RRB-JE (CBT-2) 2024

Railway Recruitment Board

Junior Engineer Examination

2900 MCQs

Fully solved multiple choice questions
with detailed explanations

Practice Book

Electrical Engineering

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PREFACE

B. Singh (Ex. IES)

With the announcement of vacancies by Railway Recruitment Board (RRB) for the post of Junior Engineer, it has given hope for many engineers between jobs. MADE EASY has always been a success partner for engineers right from the onset of engineering education up to they get a formal tag of engineer.

Owing to needs of students to utilise this opportunity in a fruitful way, it gives me great happiness to introduce the first edition of the Electrical Engineering Practice book for RRB-JE Examination. While preparing this book utmost care has been taken to cover all the chapters and variety of concepts which may be asked in the exam. It contains more than 2900 multiple choice questions with answer key and detailed explanations, segregated in subject wise manner to disseminate all kind of exposure to students in terms of quick learning. Attempt has been made to bring out all kind of probable competitive questions for the aspirants preparing for RRB-JE. This book also help every student to perform in an extraordinary way.

Full efforts have been made by MADE EASY team to provide error free solutions and explanations. The book not only covers the syllabus of RRB-JE but also useful for other examinations conducted by various Public Service Commissions.

Our team has made their best efforts to make the book error-free. Nonetheless, we would highly appreciate and acknowledge if you find and share any printing/conceptual error. It is impossible to thank all individuals who helped us, but I would like to sincerely acknowledge all the authors, editors and reviewers for putting in their efforts to publish this book.

B. Singh (Ex. IES)
Chairman and Managing Director
MADE EASY Group

Syllabus for Electrical & Allied Engineering Exam Group – JE

S.No.	Subject
1.	**Basic concepts:** Concepts of resistance, inductance, capacitance, and various factors affecting them. Concepts of current, voltage, power, energy and their units.
2.	**Circuit law:** Kirchhoff's law, Simple Circuit solution using network theorems.
3.	**Magnetic Circuit:** Concepts of flux, mmf, reluctance, Different kinds of magnetic materials, Magnetic calculations for conductors of different configuration e.g. straight, circular, solenoidal, etc. Electromagnetic induction, self and mutual induction.
4.	**AC Fundamentals:** Instantaneous, peak, R.M.S. and average values of alternating waves, Representation of sinusoidal wave form, simple series and parallel AC Circuits consisting of R.L. and C, Resonance, Tank Circuit. Poly Phase system – star and delta connection, 3 phase power, DC and sinusoidal response of R-Land R-C circuit.
5.	**Measurement and measuring instruments:** Measurement of power (1 phase and 3 phase, both active and re-active) and energy, 2 wattmeter method of 3 phase power measurement. Measurement of frequency and phase angle. Ammeter and voltmeter (both moving oil and moving iron type), extension of range wattmeter, Multimeters, Megger, Energy meter AC Bridges. Use of CRO, Signal Generator, CT, PT and their uses. Earth Fault detection.
6.	**Electrical Machines:** (a) D.C. Machine – Construction, Basic Principles of D.C. motors and generators, their characteristics, speed control and starting of D.C. Motors. Method of braking motor, Losses and efficiency of D.C. Machines. (b) 1 phase and 3 phase transformers – Construction, Principles of operation, equivalent circuit, voltage regulation, O.C. and S.C. Tests, Losses and efficiency. Effect of voltage, frequency and wave form on losses. Parallel operation of 1 phase /3 phase transformers. Auto transformers. (c) 3 phase induction motors, rotating magnetic field, principle of operation, equivalent circuit, torque-speed characteristics, starting and speed control of 3 phase induction motors. Methods of braking, effect of voltage and frequency variation on torque speed characteristics, Fractional Kilowatt Motors and Single Phase Induction Motors: Characteristics and applications.
7.	**Synchronous Machines:** Generation of 3-phase e.m.f. armature reaction, voltage regulation, parallel operation of two alternators, synchronizing, control of active and reactive power. Starting and applications of synchronous motors.
8.	**Generation, Transmission and Distribution:** Different types of power stations, Load factor, diversity factor, demand factor, cost of generation, inter-connection of power stations. Power factor improvement, various types of tariffs, types of faults, short circuit current for symmetrical faults. Switchgears and Protection: Rating of circuit breakers, Principles of arc extinction by oil and air, H.R.C. Fuses, Protection against earth leakage / over current, etc. Buchholz relay, Merz-Price system of protection of generators & transformers, protection of feeders and bus bars. Lightning arresters, various transmission and distribution system, comparison of conductor materials, efficiency of different system. Cable – Different type of cables, cable rating and derating factor.
9.	**Estimation and costing:** Estimation of lighting scheme, electric installation of machines and relevant IE rules. Earthing practices and IE Rules.
10.	**Utilization of Electrical Energy:** Illumination, Electric heating, Electric welding, Electroplating, Electric drives and motors
11.	**Basic Electronics:** Working of various electronic devices e.g. P N Junction diodes, Transistors (NPN and PNP type), BJT and JFET. Simple circuits using these devices.

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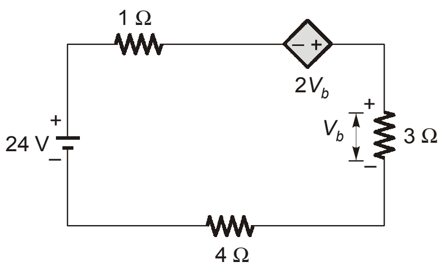
UNIT 1

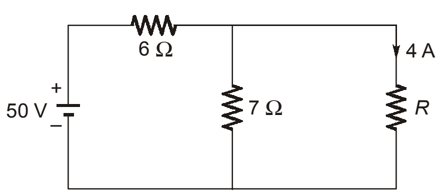
Circuit Theory

Q.1 The current in the given circuit with a dependent voltage source is



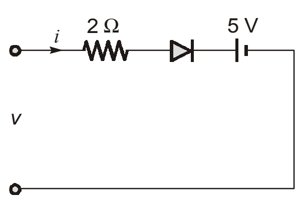
(a) 10 A (b) 12 A
(c) 14 A (d) 16 A

Q.2 The value of resistance '*R*' shown in the given figure is

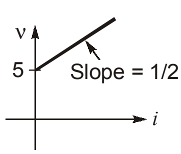


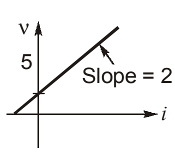
(a) 3.5 Ω (b) 2.5 Ω
(c) 1 Ω (d) 4.5 Ω

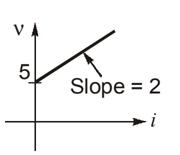
Q.3 The figure shows a network in which the diode is an ideal one.

