RRB-JE (CBT-2) 2024

Railway Recruitment Board

Junior Engineer Examination

3000 MCQs

Fully solved multiple choice questions
with detailed explanations

Practice Book
Electronics Engineering

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3000 MCQs for Railway Recruitment Board (Junior Engineer) : Electronics 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 Electronics 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 3000 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 Electronics & Allied Engineering Exam Group – JE

S.No.	Subject
1.	**Electronic Components & Materials:** Conductors, Semi conductor& Insulators; Magnetic materials; Jointing & Cleaning materials for U/G copper cable & OFC; Cells and Batteries (chargeable and non chargeable); Relays, Switches, MCB & Connectors.
2.	**Electronic Devices and circuits:** PN Junction diodes, thyristor; Diode and triode circuits; Junction Transistors; Amplifiers; Oscillator; Multivibrator, counters; Rectifiers; Inverter and UPS.
3.	**Digital Electronics:** Number System & Binary codes; Boolean Algebra & Logic gates; Combinational & Sequential logic circuits; A/D & D/A converter, counters; Memories.
4.	**Linear Integrated Circuit:** Introduction to operational Amplifier; Linear applications; Non Linear applications; Voltage regulators; Timers; Phase lock loop.
5.	**Microprocessor and Microcontroller:** Introduction to microprocessor, 8085 microprocessor working; Assembly Language programming; Peripherals & other microprocessors; Microcontrollers.
6.	**Electronic Measurements:** Measuring systems; Basic principles of measurement; Range Extension methods; Cathode ray oscilloscope, LCD, LED panel; Transducers.
7.	**Communication Engineering:** Introduction to communication; Modulation techniques; Multiplexing Techniques; Wave Propagation, Transmission line characteristics, OFC; Fundamentals of Public Address systems, Electronic exchange, Radar, Cellular and Satellite Communication.
8.	**Data communication and Network:** Introduction to data communication; Hardware and interface; Introduction to Networks and Networking devices; Local Area Network and Wide area network; Internet working.
9.	**Computer Programming:** Programming concepts; Fundamentals of 'C' and C ++; Operators in 'C' and C ++; Control Statements; Functions, Array String & Pointers, File Structure; Data Structure and DBMS.
10.	**Basic Electrical Engg:** DC Circuits; AC fundamentals; Magnetic, Thermal and Chemical effects of Electric current; Earthing-Installation, Maintenance, Testing.

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Contents

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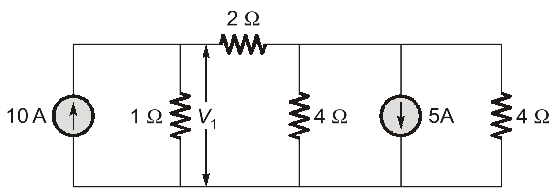
UNIT 1

Basic Electrical Engineering

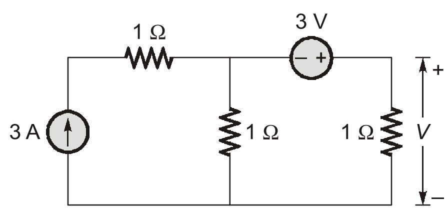
1. For the circuit shown below, voltage V_1 will be



(a) 2.64 V (b) 3.64 V
(c) 6.0 V (d) 9.1 V

2. A circuit component that opposes the change in circuit voltage is
(a) resistance (b) capacitance
(c) inductance (d) all the above

3. The value of V in the circuit shown in the given figure is

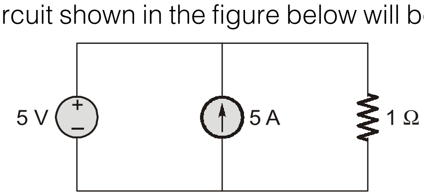


(a) 1 V (b) 2 V
(c) 3 V (d) 4 V

4. Two coupled coils with $L_1 = L_2 = 0.6$ H have a coupling coefficient of $K = 0.8$. The turn ratio N_1/N_2 is
(a) 4 (b) 2
(c) 1 (d) 0.5

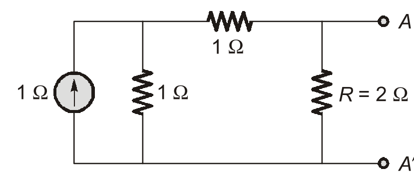
5. The efficiency for maximum power transfer to the load is
(a) 25% (b) 50%
(c) 75% (d) 100%

6. The value of current I flowing in the 1 Ω resistor in the circuit shown in the figure below will be



(a) 10 A (b) 6 A
(c) 5 A (d) zero

7. In the figure shown below, if we connect a source of 2 V, with internal resistance of 1 Ω at AA' with positive terminal at A, then current through R is



(a) 2 A (b) 1.66 A
(c) 1 A (d) 0.625 A

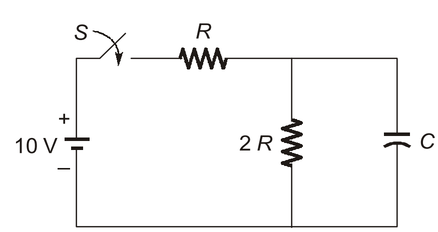
8. The curve representing Ohm's law is
(a) Linear (b) Hyperbolic
(c) Parabolic (d) Triangular

9. Specific resistance of a conductor depends upon
(a) dimension of the conductor
(b) composition of conductor material
(c) resistance of the conductor
(d) both (a) and (b)

10. Two coupled coil with $L_1 = L_2 = 0.6$ H have a coupling coefficient of $K = 0.8$. The turn ratio N_1/N_2 is
(a) 4 (b) 2
(c) 1 (d) 0.5

11. The ratio of resistances of a 100 W, 220 V lamp to that of a 100 W, 110 V lamp will be equal to
(a) 4 (b) 2
(c) $\frac{1}{2}$ (d) $\frac{1}{4}$

12. Time constant of the network shown in figure is

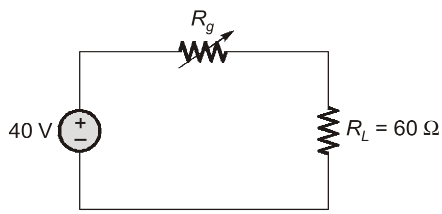


(a) $2RC$ (b) $3RC$
(c) $\frac{RC}{2}$ (d) $\frac{2RC}{3}$

13. If four 10 μF capacitors are connected in parallel the net capacitance is

(a) 2.5 μF (b) 40 μF
(c) 20 μF (d) 115 μF

14. If R_g in the circuit shown in figure is variable between 20 Ω and 80 Ω then maximum power transferred to the load R_L will be:

