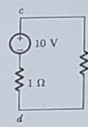
SOLUTION 2.44

Correct answer is 3.
The circuit can be simplified as

$$5 + 3 = 8\,\Omega$$

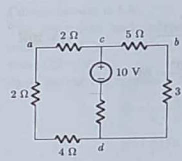
$$2 + 2 + 4 = 8\,\Omega$$

$$8\,\Omega \,||\, 8\,\Omega = 4\,\Omega$$



Using voltage division $\quad V_{cd} = \frac{4}{4+5}(10) = 8\text{ V}$

We now work backward to get V_{ab}



$$V_{cb} = \frac{5}{5+3}(V_{cd})$$

$$= \frac{5}{8}\times 8 = 5\text{ V} \qquad \text{(Voltage division)}$$

$$V_{ac} = \frac{2}{2+2+4}(-V_{cd})$$

$$= \frac{2}{8}(-8) = -2\text{ V} \qquad \text{(Voltage division)}$$

$$V_{ab} = V_{ac} + V_{cb} = -2 + 5$$

$$= 3\text{ V}$$

SOLUTION 2.45

Correct answer is 4.

$$I_1 = \frac{18}{2} = 9\text{ A}$$

Current in $4\,\Omega$ resistance is $I_0 = kI_1$. Power absorbed by $4\,\Omega$ resistance

$$P = I_0^2(4) = k^2 I_1^2(4)$$

$$5184 = k^2(9)^2(4)$$

$$k^2 = 16 \Rightarrow k = 4$$

SOLUTION 2.46

Correct answer is 8.

We have, $V_s = 20R$

Voltage across $16\,\Omega$ resistance is $V_{16\,\Omega} = 10\,V_s$

Power absorbed by $16\,\Omega$ resistor

$$P_{16\,\Omega} = \frac{(V_{16\,\Omega})^2}{16}$$

or, $$160 \times 10^3 = \frac{(10\,V_s)^2}{16}$$

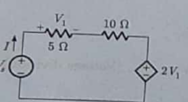
$$160 \times 10^3 = \frac{(10 \times 20R)^2}{16} \qquad V_s = 20R$$

$$R^2 = \frac{256 \times 10^4}{4 \times 10^4} = 64$$

$$R = 8\,\Omega$$

SOLUTION 2.47

Correct answer is 100.



ower dissipated by $5\,\Omega$ resistance

$$P = I^2R$$

$$20 = (I)^2(5)$$

$$I = \sqrt{\frac{20}{5}} = 4\text{ A}$$

VL around the loop

$$V_s - 5I - 10I - 2V_1 = 0$$

or, $$V_s - 15I - 2(5I) = 0$$

(Using Ohm's Law, $V_1 = 5I$)

$$V_s - 25I = 0$$

$$V_s = 25 \times 4 = 100\text{ V}$$

SOLUTION 2.48

Correct answer is 40.

Applying KVL in the left most loop

$$V_1 - 10I_1 - 10I_1 = 0$$

$$I_1 = \frac{V_1}{20}$$

$$V_2 = -kI_1(10\,\text{k}\Omega \,||\, 10\,\text{k}\Omega)$$

$$= -kI_1(5)$$

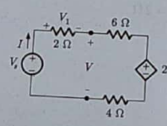
$$V_2 = -k\left(\frac{V_1}{20}\right)(5)$$

$$-4\left(\frac{V_2}{V_1}\right) = k$$

$$k = -4 \times (-10) = 40$$

SOLUTION 2.49

Correct answer is 48.



Applying KVL in the right half loop

$$V - 6I - 2V_1 - 4I = 0 \qquad \text{...(1)}$$

Since $V_1 = 2I$ (Ohm's Law)

Substituting V_1 into equation (1), we have

$$V - 10I - 2(2I) = 0$$

$$I = \frac{V}{14} = \frac{42}{14} = 3\text{ A}$$

KVL around the left half loop

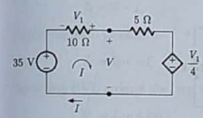
$$V_s - 2I - V = 0$$

$$V_s = 2(3) + 42$$

$$= 48\text{ V} \qquad (I = 3\text{ A}, V = 42\text{ V})$$

SOLUTION 2.50

Correct answer is 7.