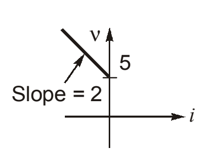


the terminal v-i characteristics of the network is given by

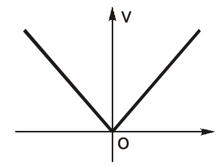
(a) 

(b) 

(c) 

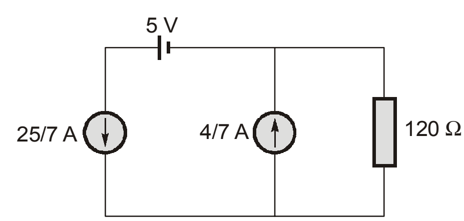
(d) 

Q.4 The v-i characteristic of an element is shown in the figure given below. The element is



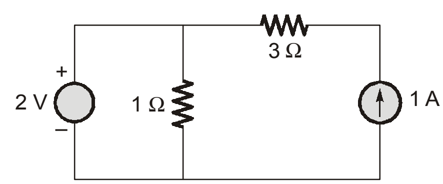
(a) non-linear, active, non-bilateral
(b) linear, active, non-bilateral
(c) non-linear, passive, non-bilateral
(d) non-linear, active, bilateral

Q.5 The current through 120 ohm resistor in the circuit shown in the figure below is



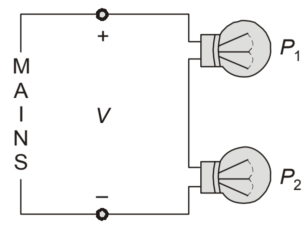
(a) 1 A (b) 2 A
(c) 3 A (d) 4 A

Q.6 For the circuit given in figure below the power delivered by the 2 volt source is given by



(a) 4 W (b) 2 W
(c) –2 W (d) –4 W

Q.7 The incandescent bulbs rated respectively as P_1 and P_2 for operation at a specified mains voltage are connected in series across the mains as shown in the above figure. Then the total power supplied by the mains to the two bulbs are



(a) $\dfrac{P_1 P_2}{P_1 + P_2}$ (b) $\sqrt{P_1^2 + P_2^2}$

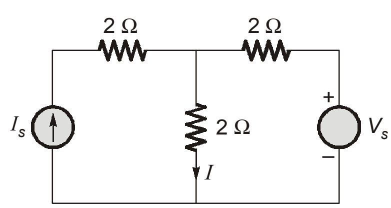
(c) $(P_1 + P_2)$ (d) $\sqrt{P_1 \times P_2}$

Q.8 A certain network consists of a large number of ideal linear resistances, one of which is designated as R and two constant ideal sources. The power consumed by R is P_1 when only the first source is active, and P_2 when only the second source is active. If both sources are active simultaneously, then the power consumed by R is

(a) $P_1 \pm P_2$ (b) $\sqrt{P_1} \pm \sqrt{P_2}$

(c) $(\sqrt{P_1} \pm \sqrt{P_2})^2$ (d) $(P_1 \pm P_2)^2$

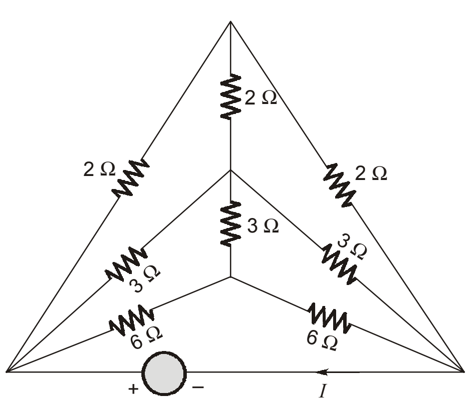
Q.9 For the circuit shown below, the value of V_s is 0 when I = 4 A. The value of I when V_s = 16 V, is



(a) 6 A (b) 8 A

(c) 10 A (d) 12 A

Q.10 Consider the following circuit:



What is the value of the current-I in the above circuit ?

(a) 1 A (b) 2 A

(c) 3 A (d) 4 A

Q.11 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

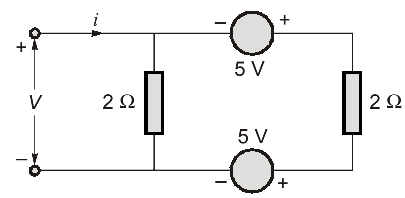
(a) Doubled

(b) Halved

(c) Decreases four times

(d) Not changed

Q.12 Consider the following circuit:



Which one of the following statements is correct? The circuit shown above is

(a) passive and linear

(b) active and linear

(c) passive and non-linear

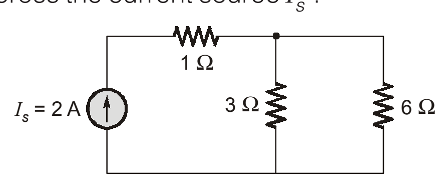
(d) active and non-linear

Q.13 Three parallel resistive branches are connected across a d. c supply. What will be the ratio of the branch currents $I_1 : I_2 : I_3$ if the branch resistances are in the ratio $R_1 : R_2 : R_3 :: 2 : 4 : 6$?

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

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

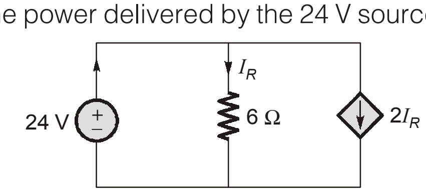
Q.14 For the circuit shown below, what is the voltage across the current source I_s ?



(a) 0 (b) 2 V

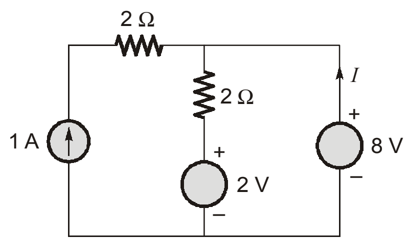
(c) 3 V (d) 6 V

Q.15 Consider the circuit in the below figure. What is the power delivered by the 24 V source?



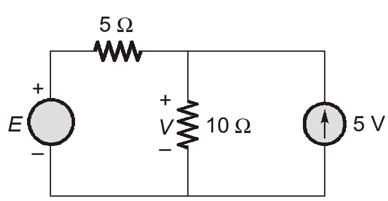
(a) 96 W (b) 144 W
(c) 192 W (d) 288 W

Q.16 In the circuit shown below, what is the value of the current-I ?



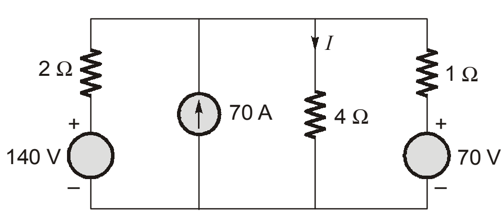
(a) 1 A (b) 2 A
(c) 3 A (d) 4 A

Q.17 If the voltage V across 10 W resistance is 10 V, what is the voltage E of the voltage source in the circuit shown below?



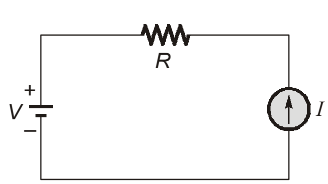
(a) –50 V (b) –10 V
(c) +10 V (d) +50 V

Q.18 What is the value of the current I in the circuit shown below?



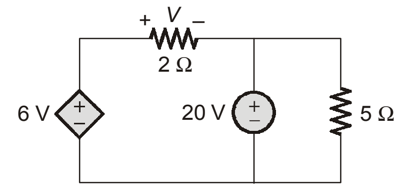
(a) 20 A (b) 25 A
(c) 30 A (d) 36 A

Q.19 For the network shown in the figure below, what is the voltage across the current source?



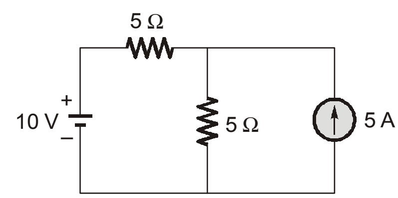
(a) $V - RI$ (b) $V + RI$
(c) Zero (d) $RI - V$

Q.20 What is the current through the 2 Ω resistance for the circuit as shown below?