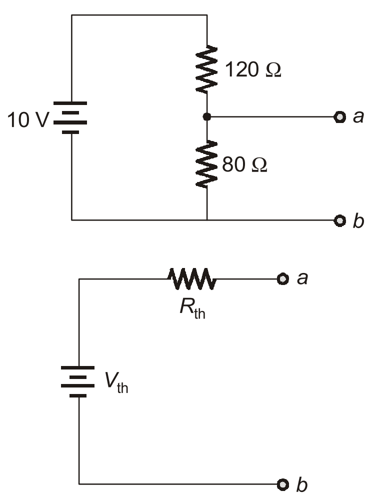


(a) 15 W (b) 13.33 W
(c) 6.67 W (d) 2.4 W

15. Permeance is analogous to:

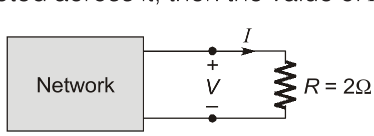
(a) Conductance (b) Reluctance
(c) Inductance (d) Resistance

16. A voltage divider circuit and its Thevenin's equivalent are shown below. The values of V_{th} and R_{th} will be



(a) 10 V, 80 Ω (b) 4 V, 80 Ω
(c) 4 V, 48 Ω (d) 5 V, 50 Ω

17. The V-I relation for the network shown in the given box is $V = 4I - 9$. If now a resistor $R = 2$ Ω is connected across it, then the value of I will be

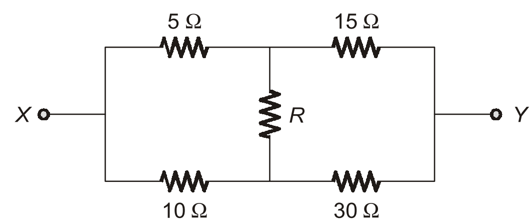


(a) –4.5 A (b) –1.5 A
(c) 1.5 A (d) 4.5 A

18. The wires A and B of the same material but of different lengths L and $2L$ have the radius r and $2r$ respectively. The ratio of specific resistance will be

(a) 1 : 4 (b) 1 : 8
(c) 1 : 1 (d) 1 : 2

19. The equivalent resistance between terminals X and Y of the network shown is



(a) 8 Ω (b) $\frac{100}{3}$ Ω
(c) $\frac{40}{3}$ Ω (d) $\frac{20}{9}$ Ω

20. Application of Thevenin's theorem in a circuit results in

(a) an ideal voltage source.
(b) an ideal current source.
(c) a current source and an impedance parallel.
(d) a voltage source and an impedance in series.

21. A voltmeter when connected across a dc supply, reads 124 V. When a series combination of the voltmeter and an unknown resistance X is connected across the supply, the meter reads 4 V. If the resistance of the voltmeter is 50 kΩ, the value of X is

(a) 1550 kΩ (b) 1600 kΩ
(c) 1.6 kΩ (d) 1.5 MΩ

22. Two 2000 Ω, 2 watt resistors are connected in parallel. Their combined resistance value and wattage rating are

(a) 1000 Ω, 2 watt (b) 1000 Ω, 4 watt
(c) 2000 Ω, 4 watt (d) 2000 Ω, 2 watt

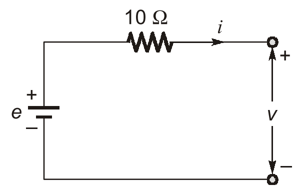
23. We have three resistances each of value 1 Ω, 2 Ω and 3 Ω. If all the three resistances are to be connected in a circuit, how many different values of equivalent resistance are possible?

(a) Five (b) Six
(c) Seven (d) Eight

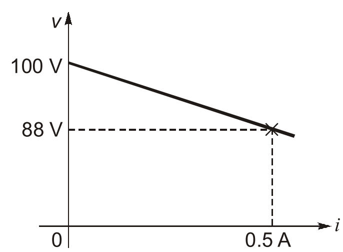
24. An electric heater draws 1000 watts from a 250 V source. The power drawn from a 200 V source is

(a) 800 W (b) 640 W
(c) 1000 W (d) 1562.5 W

25.



The voltage (v) vs current (i) curve of the circuit is shown below:



Internal resistance of the source '*e*' is

(a) 24 Ω (b) 4 Ω
(c) 10 Ω (d) 14 Ω

26. A voltage source having an open-circuit voltage of 150 V and internal resistance of 75 Ω, is equivalent to a current source of

(a) 2 A in series with 75 Ω
(b) 2 A in series with 37.5 Ω
(c) 2 A in parallel with 75 Ω
(d) 1 A in parallel with 150 Ω

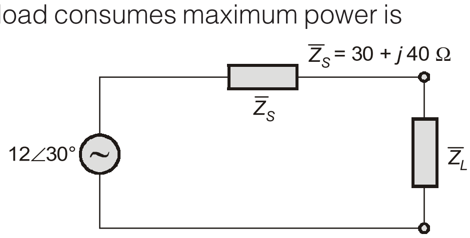
27. Superposition theorem requires as many circuits to be solved as there are

(a) nodes (b) sources
(c) loops (d) none of the above

28. Application of Norton's theorem in a circuit results in

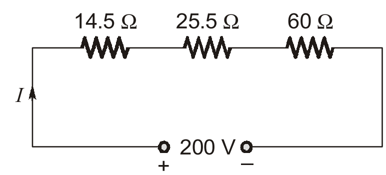
(a) a current source and an impedance in parallel.
(b) a voltage source and an impedance in series.
(c) an ideal voltage source.
(d) an ideal current source.

29. Value of the load impedance $\overline{Z}_L$ for which the load consumes maximum power is



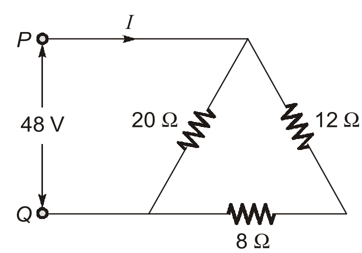
(a) 50 Ω at a power factor of 0.6 lead
(b) 50 Ω at a power factor of 0.6 lag
(c) 30 Ω at power factor of unity
(d) none of the above

30. Calculate the voltage drop across 14.5 Ω resistance.



(a) 14.5 V (b) 18 V
(c) 29 V (d) 30.5 V

31. For the network shown in the figure, the value of current in 8 Ω resistor is



(a) 4.8 A (b) 2.4 A
(c) 1.5 A (d) 1.2 A

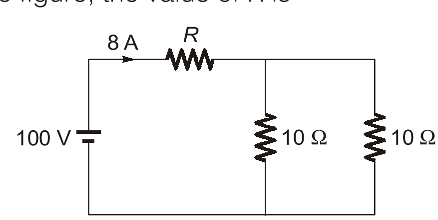
32. The current drawn by a tungsten filament lamp is measured by an ammeter. The ammeter reading under steady state condition will be _______ the ammeter reading when the supply is switched on.