Applying KVL around the loop

$$35 - 10I - 5I - \frac{V_1}{4} = 0$$

Since $V_1 = -10I$ (Ohm's Law)

$$35 - 15I - \left(-\frac{10I}{4}\right) = 0$$

$$35 - 15I + 2.5I = 0$$

$$I = \frac{35}{12.5} = 2.8\text{ A}$$

Again, Applying KVL around the left half of the loop

$$35 - 10I - V = 0$$

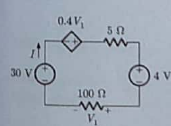
$$V = 35 - 10I$$

$$= 35 - 10(2.8)$$

$$= 7\text{ volt}$$

SOLUTION 2.51

Correct answer is -6.4.



Applying KVL around the loop

$$30 + 0.4V_1 - 5I - 4 - 100I = 0$$

Since $V_1 = 100I$ (Ohm's Law)

$$30 + 0.4(100I) - 5I - 4 - 100I = 0$$

$$30 + 40I - 5I - 4 - 100I = 0$$

$$26 - 65I = 0$$

$$I = 0.4\text{ A}$$

Power absorbed by dependent source

$$P = -(0.4V_1)I \qquad \text{(Passive sign convention)}$$

$$= -(0.4)(100I)(I) \qquad V_1 = 100I$$

$$= -40I^2$$

$$= -6.4\text{ W}$$

SOLUTION 2.52

Correct answer is 1.6.

The dependent and independent current sources are in parallel so they are replaced with a single current source of value $(12 - 5I_1)$.