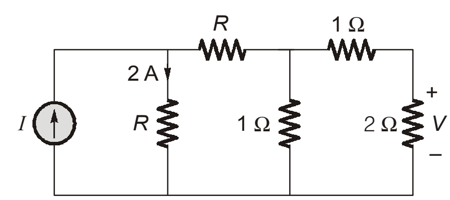
(a) 5 A (b) 4 A
(c) 3 A (d) 2 A

Q.21 What is the voltage across the current source for the below shown circuit?



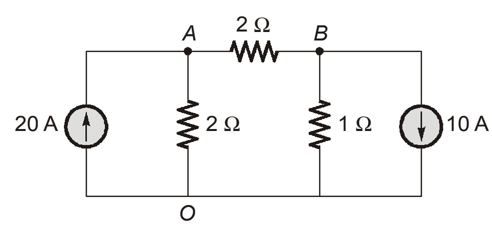
(a) 5.0 V (b) 7.5 V
(c) 12.5 V (d) 17.5 V

Q.22 What is the value of I for the below shown circuit, if V = 2 volts?



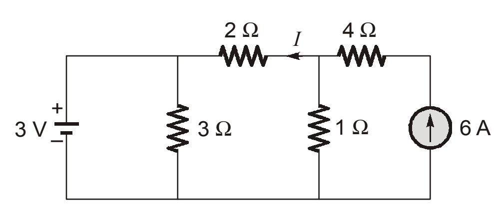
(a) 2 A (b) 4 A
(c) 6 A (d) 8 A

Q.23 Find the voltage of the node A with respect to 'O' for the circuit as shown in below.



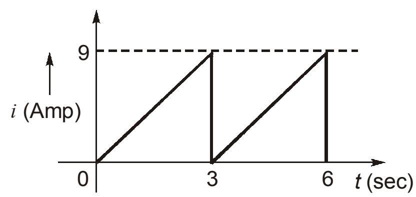
(a) 40 V (b) 20 V
(c) 50 V (d) 60 V

Q.24 For the circuit as shown below, what is the value of I ?



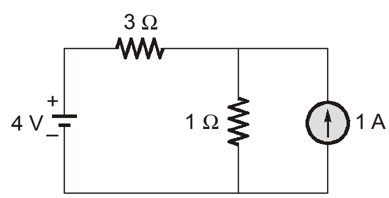
(a) 4 A (b) 3 A
(c) 2 A (d) 1 A

Q.25 The current waveform as shown below, is applied in a pure resistor of 10 Ω. What is the power dissipated in the resistor?



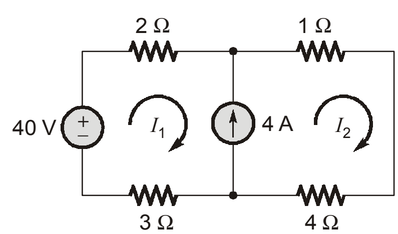
(a) 270 W (b) 135 W
(c) 52 W (d) 7 W

Q.26 For the circuit shown in the figure below, the voltage across the 1 ohm resistor is given by



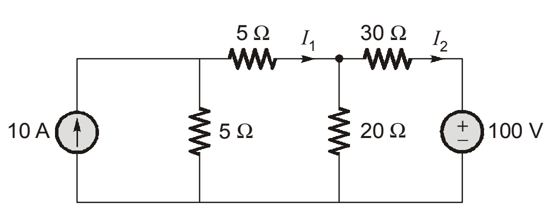
(a) 7 V/4 (b) 5 V/4
(c) 7 V/3 (d) 2 V/3

Q.27 The currents I_1 and I_2 in the below circuit are respectively



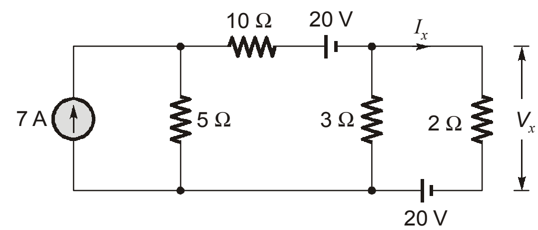
(a) 4 A; 4 A (b) 3 A; 5 A
(c) 2 A; 6 A (d) 6 A; 2 A

Q.28 The currents I_1 and I_2 in the below circuit are respectively



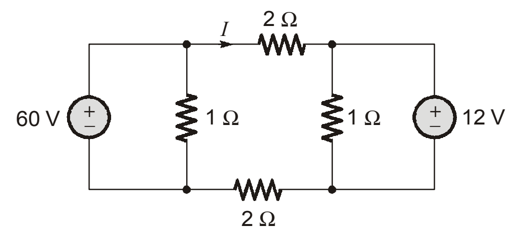
(a) 1.818 A; -0.4545 A
(b) 2.451 A; -1.568 A
(c) 0.4545 A; -1.818 A
(d) 1.56 A; -2.45 A

Q.29 The currents I_x and V_x in the below circuit are respectively



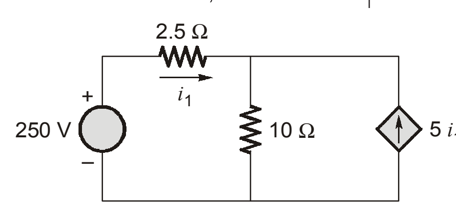
(a) 5 A; 10 V (b) 10 A; 20 V
(c) 6 A; 12 V (d) 4 A; 8 V

Q.30 For the circuit shown in figure below, the value of current, I is



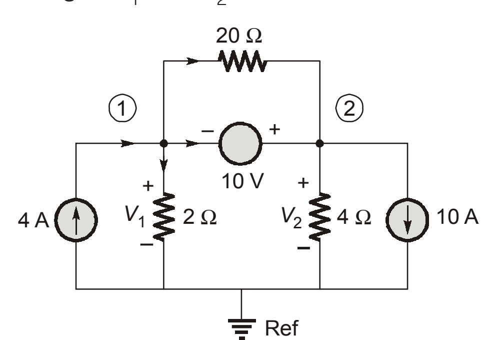
(a) 2 A (b) 3 A
(c) 6 A (d) 12 A

Q.31 In the circuit shown, the current i_1 is



(a) 4 A (b) 2 A
(c) 4.76 A (d) 20 A

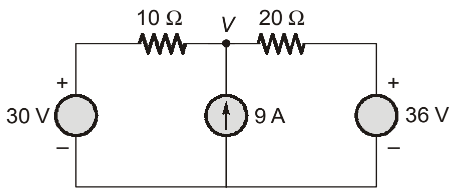
Q.32 When KCL is applied at the super node in the below circuit, the current equation in terms of node voltages V_1 and V_2 is



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

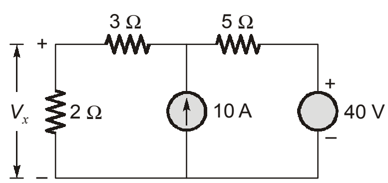
(c) $4 = \dfrac{V_1}{2} + \dfrac{V_1 - V_2}{20}$ (d) $4 = \dfrac{V_1}{2} + \dfrac{V_2}{4}$

Q.33 The node voltage V in the circuit is



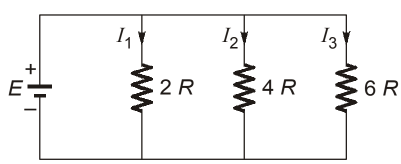
(a) 6 V (b) 30 V
(c) 36 V (d) 92 V

Q.34 The voltage V_x across the 2 Ω resistance in the circuit is



(a) 16 V (b) 60 V
(c) 18 V (d) 10 V

Q.35 Three parallel branches of resistors are connected across a d.c. source as shown in the figure. What is $I_1 : I_2 : I_3$?