(a) same as (b) less than
(c) greater than (d) double

33. Four resistance 2 Ω, 4 Ω, 5 Ω, 20 Ω are connected in parallel. Their combined resistance is

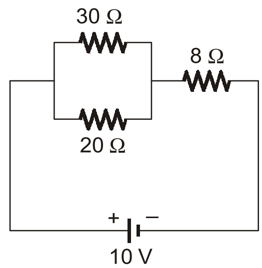
(a) 1 Ω (b) 2 Ω
(c) 4 Ω (d) 5 Ω

34. In the figure, the value of *R* is



(a) 2.5 Ω (b) 5.0 Ω
(c) 7.5 Ω (d) 10.0 Ω

35. Power consumed in the given circuit is

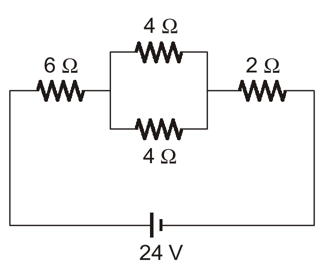


(a) 100 watts (b) 5 watts
(c) 20 watts (d) 40 watts

36. A 200 W, 200 V bulb and a 100 W, 200 V bulb are connected in series and the voltage of 400 V is applied across the series connected bulbs. Under this condition

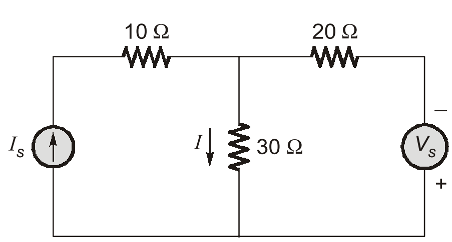
(a) 100 W bulb will be brighter than 200 W bulb.
(b) 200 W bulb will be brighter than 100 W bulb.
(c) Both the bulbs will have equal brightness.
(d) Both the bulbs will be darker than when they are connected across rated voltage.

37. In the network shown, if one of the 4 Ω resistances is disconnected, when the circuit is active, the current flowing now will



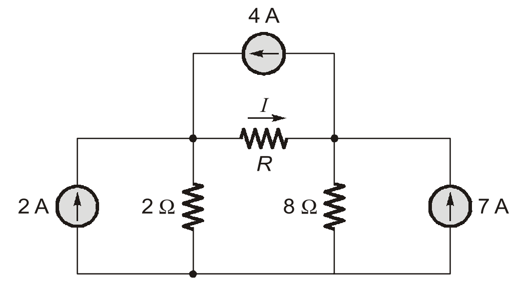
(a) increase very much
(b) decrease
(c) be zero
(d) increase very slightly

38. For the circuit shown in figure, when $V_s = 0$, $I = 3$A. When $V_s = 200$ V, what will be the value of I?



(a) –4 A (b) –1 A
(c) 1 A (d) 7 A

39. The current I in the circuit shown in the figure is



(a) –3.67 A (b) –1 A
(c) 4 A (d) can't be determined

40. Two wires A and B have the same cross-section and are made of the same material. $R_A = 600\ \Omega$ and $R_B = 100\ \Omega$. The number of times A is longer than B is:

(a) 5 (b) 6
(c) 2 (d) 4

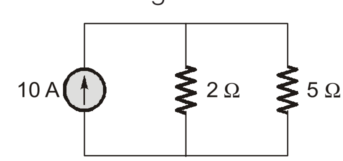
41. Two 100 W, 200 V lamps are connected in series across a 200 V supply. The total power consumed by each lamp in watts will be