Applying current division

$$I_1 = \frac{\frac{1}{3}}{\frac{1}{3} + \frac{1}{6} + \frac{1}{3}}(12 - 5I_1)$$

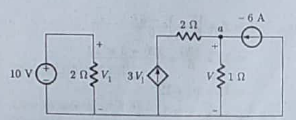
$$I_1 = \frac{2}{5}(12 - 5I_1)$$

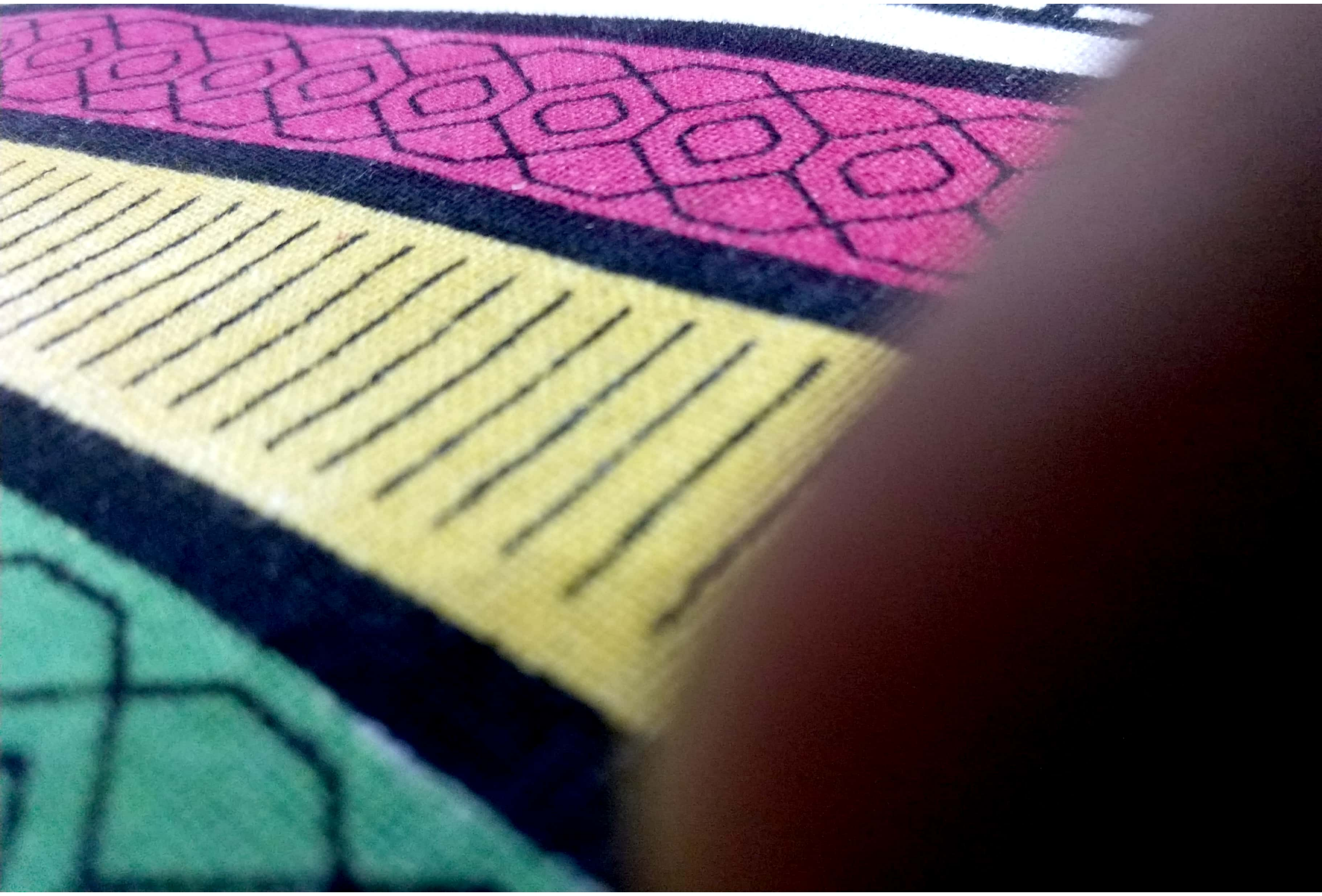
$$5I_1 = 24 - 10I_1$$

$$I_1 = 1.6\text{ A}$$

SOLUTION 2.53

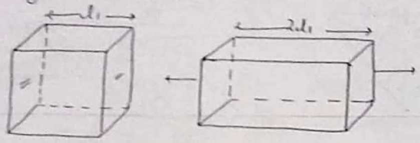
Correct answer is 24.





Q. The Resistance of cube shape material b/w any of its opp faces is 2Ω if this cube is stretched in 1 dirn by applying a linear force to double its original length then find the resis b/w 2 oppositly stretched faces.

Soln.



$R_1 = 2\Omega$ $\qquad$ $R_2 = ?$

$R_1 = \frac{\rho_1 l_1}{a_1} = 2$ $\qquad$ $R_2 = \frac{\rho_2 l_2}{a_2}$

2 $\qquad$ $R_2 = \frac{\rho_2 (2l_1)}{a_2}$ (i)

$V_1 = V_2$

So $l_1 a_1 = l_2 a_2$

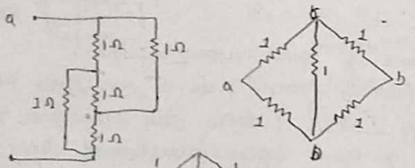
$a_2 = \frac{l_1 a_1}{l_2} = \frac{\cancel{l_1} a_1}{2\cancel{l_1}}$ $\qquad$ $\left[\rho_1 = \rho_2\right.$ so $\frac{\rho_1 l_1}{a_1} = \frac{\rho_2 l_1}{a_1}$