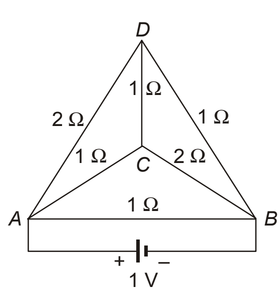


(a) 3 : 2 : 6 (b) 2 : 4 : 6
(c) 6 : 3 : 2 (d) 6 : 2 : 4

Q.36 The number of independent KVL and KCL equations for a network with n-nodes and l links are respectively

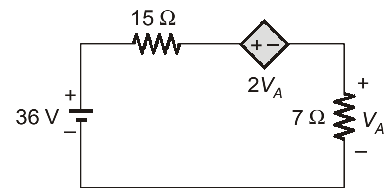
(a) l and n (b) l and $n - 1$
(c) $n - 1$ and l (d) $n - 1$ and $l - 1$

Q.37 A triangular pyramid, built up of six wires whose resistances are shown in the figure, is fed from a 1 V battery at the terminals A and B. The current through the branch DB is



(a) $\frac{1}{7}$ A (b) $\frac{2}{7}$ A
(c) $\frac{3}{7}$ A (d) $\frac{4}{7}$ A

Q.38 The power dissipated in the controlled source of the network shown below is



(a) 36 W (b) 15 W
(c) 07 W (d) 14 W

Q.39 A conductor of diameter d, length l consumes a power of W when a current I flows through it. What will be the power consumed if d is doubled, l is halved and current is tripled?

(a) 18 W (b) 36 W
(c) 48 W (d) 9/8 W

Q.40 Consider the following two types of non-identical sources:

1. Voltage source $e_1(t)$ and $e_2(t)$
2. Current sources i_1 and $i_2(t)$

Regarding the mode of their connection in a circuit.

(a) 1 cannot be connected in parallel, and 2 cannot be connected in series.
(b) 1 cannot be connected in series, and 2 cannot be connected in parallel.
(c) Both 1 and 2 cannot be connected in parallel.
(d) Both 1 and 2 cannot be connected in parallel

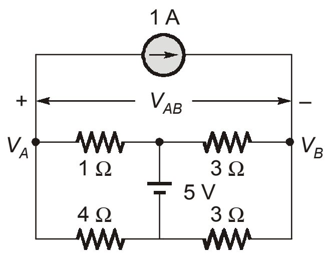
Q.41 n resistors each of resistance R when connected in series offer an equivalent resistance of 50 Ω and when reconnected in parallel the effective resistance is 2 Ω. The value of R is

(a) 2.5 Ω (b) 5 Ω
(c) 7.5 Ω (d) 10 Ω

Q.42 Two bulbs of 100 W/250 V and 150 W/250 V are connected in series across a supply of 250 V. The power consumed by the circuit is

(a) 30 W (b) 60 W
(c) 100 W (d) 250 W

Q.43 The potential difference V_{AB} in the circuit is



(a) 0.8 V (b) –0.8 V
(c) 1.8 V (d) –1.8 V

Q.44 Three 30 Ω resistors are connected in parallel across an ideal 40 V source. What would be the equivalent resistance seen by the load connected across this circuit?

(a) 0 Ω (b) 10 Ω
(c) 20 Ω (d) 30 Ω

Q.45 Two networks are said to be dual when

(a) their node equations are the same
(b) the loop equations of one network are analogous to the node equations of the other
(c) their loop equations are the same
(d) the voltage sources of one networks are the current sources of the other

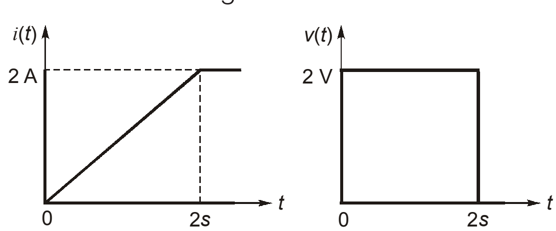
Q.46 The mesh-current method

1. works with both planar and non-planar circuits.
2. uses Kirchhoffs voltage law.

Which of the above is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

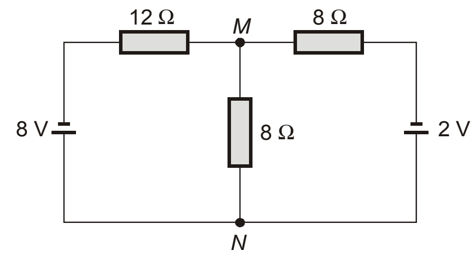
Q.47 The voltage and current waveforms for an element are shown in the figure.



The circuit element and its value are

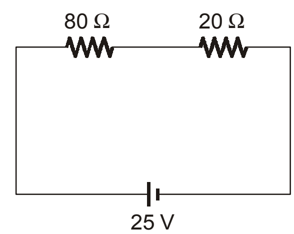
(a) Capacitor, 2 F (b) Inductor, 2 H
(c) Capacitor, 0.5 F (d) Inductor, 0.5 H

Q.48 What is the current through the 8 Ω resistance connected across terminals, *M* and *N* in the circuit?



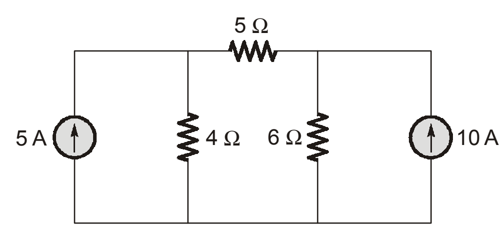
(a) 0.34 A from *M* to *N*
(b) 0.29 A from *M* to *N*
(c) 0.29 A from *N* to *M*
(d) 0.34 A from *N* to *M*

Q.49 What is the potential drop across the 80 Ω resistor in the figure?



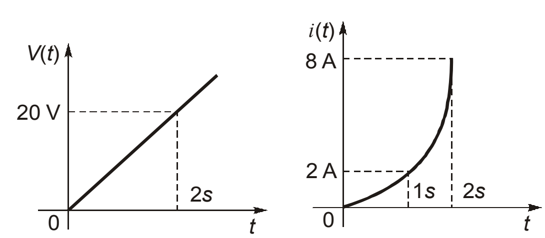
(a) 20 V (b) 15 V
(c) 10 V (d) 5 V

Q.50 What is the current through the 5 Ω resistance in the circuit shown?