(a) 200 (b) 25
(c) 50 (d) 100

42. A terminal where three or more branches meet is known as:

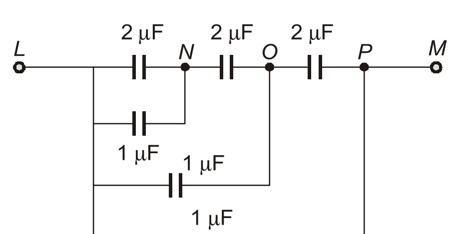
(a) mesh (b) node
(c) terminus (d) loop

43. Find the current through 5 Ω resistor:



(a) 3.5 A (b) 7.15 A
(c) 5 A (d) 2.85 A

44. Total capacitance between the point *L* and *M* in figure is



(a) 4.05 μF (b) 1.45 μF
(c) 1.85 μF (d) 2.05 μF

Answers Basic Electrical Engineering

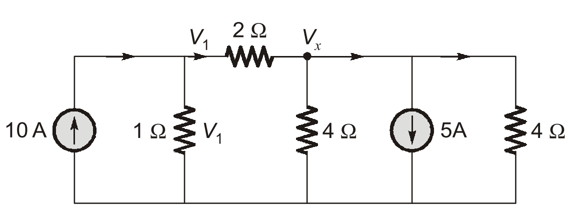
1.	(c)	2.	(b)	3.	(c)	4.	(c)	5.	(b)	6.	(c)	7.	(d)	8.	(a)
9.	(b)	10.	(c)	11.	(a)	12.	(d)	13.	(b)	14.	(a)	15.	(a)	16.	(c)
17.	(d)	18.	(c)	19.	(c)	20.	(d)	21.	(d)	22.	(b)	23.	(d)	24.	(b)
25.	(d)	26.	(c)	27.	(b)	28.	(a)	29.	(a)	30.	(c)	31.	(b)	32.	(b)
33.	(a)	34.	(c)	35.	(b)	36.	(a)	37.	(b)	38.	(b)	39.	(d)	40.	(b)
41.	(b)	42.	(b)	43.	(d)	44.	(d)	45.	(c)	46.	(c)	47.	(a)	48.	(d)
49.	(b)	50.	(b)	51.	(b)	52.	(a)	53.	(c)	54.	(d)	55.	(b)	56.	(c)
57.	(a)	58.	(b)	59.	(b)	60.	(c)	61.	(c)	62.	(b)	63.	(b)	64.	(c)
65.	(b)	66.	(d)	67.	(b)	68.	(c)	69.	(a)	70.	(c)	71.	(d)	72.	(a)
73.	(b)	74.	(b)	75.	(c)	76.	(a)	77.	(a)	78.	(c)	79.	(b)	80.	(a)
81.	(b)	82.	(a)	83.	(d)	84.	(a)	85.	(b)	86.	(c)	87.	(b)	88.	(b)
89.	(b)	90.	(b)	91.	(a)	92.	(c)	93.	(c)	94.	(d)	95.	(a)	96.	(d)
97.	(c)	98.	(a)	99.	(b)	100.	(d)	101.	(d)	102.	(c)	103.	(b)	104.	(d)
105.	(a)	106.	(d)	107.	(c)	108.	(c)	109.	(d)	110.	(d)	111.	(d)	112.	(d)
113.	(c)	114.	(a)	115.	(b)	116.	(a)	117.	(b)	118.	(b)	119.	(c)	120.	(d)
121.	(a)	122.	(b)	123.	(a)	124.	(c)	125.	(d)	126.	(d)	127.	(c)	128.	(c)
129.	(c)	130.	(a)	131.	(d)	132.	(d)	133.	(c)	134.	(a)	135.	(b)	136.	(a)
137.	(d)	138.	(d)	139.	(d)	140.	(c)	141.	(b)	142.	(d)	143.	(b)	144.	(a)
145.	(a)	146.	(c)	147.	(b)	148.	(b)	149.	(c)	150.	(b)	151.	(a)	152.	(c)
153.	(d)	154.	(a)	155.	(b)	156.	(a)	157.	(c)	158.	(b)	159.	(d)	160.	(a)
161.	(b)	162.	(d)	163.	(d)	164.	(b)	165.	(a)	166.	(b)	167.	(d)	168.	(c)
169.	(a)	170.	(b)	171.	(c)	172.	(d)	173.	(d)	174.	(a)	175.	(d)	176.	(c)
177.	(b)	178.	(a)	179.	(d)	180.	(c)	181.	(c)	182.	(b)	183.	(c)	184.	(a)
185.	(d)	186.	(b)	187.	(a)	188.	(d)	189.	(c)	190.	(b)	191.	(a)	192.	(b)
193.	(b)	194.	(d)	195.	(c)	196.	(c)	197.	(a)	198.	(d)	199.	(c)	200.	(b)
201.	(b)	202.	(c)	203.	(d)	204.	(d)	205.	(d)	206.	(a)	207.	(a)	208.	(c)
209.	(d)	210.	(b)	211.	(b)	212.	(d)	213.	(b)	214.	(d)	215.	(b)	216.	(b)
217.	(d)	218.	(a)	219.	(b)	220.	(a)	221.	(c)	222.	(c)	223.	(d)	224.	(d)
225.	(a)	226.	(a)	227.	(b)	228.	(c)	229.	(c)	230.	(d)	231.	(b)	232.	(a)
233.	(c)	234.	(a)	235.	(c)	236.	(d)	237.	(d)	238.	(a)	239.	(d)	240.	(d)
241.	(c)	242.	(a)	243.	(b)	244.	(b)	245.	(d)	246.	(a)	247.	(d)	248.	(c)
249.	(c)	250.	(d)	251.	(a)	252.	(a)	253.	(c)	254.	(c)	255.	(a)	256.	(c)
257.	(b)	258.	(a)	259.	(a)	260.	(b)	261.	(a)	262.	(a)	263.	(d)	264.	(c)
265.	(d)	266.	(a)	267.	(d)	268.	(c)	269.	(c)	270.	(d)	271.	(a)	272.	(d)

273. (a)	274. (c)	275. (d)	276. (d)	277. (d)	278. (a)	279. (c)	280. (b)
281. (a)	282. (a)	283. (a)	284. (c)	285. (b)	286. (a)	287. (b)	288. (c)
289. (b)	290. (b)	291. (a)	292. (d)	293. (d)	294. (c)	295. (a)	296. (b)
297. (c)	298. (b)	299. (a)	300. (a)	301. (a)	302. (a)	303. (b)	304. (c)
305. (a)	306. (b)	307. (b)	308. (d)	309. (d)	310. (b)	311. (d)	312. (c)
313. (d)	314. (d)	315. (a)	316. (b)	317. (b)	318. (c)	319. (d)	320. (a)
321. (d)	322. (b)	323. (a)	324. (d)	325. (b)	326. (b)	327. (b)	328. (a)
329. (a)	330. (a)	331. (a)	332. (c)	333. (b)	334. (b)	335. (a)	336. (d)
337. (b)	338. (d)	339. (b)	340. (c)	341. (b)	342. (a)	343. (b)	344. (a)
345. (c)	346. (c)	347. (d)	348. (a)	349. (a)	350. (c)	351. (d)	352. (a)
353. (b)	354. (c)	355. (c)	356. (c)	357. (d)	358. (d)	359. (a)	360. (d)
361. (a)	362. (c)	363. (c)	364. (d)	365. (b)	366. (c)	367. (c)	368. (c)
369. (c)	370. (d)	371. (b)	372. (c)	373. (b)	374. (d)	375. (d)	376. (c)
377. (d)	378. (c)	379. (b)	380. (d)	381. (d)	382. (b)	383. (b)	384. (c)
385. (c)	386. (c)	387. (b)	388. (a)	389. (c)	390. (a)	391. (d)	392. (d)
393. (b)	394. (b)	395. (d)	396. (b)	397. (c)	398. (d)	399. (a)	400. (d)
401. (c)	402. (b)	403. (b)	404. (c)	405. (a)	406. (b)	407. (d)	408. (c)
409. (b)	410. (c)	411. (c)	412. (d)	413. (c)	414. (c)	415. (c)	416. (d)
417. (b)	418. (b)	419. (a)	420. (c)	421. (a)	422. (c)	423. (a)	424. (b)
425. (a)	426. (b)	427. (d)	428. (c)	429. (b)	430. (d)	431. (a)	432. (d)
433. (a)	434. (c)	435. (b)	436. (c)				

Explanations

1. (c)

Let us mark the current directions as shown in figure below.



Applying KCL at points of voltages V_1 and V_x, we have:

$$10 = \frac{V_1}{1} + \frac{V_1 - V_x}{2}$$

or, $\quad V_1 - V_x + 2V_1 = 20$

$$3V_1 - V_x = 20 \quad \ldots(i)$$

At node,

V_x, $\quad \dfrac{V_1 - V_x}{2} = \dfrac{V_x}{4} + 5 + \dfrac{V_x}{4}$

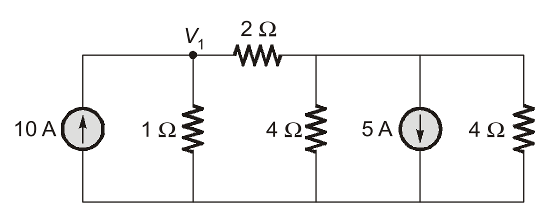
or, $\quad 2V_1 - 4V_x = 20 \quad \ldots(ii)$