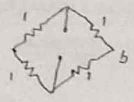
ie $\boxed{a_2 = a_1/2}$

$\rho_1 = \rho_2$

So $R_2 = \frac{\rho_2 (2l_1)}{(a_1/2)} = 4\left(\frac{\rho_2 l_1}{a_1}\right) = 4 \times 2 = \boxed{8\ \Omega}$

Ques

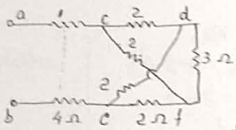


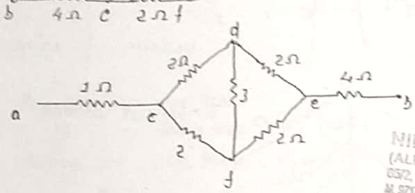


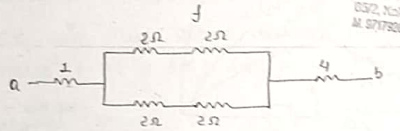
$R_{ab} = (2 \parallel 2)$

$\boxed{R_{ab} = 1\ \Omega}$

Q.

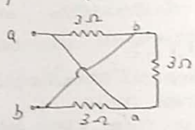


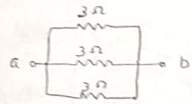




$R_{eq} = 1 + (4 \parallel 4) + 4 = 1 + 2 + 4 = 7\ \Omega$

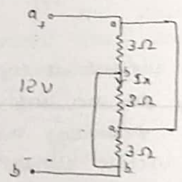
Q.



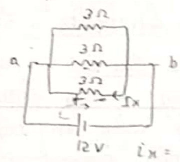


$R_{ab} = 3/3 = 1\ \Omega$

Ques.

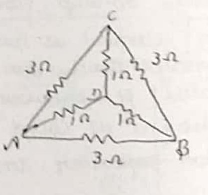


⇒

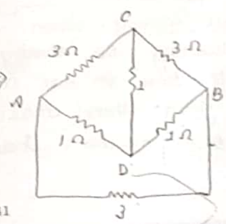


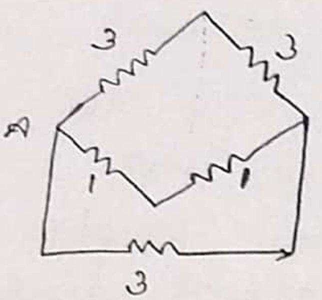
$i_x = \frac{-12}{3} = -4A$

Ques.



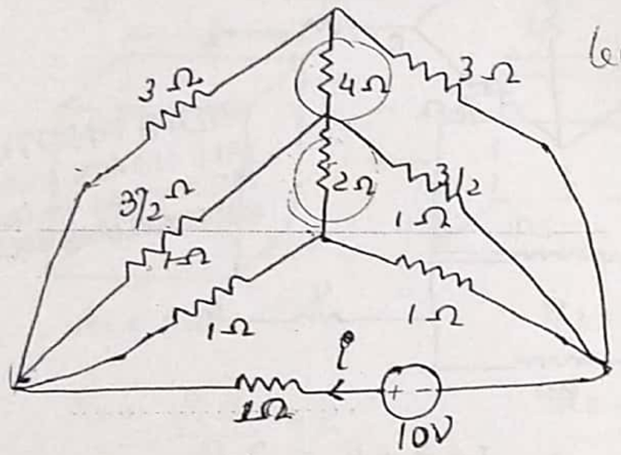
⇒





Rab
$= (6) \parallel 2 \parallel 3$
$= 2 \parallel 2$
$= 1$

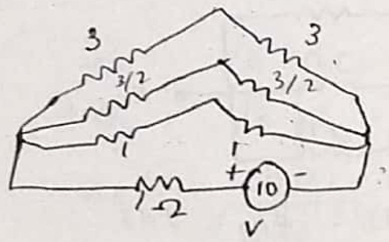
Q.



balanced bridge

+ve Res → deliver P

-ve R → absorb P



$R_{AB} = 6 \parallel 3 \parallel 2$
$= 2 \parallel 2$
$R_{AB} = 1\ \Omega$

$i = \frac{10}{1+1} = 5A$

Circuit Elements -

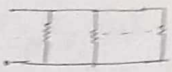
Active Element - When an element is capable of delivering energy independently for an infinite duraⁿ of time or capable of providing the power gain then element is called active element.