(a) 5.33 A (b) 4.66 A
(c) 2.66 A (d) 1.33 A

Q.51 The voltage and current characteristic of an element is as shown in figure. The nature and value of the element are



(a) Capacitor of 3.3 μF
(b) Inductor of 2.5 H
(c) Capacitor of 6.7 μF
(d) Inductor of 5.0 H

Answers Circuit Theory

1.	(b)	2.	(a)	3.	(c)	4.	(a)	5.	(c)	6.	(b)	7.	(a)	8.	(c)
9.	(b)	10.	(c)	11.	(d)	12.	(a)	13.	(c)	14.	(d)	15.	(d)	16.	(b)
17.	(b)	18.	(c)	19.	(b)	20.	(d)	21.	(d)	22.	(c)	23.	(b)	24.	(d)
25.	(a)	26.	(a)	27.	(c)	28.	(c)	29.	(a)	30.	(d)	31.	(a)	32.	(a)
33.	(d)	34.	(c)	35.	(c)	36.	(b)	37.	(c)	38.	(d)	39.	(d)	40.	(a)
41.	(d)	42.	(b)	43.	(b)	44.	(a)	45.	(b)	46.	(b)	47.	(b)	48.	(d)
49.	(a)	50.	(c)	51.	(b)	52.	(b)	53.	(c)	54.	(b)	55.	(c)	56.	(c)
57.	(b)	58.	(c)	59.	(d)	60.	(d)	61.	(c)	62.	(c)	63.	(c)	64.	(a)
65.	(a)	66.	(a)	67.	(d)	68.	(b)	69.	(a)	70.	(c)	71.	(b)	72.	(b)
73.	(d)	74.	(b)	75.	(c)	76.	(a)	77.	(a)	78.	(a)	79.	(b)	80.	(b)
81.	(a)	82.	(b)	83.	(b)	84.	(d)	85.	(d)	86.	(d)	87.	(b)	88.	(c)
89.	(c)	90.	(b)	91.	(d)	92.	(a)	93.	(b)	94.	(b)	95.	(c)	96.	(b)
97.	(b)	98.	(d)	99.	(d)	100.	(a)	101.	(d)	102.	(d)	103.	(b)	104.	(b)
105.	(d)	106.	(c)	107.	(d)	108.	(c)	109	(b)	110.	(a)	111.	(c)	112.	(a)
113.	(d)	114.	(b)	115.	(d)	116.	(b)	117	(b)	118.	(a)	119	(a)	120.	(b)
121.	(d)	122.	(c)	123.	(a)	124.	(c)	125.	(d)	126.	(c)	127.	(c)	128.	(a)
129.	(b)	130.	(d)	131.	(b)	132.	(b)	133.	(d)	134.	(d)	135.	(c)	136.	(a)
137.	(c)	138.	(a)	139.	(b)	140.	(d)	141.	(a)	142.	(a)	143.	(a)	144.	(b)
145.	(b)	146.	(b)	147.	(a)	148.	(c)	149.	(d)	150.	(c)	151.	(c)	152.	(a)
153.	(b)	154.	(a)	155.	(b)	156.	(b)	157.	(c)	158.	(d)	159.	(b)	160.	(b)
161.	(d)	1.62	(b)	163.	(d)	164.	(b)	165	(c)	166.	(b)	167.	(d)	168.	(d)
169.	(d)	170.	(a)	171.	(b)	172.	(d)	173.	(c)	174.	(d)	175.	(d)	176.	(c)
177.	(a)	178.	(c)	179.	(c)	180.	(b)	181.	(b)	182.	(b)	183.	(d)	184.	(c)
185.	(d)	186.	(b)	187.	(a)	188.	(c)	189.	(a)	190.	(c)	191.	(b)	192.	(b)
193.	(c)	194.	(c)	195.	(c)	196.	(a)	197.	(b)	198.	(c)	199.	(d)	200.	(d)
201.	(d)	202.	(b)	203.	(a)	204.	(c)	205.	(d)	206.	(b)	207.	(d)	208.	(c)
209.	(b)	210.	(d)	211.	(c)	212.	(d)	213.	(b)	214.	(d)	215.	(d)	216.	(c)
217.	(c)	218.	(a)	219.	(c)	220.	(a)	221.	(d)	222.	(a)	223.	(c)	224.	(c)
225.	(d)	226.	(c)	227.	(c)	228.	(c)	229.	(d)	230.	(c)	231.	(d)	232.	(d)
233.	(b)	234.	(c)	235.	(a)	236.	(d)	237.	(c)	238.	(d)	239.	(b)	240.	(d)
241.	(c)	242.	(d)	243.	(a)	244.	(b)	245.	(a)	246.	(d)	247.	(a)	248.	(d)
249.	(c)	250.	(d)	251.	(b)	252.	(a)	253.	(a)	254.	(b)	255.	(d)	256.	(c)
257.	(a)	258.	(c)	259.	(b)	260.	(d)	261.	(c)	262.	(c)	263.	(b)	264.	(d)
265.	(b)	266.	(c)	267.	(c)	268.	(d)	269.	(c)	270.	(c)	271.	(d)	272.	(c)
273.	(a)	274.	(b)	275.	(d)	276.	(c)	277.	(b)	278.	(a)	279.	(d)	280.	(c)
281.	(a)	282.	(b)	283.	(a)	284.	(d)	285.	(d)	286.	(b)	288.	(b)	289.	(c)
290.	(c)	291.	(c)	292.	(d)	293.	(b)	294.	(d)	295.	(a)	296.	(d)	297.	(d)
298.	(c)	299.	(d)	300.	(c)	301.	(b)	302.	(c)	303.	(d)	304.	(c)	305.	(d)
306.	(c)	307.	(a)	308.	(b)										

Explanations

1. (b)

Applying KVL in the loop

$24 - 1I + 2V_b - V_b - 4I = 0$

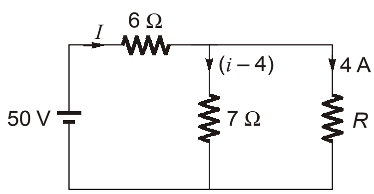
where, $V_b = 3I$

$\Rightarrow \quad 24 - 5I + V_b = 0$

$\Rightarrow \quad 24 - 5I + 3I = 0$

$I = 12$ A

2. (a)



By applying KVL in 1st loop

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

$\Rightarrow \quad 13i = 78$

$\Rightarrow \quad i = 6$ A

Now, by applying KVL in 2nd loop

$7 \times 2 = 4 \times R$

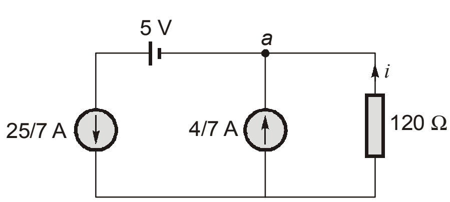
$R = 3.5\ \Omega$

3. (c)

By applying KVL

The terminal v-i characteristic is $v = 2i + 5$

5. (c)

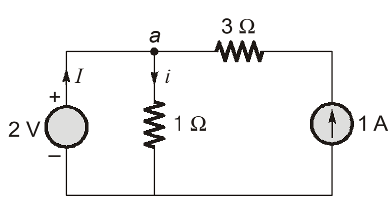


By applying KCL at node a

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

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

6. (b)



From figure, $i = \frac{2}{1} = 2$ Amp

By applying KCL at node a

$I = i - 1 = 2 - 1 = 1$ Amp

i.e. the current delivered by voltage source = 1 amp.