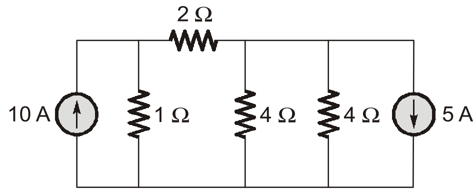
Solving equations (*i*) and (*ii*),

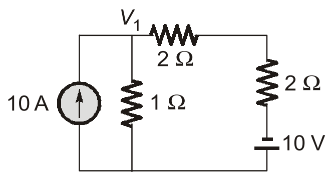
$$V_1 = 6 \text{ Volts}$$

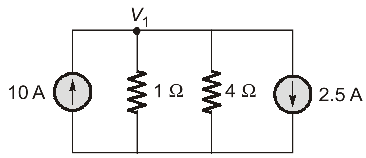
Shortcut:

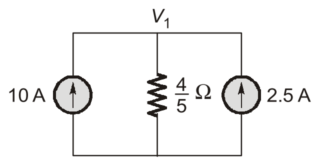
By source transformation techniques:



⇒ 



⇒ 

⇒ 

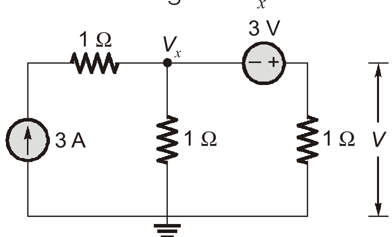
So, $V_1 = 7.5 \times \frac{4}{5} \text{ V} = 6 \text{ V}$

2. (b)

Capacitor opposes the sudden change in voltage. i.e. it opposes the *dv*/*dt* across it. It is used to maintain the voltage between two points.

3. (c)

Let the node voltage be V_x.



Applying KCL at the given node, we have:

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

or $V_x = 0 \text{ V}$

∴ $V_x + 3 = V$

or $V = 3 \text{ V}$

4. (c)

Since for a coil/inductor, the inductance

$$L = \frac{N^2}{\text{Reluctance}} = \frac{N^2}{l/\mu_0 A}$$

(for air core)

or, $L = \frac{\mu_0 N^2 A}{l}$ or $L \propto N^2$

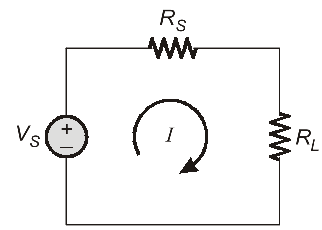
∴ $\frac{L_1}{L_2} = \left(\frac{N_1}{N_2}\right)^2$

∵ $\frac{L_1}{L_2} = \frac{0.6}{0.6} = 1 \Rightarrow \frac{N_1}{N_2} = 1$

5. (b)

At maximum power transfer condition, the load resistance = Source resistance

i.e., $R_L = R_S$ (in dc circuit)



From above circuit,

$$I = \frac{V_s}{R_s + R_L}$$

∴ Load power = $I^2 R_L$ = Output power

loss = $I^2 R_s$

∵ $\eta = \frac{\text{output}}{\text{input}} = \frac{\text{output}}{\text{output + loss}}$

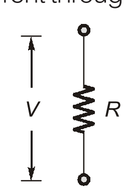
∴ $\eta = \frac{I^2 R_L}{I^2 R_L + I^2 R_s}$

∵ $R_L = R_s$

∴ $\eta = \frac{I^2 R_L}{2 I^2 R_L} = \frac{1}{2}$ or $\eta = 50\,\%$

6. (c)

From ohm's law, if we know the voltage across a resistor, then we can determine the current through resistor R as $I = \frac{V}{R}$.



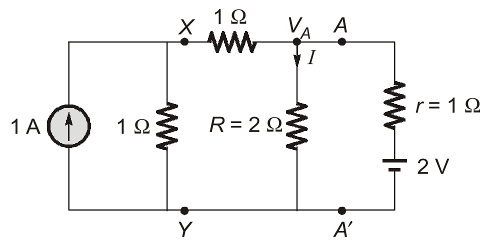
Here, $V = 5 \text{ V}$ (constant)

So, $I = \frac{5}{1} = 5 \text{ A}$

Note: The voltage across any current source is purely arbitrarily. The voltage across it depends purely upon the voltage source connected in parallel across it. Hence, in present case voltage across the current source = 5 V.

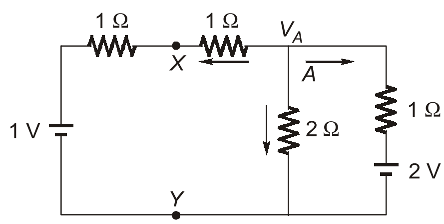
7. (d)

According to question,



Here, I is to be determined.

If we can find the value of V_A then $I = \frac{V_A}{R}$ A . Now converting current source to voltage source



Applying nodal analysis at node V_A.

$$\frac{V_A - 1}{2} + \frac{V_A}{2} + \frac{V_A - 2}{1} = 0$$

$\Rightarrow$ $2V_A = 2.5$

$\Rightarrow$ $V_A = 1.25$ V

or, $I = \frac{1.25}{2} = 0.625$ A

8. (a)

Ohm's law is $I = \frac{V}{R}$ or $I \propto V$.

$\therefore$ The relation between V & I is linear (If $1/R$ is a constant).

9. (b)

Specific resistance 'ρ' of a material is a property of that material which depends only upon temperature and the composition of material. However, the resistance depends on length, area, temperature.

Resistance, $R \propto \frac{l}{A}$

or, $R = \frac{\rho l}{A}$ (ρ = specific resistance)

where, 'ρ' is constant for constant temperature.

10. (c)

The inductance of a coil is

$$L = \frac{N^2 \mu_0 A}{l} \quad \text{(For air core)}$$

$\therefore$ $L \propto N^2$

or, $\frac{L_1}{L_2} = \frac{N_1^2}{N_2^2}$

$\therefore$ $\frac{N_1}{N_2} = \sqrt{\frac{L_1}{L_2}} = \sqrt{\frac{0.6}{0.6}} = 1$

11. (a)

Given: $P_1 = 100$ W, $V_1 = 220$ V

$P_2 = 100$ W, $V_2 = 110$ V

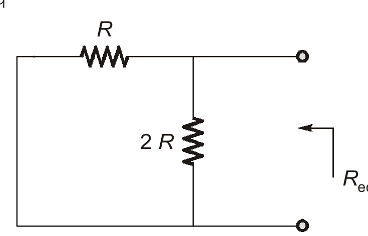
Now, $R_1 = \frac{V_1^2}{P_1} = \frac{(220)^2}{100} = 484\ \Omega$

Also, $R_2 = \frac{V_2^2}{P_2} = \frac{(110)^2}{100} = 121\ \Omega$

$\therefore$ $\frac{R_1}{R_2} = \frac{484}{121} = \frac{4}{1} = 4$

12. (d)

For finding R_{eq}, voltage source is short circuited and R_{eq} is found across 'C'.



$$R_{eq} = \frac{2R \times R}{3R} = \frac{2}{3}R$$

$\therefore$ T = Time constant = $R_{eq}\,C$

$= \frac{2}{3}RC$

13. (b)

The equivalent capacitance for parallel connection is equal to sum of the individual capacitance.