Eg - Vltg source, transistor, op-amp, current sour.

Passive Element - When an element is not capable of delivering the energy independently for an ∞ duraⁿ of time or not capable of providing the power gain then that element is called passive element. Eg. Resistor, Inductor capacitor, Xmer.

Hint →

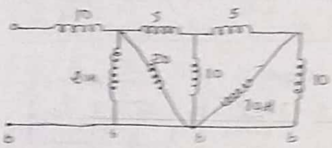
$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots \frac{1}{R_n}$$



$$\frac{1}{R_{eq}} = \frac{n}{R}$$

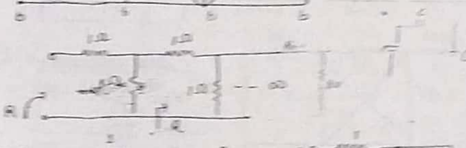
$$\boxed{R_{eq} = R/n}$$

Q.



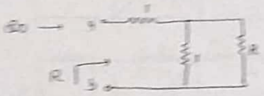
$L_{eq} = 15H$

Q.



Soln →

So →



$$R_{eq} = 1 + (R \parallel 1)$$

$$R = 1 + \left(\frac{R}{R+1}\right)$$

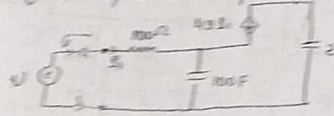
$$R^2 + R = R + 1 + R$$

$$R^2 - R - 1 = 0$$

$$R = \frac{-(-1) \pm \sqrt{1-(-4)}}{2} = \frac{1 \pm \sqrt{5}}{2}$$

So $\boxed{R = \frac{1+\sqrt{5}}{2}}$

Q. Find equivalent cap b/w terminals a & b

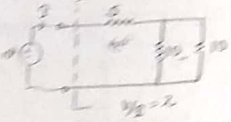


Hint

$$\frac{V}{I_1} = Z = R + jX_L - jX_C$$

$$= R + SL + \frac{1}{CS}$$

$$= I_1 R + L_1 \frac{di}{dt} + \frac{1}{C_{eq}} \int i\,dt$$



Soln

$$\Rightarrow V(s) = 100\, I(s) + 50\, I_1 \left(\frac{1}{(100)s}\right)$$

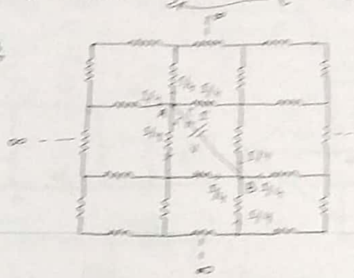
$$\frac{V(s)}{I(s)} = 100 + \frac{1}{2s}$$

$$Z(s) = 100 + \frac{1}{2s} \quad \text{i.e.} \quad R + \frac{1}{C_{eq} S} \qquad \therefore \boxed{C = 2F}$$

$$V = 100 I_1 + \frac{1}{100} \int 50 I_1\, dt$$

$$V = 100 I_1 + \frac{1}{2} \int I_1\, dt$$

Ques



Find eq. Resis b/w A & B & each Resis is of R Ω

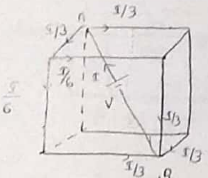
apply KVL → $-V + \frac{I}{4}R + \frac{I}{4}R = 0$

$$V = R\, I \left(\frac{R}{4} + \frac{R}{4}\right)$$

$$V/I = R_{ab} = \frac{R}{2}\,\Omega \quad \text{Ans}$$

Ques find eq. Resis of b/w A & B when each edge has Resis of R Ω.