$\therefore$ power delivered by voltage source

$= 2 \times 1 = 2$ W

7. (a)

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

Bulbs are connected in series

$$R_{eq} = R_1 + R_2$$

$$= V^2\left[\frac{1}{P_1} + \frac{1}{P_2}\right] = V^2\left[\frac{P_1 + P_2}{P_1 P_2}\right]$$

$$\text{Total power} = \frac{V^2}{R_{eq}} = \frac{P_1 P_2}{P_1 + P_2}$$

8. (c)

$$i_1 = \sqrt{\frac{P_1}{R}} \text{ and } i_2 = \sqrt{\frac{P_2}{R}}$$

when both source are active

$$i = i_1 \pm i_2 = \sqrt{\frac{P_1}{R}} \pm \sqrt{\frac{P_2}{R}}$$

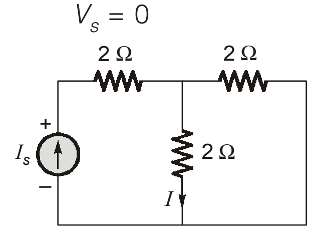
$$\text{Total power} = i^2 R$$

$$= \left(\sqrt{\frac{P_1}{R}} \pm \sqrt{\frac{P_2}{R}}\right)^2 R$$

$$= (\sqrt{P_1} \pm \sqrt{P_2})^2$$

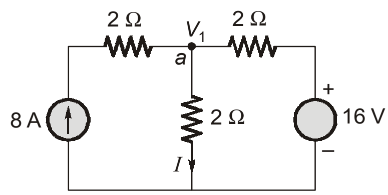
9. (b)

When, $V_s = 0$



$$I = \frac{I_s}{2}$$

$\Rightarrow \quad I_s = 2I = 2 \times 4 = 8$ A



When $V_s = 16$ V

Applying KCL node a,

$$-8+\frac{V_1}{2}+\frac{V_1-16}{2} = 0$$

$$V_1 = 16 \text{ V}$$

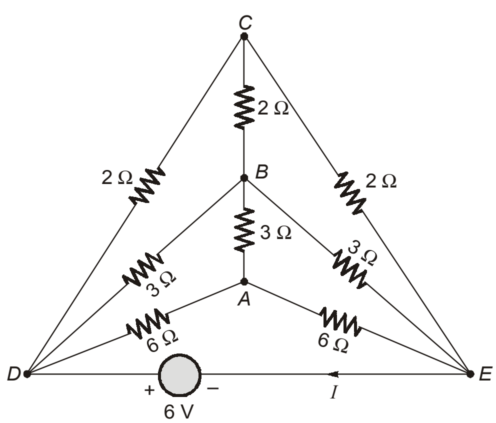
$$I = \frac{V_1}{2}=\frac{16}{2}=8 \text{ A}$$

10. (c)

Circuit is symmetrical, so voltage at nodes V_A, V_B and V_C are equal and no current flows between these nodes.

or

DCEB and *DBEA* are two balanced Wheatstone's bridges hence these will not be any current in branch *CB* and *BA*.



$$I = \frac{6}{2+2}+\frac{6}{3+3}+\frac{6}{6+6}=3 \text{ A}$$

11. (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.

12. (a)

In the given circuit there are only resistor/inductor or capacitor and a voltage source, of $V = 5-5 = 0$ V. As these are passive elements and follow the superposition theorem. The circuit is passive and linear.

13. (c)

As all the resistive branches are in parallel.

∴ voltage across each branch will be constant and will be equal to the dc supply voltage

∴ $V = IR$ = constant

$$\Rightarrow \qquad I \propto \frac{1}{R}$$

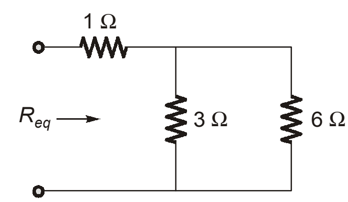
$$I_1 : I_2 : I_3 = \frac{1}{R_1}:\frac{1}{R_2}:\frac{1}{R_3}$$

$$= R_2R_3 : R_1R_3 : R_1R_2$$

$$= 24 : 12 : 8$$

$$= 6 : 3 : 2$$

14. (d)



$$R_{eq} = 1 + (3 \,||\, 6) = 3\ \Omega$$

Voltage across current source

$$I_sR_{eq} = 2\times 3 = 6 \text{ V}$$

15. (d)

$$I_R = \frac{24}{6}=4 \text{ A}$$

Current delivered by the voltage source.

$$I = I_R + 2I_R = 3I_R = 3\times 4 = 12 \text{ A}$$

Power delivered by the voltage source

$$= 24 \times 12 = 288 \text{ W}$$

16. (b)

Applying KCL,

$$-1+\frac{8-2}{2}-I=0 \;\Rightarrow\; I = 2 \text{ A}$$

17. (b)

Appying KCL,

$$-5+\frac{V}{10}+\frac{V-E}{5}=0$$

$$\Rightarrow \quad -5+\frac{10}{10}+\frac{10-E}{5}=0$$

$$\Rightarrow \quad E = -10 \text{ V}$$

18. (c)

Assuming voltage of the node V

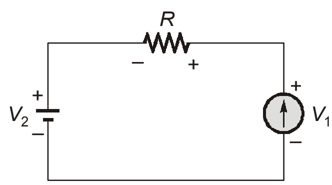
Applying KCL,

$$\frac{V-140}{2} - 70 + \frac{V}{4} + \frac{V-70}{1} = 0$$

$$\Rightarrow \quad V = 120\text{ V}$$

$$I = \frac{V}{4} = \frac{120}{4} = 30\text{ A}$$

19. (b)



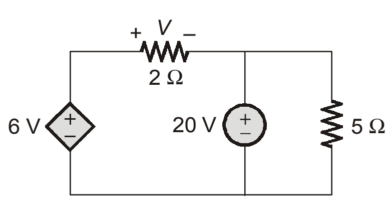
Assuming voltage across current source is V_1

Applying KVL,

$$V + IR - V_1 = 0$$

$$\Rightarrow \quad V_1 = V + IR$$

20. (d)

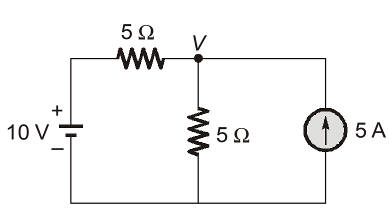


$$6\,V - V - 20 = 0$$

$$V = 4\text{ V}$$

Current through 2 Ω resistor $= \frac{V}{2} = \frac{4}{2} = 2\text{ A}$

21. (d)



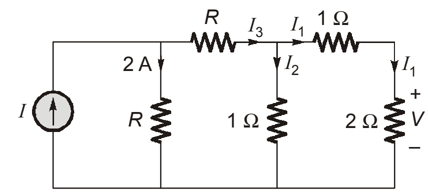
Applying Nodal Analysis

$$\frac{10-V}{5} + 5 = \frac{V}{5}$$

$$\therefore \quad 10 - V + 25 = V$$

$$\therefore \quad V = 17.5\text{ V}$$

22. (c)



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

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

and $$I_1 = \left(\frac{1}{1+3}\right) I_3$$

$$I = \frac{1}{4} I_3$$

$$\therefore \quad I_3 = 4\text{ A}$$

and $$I = 4 + 2 = 6\text{ A}$$

23. (b)

Applying Nodal Analysis

$$20 = \frac{V_A}{2} + \frac{V_A - V_B}{2}$$

$$40 = 2\,V_A - V_B \qquad \ldots(i)$$

and $$\frac{V_A + V_B}{2} = \frac{V_B}{1} + 10$$

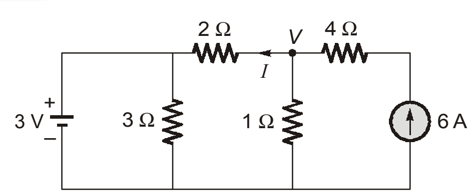
$$V_A - V_B = 2V_B + 20$$

$$\therefore \quad V_A - 3V_B = 20 \qquad \ldots(ii)$$

Solving (i) and (ii),

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

24. (d)