$\therefore$ $C_{eq} = C_1 + C_2 + C_3 + C_4$

$C_{eq} = 40\ \mu$F (for parallel connection)

Note: For series connection,

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \frac{1}{C_4}$$

14. (a)

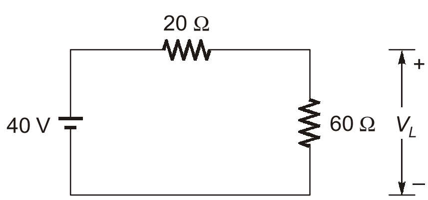
Maximum power transfer theorem is valid when the load resistance R_L is variable but here R_L is constant.

Then, for a constant resistance R_L , the power

$P = \frac{V_L^2}{R_L}$ will be maximum when V_L will be maximum (since R_L is constant).

Now, V_L will be maximum when R_g drop is minimum i.e. R_g is minimum.

So, $R_{g\,min} = 20\ \Omega$ if $20 \le R_g \le 80\ \Omega$



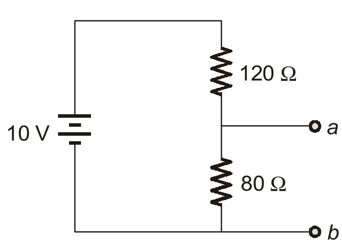
So, $V_L = \frac{40 \times 60}{80} = 30\ \text{V}$

$P_L = \frac{30 \times 30}{60} = 15\ \text{W}$

15. (a)

Magnetic properties		Electrical properties
MMF	≈	EMF
Flux	≈	Current
Permeance	≈	Conductance
Reluctance	≈	Resistance

16. (c)



$V_{Th} = V_{ab}$

= Open circuit voltage across *ab*

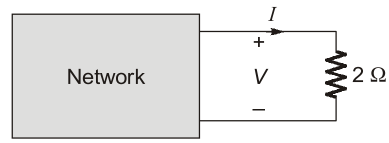
$= \frac{80}{200} \times 10\ \text{V} = 4\ \text{V}$

Also, $R_{Th} = 80\ \Omega \,||\, 120\ \Omega$

$= \frac{80 \times 120}{200} = 48\ \Omega$

(For finding R_{Th} 10 V voltage source short circuited)

17. (d)



$V = 4I - 9$ (given) ...(*i*)

Also, $V = 2I$ ..(*ii*)

From equation (*i*) and (*ii*), we have

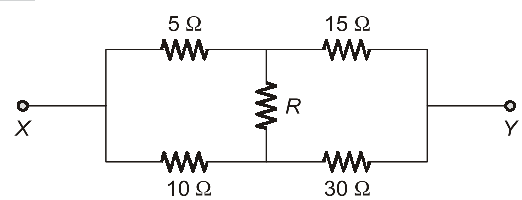
$2I = 4I - 9$

$\Rightarrow \quad I = 4.5\ \text{A}$

18. (c)

As the wires are of same material, therefore specific resistance of both the wires *A* and *B* will be same (Because specific resistance depends only on type of materials).

19. (c)



Above circuit is a balanced Wheatstone bridge, Hence, no current flows through the resistance *R* since arms ratio is constant.

i.e. $\frac{5}{10} = \frac{15}{30} = \frac{1}{2} = \text{constant}$

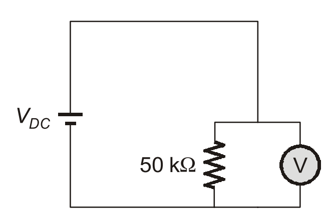
$\therefore \quad R_{xy} = (5 + 15) \,||\, (10 + 30) = 20 \,||\, 40$

$= \frac{20 \times 40}{20 + 40} = \frac{40}{3}\Omega$

20. (d)

Thevenin's theorem results in simplification of circuit containing a voltage source and an impedance connected in series.

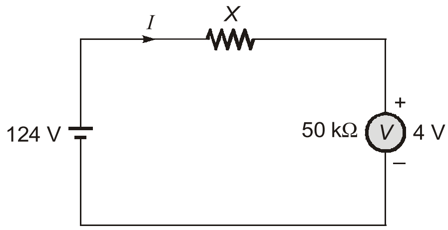
21. (d)



As voltmeter reads 124 V across DC supply.

Hence, $V_{DC} = 124\ \text{V}$

Now, a resistor is connected in series. Let the current through the circuit be 'I'.



Then, $124 - 4 = IX$

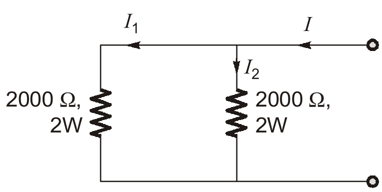
or, $120 = IX$ or $X = \dfrac{120}{I}$

Also, $I = \dfrac{4}{50\text{ k}}$

$\therefore$ $X = \dfrac{120 \times 50\text{ k}}{4}$

$\Rightarrow$ $X = 1500\text{ k}\Omega = 1.5\text{ M}\Omega$

22. (b)



Equivalent resistance,

$$R_{eq} = R_1 \,||\, R_2$$
$$= 2000 \,||\, 2000 = 1000\ \Omega$$

Also, $P_1 = 2\text{ W} = I_1^2 \,.\, 2000$

or, $I_1^2 = \dfrac{1}{1000}$

Since, applied voltage is same across both resistors, therefore

$$I_1 = \frac{1}{\sqrt{1000}}\text{ A} = I_2$$

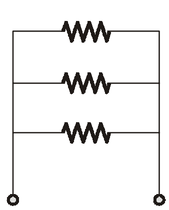
$\therefore$ $I = I_1 + I_2 = \dfrac{2}{\sqrt{1000}}\text{ A}$

$\therefore$ $P = I^2 . R_{eq} = \dfrac{4}{1000} \times 1000 = 4\text{ W}$

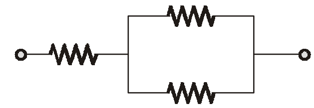
23. (d)

In eight ways, we can connect the given three resistances as shown below:

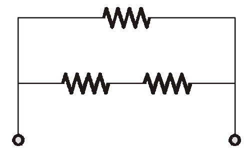
(All in series)



(All in parallel)



(It can have 3 combinations)



(It can have 3 combinations)

24. (b)

Given, $V = 250\text{ V}$

and power drawn,

$$P = 1000\text{ W} = \frac{(250)^2}{R}$$

or, $R = \dfrac{250 \times 250}{1000} = \dfrac{125}{2} = 62.5\,\Omega$

= Heater resistance

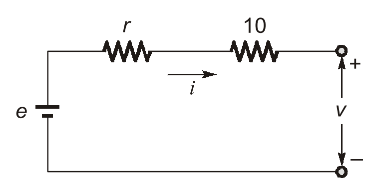
Now, $V = 200$ Volt

$\therefore$ Power drawn from 200 V voltage source

$$P = \frac{V^2}{R} = \frac{200 \times 200}{62.5} = 640\text{ W}$$

25. (d)

Let internal resistance of source is r.