Soln -

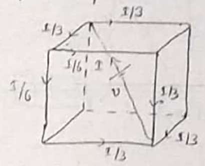


$$-V + \frac{I}{3}R + \frac{I}{6}R + \frac{I}{3}R = 0$$

$$V = I\left[\frac{R}{3} + \frac{R}{6} + \frac{R}{3}\right]$$

$$\frac{V}{I} = \frac{5}{6}R$$

find capacitance -



$$-V + \frac{1}{C}\int \frac{I}{3}dt + \frac{1}{C}\int \frac{I}{6}dt + \frac{1}{C}\int \frac{I}{3}dt = 0$$

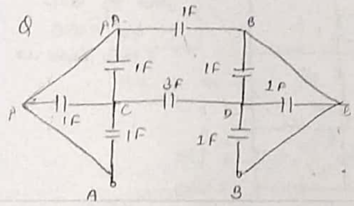
$$V = \int I dt \left[\frac{1}{3C} + \frac{1}{6C} + \frac{1}{C3}\right]$$

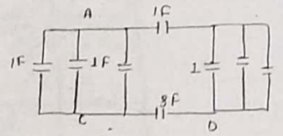
$$V = \int I dt \left[\frac{5}{6C}\right]$$

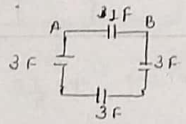
$$V = \frac{1}{\frac{6}{5}C}\int I dt$$

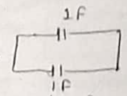
$$\boxed{C_{eq} = \frac{6}{5}C}$$

Q



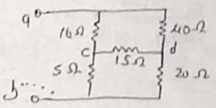


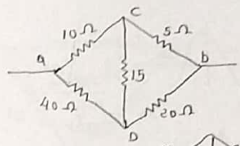




$C_{eq} \Rightarrow$ = 2 F

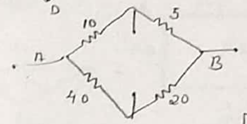
Q. find equiv. Res. b/w terminal A & B





bridge

$10 \times 20 = 5 \times 40$



$R_{ab} = 15 \parallel 60$

$= \frac{15 \times 60}{15 + 60}$

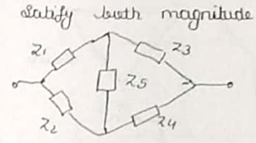
$\boxed{R_{ab} = 12\,\Omega}$

Condition for balanced bridge

→ Product of resistance of opp arm should be equal

→ $V_C = V_d$ & $I_{CD} = 0$

→ If impedences are there in bridge then it should satify both magnitude as well as angle condition.



$Z_1 Z_4 = Z_2 Z_3$

$\boxed{|Z_1||Z_4| = |Z_2||Z_3|}$

&

$\boxed{\theta_1 + \theta_4 = \theta_2 + \theta_3}$

Ques If $Z_1 = 10\angle 30$, $Z_2 = 5\angle -50$, $Z_3 = 4\angle -40$ then for the bridge to be balanced find Z_4

$|Z_1||Z_4| = |Z_2||Z_3|$

$10\angle 30 \times Z_4 = 20$

$Z_4 = 2.$

$30 + \theta_4 = -50 + (-40)$

$\theta_4 = -90 - 30$

$\theta_4 = -120$

$Z_4 = 2\angle -120$ X wrong Ithly check

a) $2\angle 120$

b) $2\angle -120$

c) $5\angle 60$

d) None ✓

$Z_4 = 2\angle -120$

$= 2\left[\cos(120) - j\sin(120)\right]$

$= 2\left[\frac{-1}{2} - \frac{j\sqrt{3}}{2}\right] = (-1) - j\sqrt{3}$

Real term → -ve so can not