Applying Nodal Analysis,

$$6 = \frac{V-3}{2} + \frac{V}{1}$$

$$12 = V - 3 + 2\,V$$

$$\therefore \quad \boxed{V = 5\text{ V}}$$

$$I = \frac{5-3}{2} = 1\text{ A}$$

25. (a)

$$i_{rms}^2 = \frac{1}{T}\int_0^T (i_{avg})^2 \cdot dt$$

$$\therefore \quad i_{avg} = \left(\frac{9-0}{3-0}\right)\times t = 3t$$

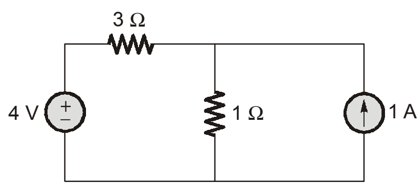
$$\therefore \quad i_{rms}^2 = \frac{1}{3}\int_0^3 (3t)^2 \times dt$$

$$= \frac{1}{3}\times 9\times\left[\frac{t^3}{3}\right]_0^3 = 27$$

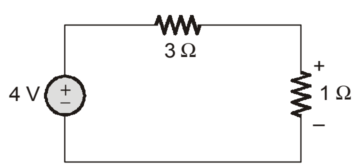
and $\quad P = i_{rms}^2 \times R$

$$= 27 \times 10 = 270 \text{ W}$$

26. (a)

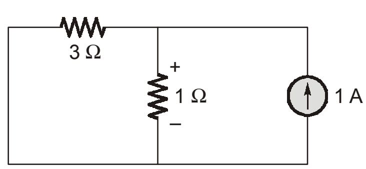


1. By O.C. the 1 A current source.



$$V'_{1\Omega} = \frac{4\times 1}{4} = 1\text{ V}$$

2. By S.C. the voltage source.



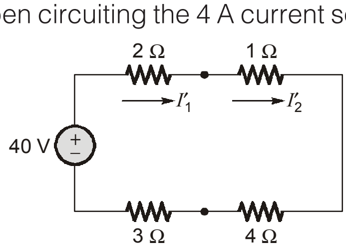
$$V''_{1\Omega} = \frac{3\times 1}{4} = \frac{3}{4}\text{ V}$$

By superposition theorem,

$$V_{1\Omega}^{total} = V'_{1\Omega} + V''_{1\Omega} = 1 + \frac{3}{4} = \frac{7}{4}\text{ V}$$

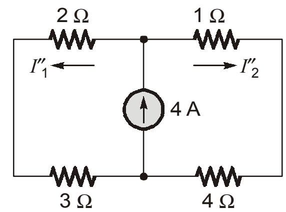
27. (c)

By open circuiting the 4 A current source.



$$I'_1 = I'_2 = 4\text{ A}$$

By short-circuiting 40 V voltage source.



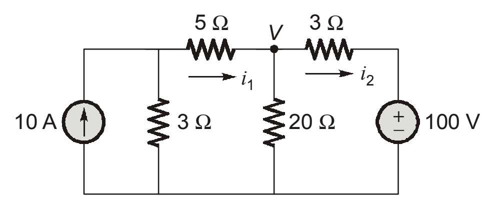
$$I''_1 = I''_2 = 2\text{ A}$$

By superposition theorem

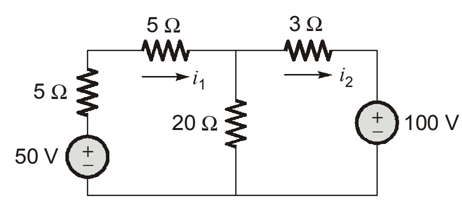
$$I_1 = I'_1 - I''_1 = 2\text{ A}$$

$$I_2 = I'_2 - I''_2 = 6\text{ A}$$

28. (c)



By applying source transformation



By applying KCL

$$\frac{V-50}{10} + \frac{V}{20} + \frac{V-100}{30} = 0$$

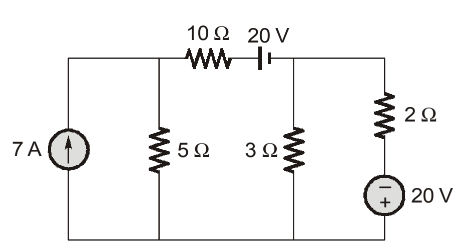
$$\frac{11}{60}V = 8.33$$

$$V = 45.45\text{ V}$$

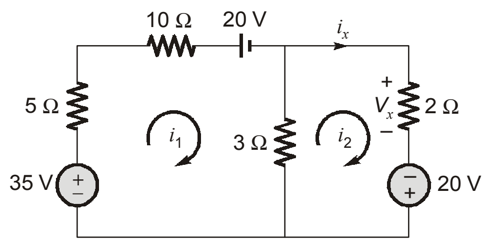
$$i_1 = \frac{50-45.45}{10} = 0.4545\text{ A}$$

$$i_2 = \frac{45.45-100}{10} = -1.818\text{ A}$$

29. (a)



By applying source transformation



$$35 - 20 = 18i_1 - 3i_2$$

$$15 = 18i_1 - 3i_2 \quad \ldots(i)$$

$$20 = 5i_2 - 3i_1 \quad \ldots(ii)$$

By equation (i) and (ii),

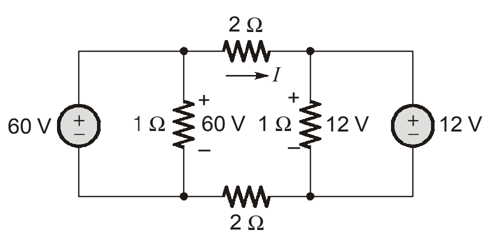
$$i_1 = 1.66 \text{ A}$$

$$i_2 = 5 \text{ A}$$

so,
$$i_x = 5 \text{ A}$$

$$V_x = 10 \text{ V}$$

30. (d)

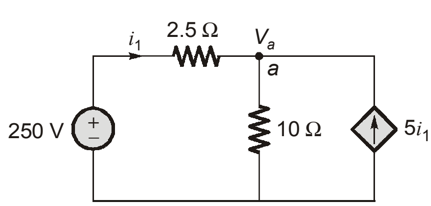


$$-60 + 2I + 12 + 2I = 0$$

$$48 = 4I$$

$$I = 12 \text{ A}$$

31. (a)



Applying KCL at node a.

$$-i_1 - 5i_1 + \frac{V_a}{10} = 0$$

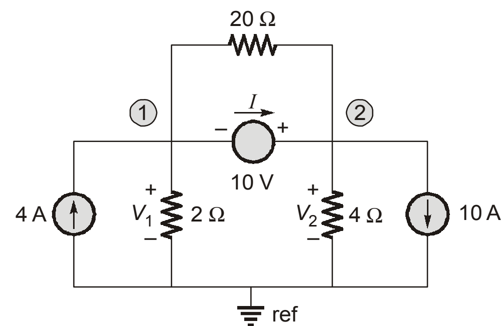
$$\Rightarrow \quad V_a = 60\, i_1$$

$$i_1 = \frac{250 - V_a}{2.5} = \frac{250 - 60\,i_1}{2.56}$$

$$\Rightarrow \quad i_1 = \frac{250}{62.5} = 4 \text{ A}$$

Hence, option (a) is correct.

32. (a)



Let current through 10 V source is I.

Applying KCL at node 1,

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

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.

33. (d)

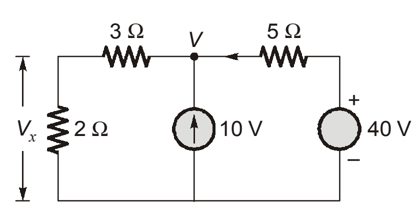
Applying KCL,

$$\frac{V - 30}{10} - 9 + \frac{V - 36}{20} = 0$$

$$V = 92 \text{ V}$$

Hence, option (d) is correct.