Applying KVL, we get

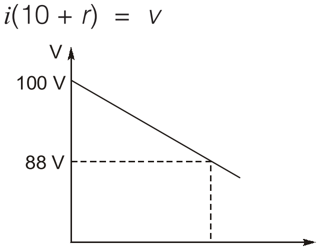
$e - i(10 + r) = v$ ...(*i*)

Now, from given curve when $i = 0$,

$e = v = 100\text{ V}$

Putting this value in equation (*i*), we have

$100 - i(10 + r) = v$ ...(*ii*)



From graph, $v - i$ relation is

$v = -24i + 100$ ...(*iii*)

From equation (*ii*) and (*iii*), we have

$24 = 10 + r$

or, $r = 14\ \Omega$

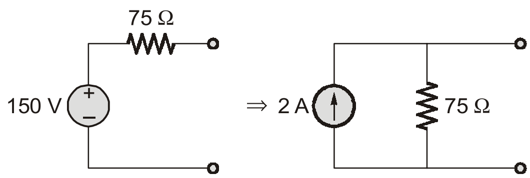
= Internal resistance of source 'e'

26. (c)

Given, $V_{OC} = 150$

$R_i = 75\ \Omega$

$$I_{SC} = \frac{V_{OC}}{R_i} = \frac{150}{75} = 2\text{ A}$$



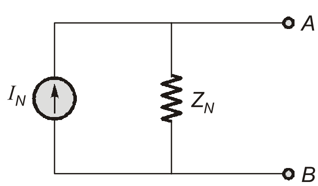
(Voltage source to current source transformation)

27. (b)

Superposition theorem requires as many circuits to be solved as there are sources.
It considers one source at a time and deactivates other sources.

28. (a)

Norton's theorem application in a circuit results in a current source and an impedance in parallel as shown below:



29. (a)

Value of Z_L for maximum power transfer is

$$Z_L = Z_S^*$$

Here, $Z_S = 30 + j40\ \Omega$

∴ $Z_L = 30 - j40\ \Omega$

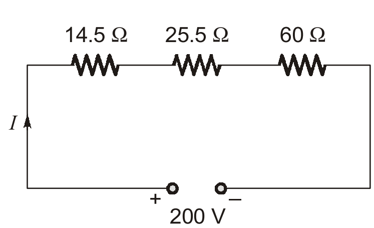
Hence, $|Z_L| = \sqrt{(30)^2 + (40)^2} = 50\Omega$

$$\text{Power factor} = \frac{R}{|Z_L|} = \frac{30}{50} = 0.6$$

As load reactance is capacitive in nature (negative imaginary part), therefore, power factor is leading.

Hence, $|Z_L| = 50\ \Omega$ at power factor of 0.6 lead.

30. (c)



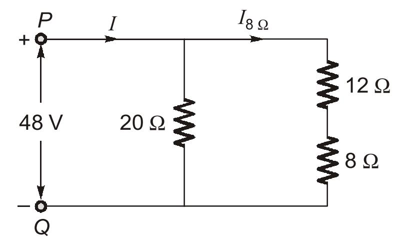
Current in the circuit is

$$I = \frac{V}{R} = \frac{200}{100} = 2\text{ A}$$

$$\therefore\ V_{14.5\,\Omega} = I \times R = 2 \times 14.5 = 29.0\text{ V}$$

31. (b)

The circuit can be redrawn as shown below:



As $V = 48$ V

and $R = 12 + 8 = 20\ \Omega$

$$\Rightarrow\ I_{8\,\Omega} = \frac{48}{20} = 2.4\text{ A}$$

32. (b)

When the supply is switched ON, the current drawn is more because more current is required during starting to create high voltage compared to that required by the ammeter in steady state.

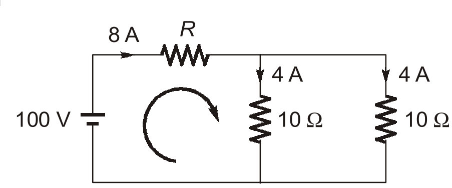
33. (a)

$$\frac{1}{R_{eq}} = \frac{1}{2} + \frac{1}{4} + \frac{1}{5} + \frac{1}{20}$$

or, $$\frac{1}{R_{eq}} = \frac{10+5+4+1}{20}$$

$$\Rightarrow\ R_{eq} = \frac{20}{20} = 1\ \Omega$$

34. (c)



Current in 10 Ω resistance = 4 A

and $V_{10\,\Omega} = 40$ V

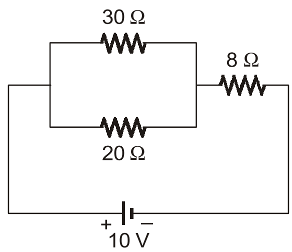
Applying KVL in I[st] loop, we have:

$100 - 8R - 40 = 0$

⇒ $8R = 60$

⇒ $R = 7.5\ \Omega$

35. (b)

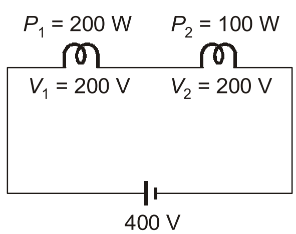


$$R_{eq} = (30 \,\|\, 20) + 8 = 20\ \Omega$$

∴ Power consumed,

$$P = \frac{V^2}{R_{eq}} = \frac{100}{20} = 5\ \text{W}$$

36. (a)



Here, $R_1 = \dfrac{V_1^2}{P_1} = \dfrac{200 \times 200}{200} = 200\ \Omega$

$$R_2 = \frac{V_2^2}{P_2} = \frac{200 \times 200}{100} = 400\ \Omega$$

In series connection current is same and power = I^2R

$$P_1 = I^2R_1$$

and $P_2 = I^2R_2$

As resistance of 2[nd] bulb (100 W, 200 V) is more hence it draws more power and glows brighter.

37. (b)

If 4 Ω is not disconnected,

$$R_{eq} = 6 + (4 \,\|\, 4) + 2 = 0\ \Omega$$

If one 4 Ω is disconnected,

$$R'_{eq} = 6 + 4 + 2 = 12\ \Omega$$

As equivalent resistance is increasing after disconnecting 4 Ω resistance, hence current decreases.

38. (b)

When, $V_S = 0,\ I = 3\text{ A} = I_1$

Now let, $I_S = 0$ and $V_S = 200$ V

Then, $I_2 = \dfrac{-200}{50} = -4$ A

Hence, current when both I_S and V_S are connected is

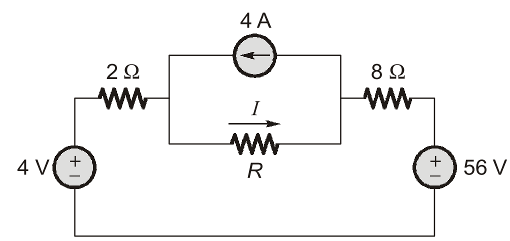
$$I = I_1 + I_2$$

(Using superposition theorem)

$$= 3 - 4$$
$$= -1\ \text{A}$$

39. (d)

Circuit can be redrawn as shown below.



Value of R is missing. So it can't be solved.

40. (b)

Given, $R_A = 600\ \Omega$; $R_B = 100\ \Omega$

Resistance, $R = \dfrac{\rho l}{A}$

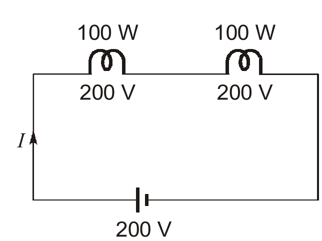
As ρ and A are same, therefore $R \propto l$.

$$\Rightarrow \quad \frac{R_A}{R_B} = \frac{l_A}{l_B}$$

$$\Rightarrow \quad \frac{l_A}{l_B} = 6$$

$$\Rightarrow \quad l_A = 6\, l_B$$

41. (b)



$$R_1 = \frac{V^2}{P} = \frac{200 \times 200}{100} = 400\ \Omega = R_2$$

$$\therefore \quad I = \frac{200}{800} = 0.25\ \text{A}$$

Hence, $P_1 = I^2R_1 = \left(\dfrac{1}{4}\right)^2 \times 400$

$$= \frac{1}{16} \times 400 = 25\ \text{W}$$

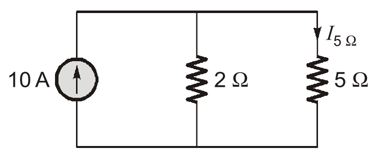
As $R_1 = R_2$ and current is same in series, therefore,

$$P_1 = P_2 = 25 \text{ W}$$

42. (b)

Terminal where three or more branches meet is known as node.

43. (d)

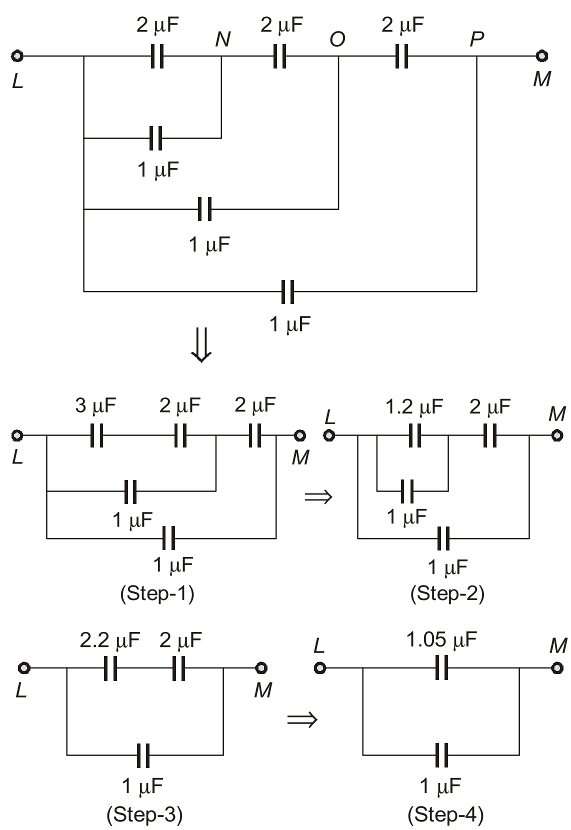


According to current division rule,

$$I_{5\,\Omega} = \frac{2}{7} \times 10 = 2.85 \text{ A}$$

44. (d)

We simplify the given figure as shown below:



Hence, C_{eq} across the points L and M is

$$C_{eq} = 1.05 + 1 = 2.05 \text{ μF}$$

45. (c)

Given, $L_1 = 9 \text{ H}; L_2 = 4 \text{ H}$

Mutual inductance,

$$M = K\sqrt{L_1 L_2} \text{ and } K = 1 \quad \text{(Given)}$$

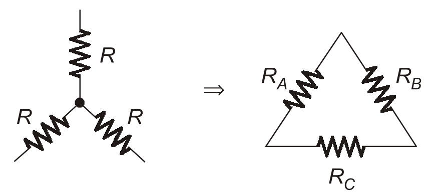
$$\Rightarrow \quad M = \sqrt{36} = 6 \text{ H}$$

46. (c)

According to voltage divider rule,

$$V_c = \frac{50}{100 + 50} \times 120 = 40 \text{ V}$$

47. (a)



Here, $R_A = R_B = R_C$

(Since all resistors are reequal in start connection)

$$\therefore \quad R_A = R_B = R_C$$

$$= \frac{R \times R + R \times R + R \times R}{R} = 3R$$

48. (d)

An ideal voltage source should have zero source resistance because no internal voltage drop must be present ideally.

49. (b)

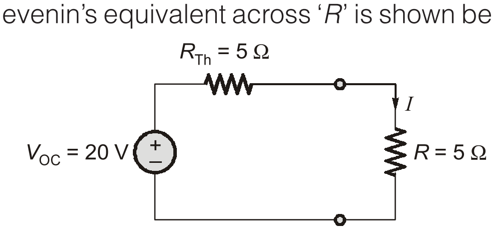
For $R = \infty;\ V = 20 \text{ V}$

$$\Rightarrow \quad V_{OC} = 20 \text{ V} = V_{Th}$$

Also, for $R = 0;\ I = 4 \text{ A} = I_{SC}$

$$\therefore \quad R_{Th} = \frac{V_{OC}}{I_{SC}} = \frac{20}{4} = 5\,\Omega$$

Thevenin's equivalent across 'R' is shown below.



Here, $I = \frac{20}{5 + 5} = 2 \text{ A}$

50. (b)

Maximum power will be transferred to R_L.

when, $R_L = R_{TH}$

R_{Th} across R_L is obtained by open circuiting the current source.