34. (c)



Applying KCL,

$$\frac{V}{5} + \frac{V - 40}{5} - 10 = 0$$

$$V = 45 \text{ V}$$

$$V_x = \frac{V}{5} \times 2 = \frac{45}{5} \times 2 = 18 \text{ V}$$

Hence, option (c) is correct.

35. (c)

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

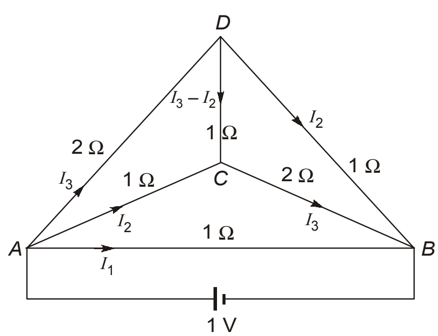
$$I_1 : I_2 : I_3 = \frac{E}{2R} : \frac{E}{4R} : \frac{E}{6R} = 6 : 3 : 2$$

Hence, option (c) is correct.

36. (b)

In any linear, planer network number of independent KVL equations are equal to number of links and KCL equations are $(n-1)$.

37. (c)



$$1 = 2I_3 + I_2 \quad \ldots(i)$$

$$2I_3 + I_3 - I_2 - I_2 = 0 \quad \ldots(ii)$$

$$\Rightarrow \quad I_3 = \frac{2}{3}I_2$$

From equation (i),

$$1 = 2 \times \frac{2}{3}I_2 + I_2$$

$$1 = \frac{7}{3}I_2 \Rightarrow I_2 = \frac{3}{7}\text{ A}$$

38. (d)

Let current flowing through the circuit = I

So that, $V_A = 7I$

∴ Using KVL,

$36 - 15I - 2V_A - V_A = 0$

$36 - 15I - 3 \times (7I) = 0 \Rightarrow I = 1\text{ A}$

and $V_A = 7\text{ V}$

∴ Power dissipated in the controlled source

$= 2V_A I = 14\text{ W}$

39. (d)

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

$$P \propto I^2 \times \frac{l}{d^2}$$

$$\frac{W}{x} = \frac{P_1}{P_2} = \frac{I^2 \times \frac{l}{d^2}}{(3I)^2 \times \frac{l/2}{(2d)^2}}$$

$$= \frac{I^2 \times \frac{l}{d^2}}{9I^2 \times \frac{l}{2} \times \frac{1}{4d^2}} = \frac{8}{9}$$

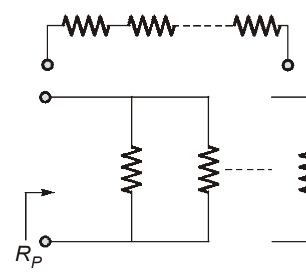
$$x = \frac{9}{8}\text{ W}$$

40. (a)

Voltage sources of different values cannot be connected in parallel, because voltage across a parallel paths will be equal.

The current sources of different values cannot be connected in series, because current through a series circuit path is same.

41. (d)



$$R_S = nR$$

$$R_P = \frac{R}{n}$$

$$\Rightarrow \quad n \cdot R = 50$$

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

$$R = \frac{50}{n} \quad \ldots(1)$$

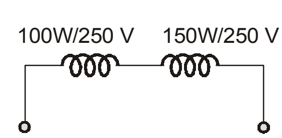
$$\Rightarrow \quad R = 2n \quad \ldots(2)$$

Multiplying equation (1) and (2),

$$R^2 = \frac{50}{n} \times 2n = 100$$

$$\Rightarrow \quad R = \sqrt{100} = 10\ \Omega$$

42. (b)



$$R_1 = \frac{V^2}{P_1} = \frac{250 \times 250}{100} = 625\ \Omega$$

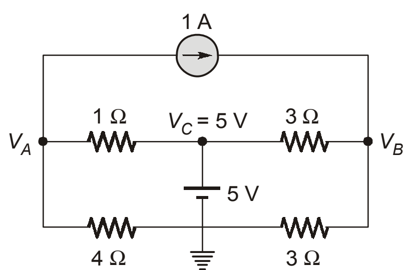
$$R_2 = \frac{V^2}{P_2}$$

$$= \frac{250 \times 250}{150} = 416.67\ \Omega$$

$$R_{eq} = R_1 + R_2 = 1041.67\ \Omega$$

$$P = \frac{V^2}{R_{eq}} = \frac{250 \times 250}{1041.66} \simeq 60\ \text{W}$$

43. (b)



$$V_C - 0 = 5 \Rightarrow V_C = 5\ \text{V}$$

At node A:

$$1 + \frac{V_A - 5}{1} + \frac{V_A}{4} = 0$$

$$5\ V_A = 16 \Rightarrow V_A = \frac{16}{5}\ \text{V}$$

At node B:

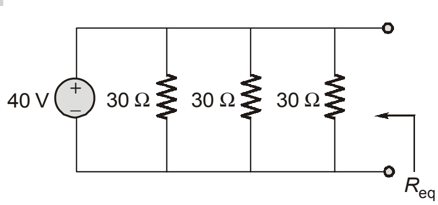
$$-1 + \frac{V_B - 5}{3} + \frac{V_B}{3} = 0 \Rightarrow 2V_B = 8$$

$\therefore$ $$V_B = 4\ \text{V}$$

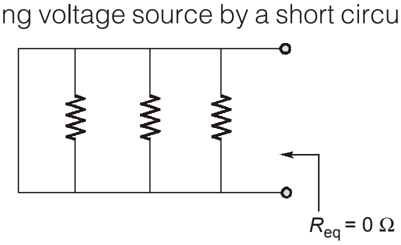
$\therefore$ $$V_{AB} = V_A - V_B = \frac{16}{5} - 4$$

$$= -0.8\ \text{V}$$

44. (a)



Replacing voltage source by a short circuit



45. (b)

Duality means mathematical representation of both the networks should be identical (KVL and KCL).

$\therefore$ Loop equations of one network are analogous to the node euqations of the other.

46. (b)

Mesh analysis is valid only for planar networks and for its application we apply KVL.

47. (b)

From the given waveforms,

$$\text{slope} = \frac{di}{dt} = \frac{2}{2} = 1\ \text{A/sec}$$

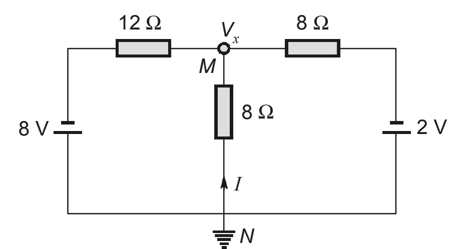
$$v = L\frac{di}{dt}$$

$$2 = L\ (1)$$

$$L = 2\ \text{H}$$

48. (d)

From the given network,



Applying KCL at M,

$$\frac{V_x + 8}{12} + \frac{V_x}{8} + \frac{V_x + 2}{8} = 0$$

$$2V_x + 16 + 3V_x + 3V_x + 6 = 0$$

$$8V_x = -22$$

$\Rightarrow$ $$V_x = -\frac{22}{8}\ \text{V}$$

$$I = \frac{0 - V_x}{8} = \frac{0 - \left(-\frac{22}{8}\right)}{8} = \frac{22}{64}\ \text{A}$$

$$= 0.343\ \text{A from } N \text{ to } M$$

49. (a)

$$V_{80\,\Omega} = \frac{25}{80 + 20} \times 80 = \frac{25}{100} \times 80$$

$$= \frac{1}{4} \times 80 = 20\ \text{V}$$