

# Current Electricity

## Question1

A uniform wire of diameter  $d$  carries a current of 100 mA when the mean drift velocity of electrons in the wire is  $v$ . For a wire of diameter  $d/2$  of the same material to carry a current of 200 mA, the mean drift velocity of electrons in the wire is

[NEET 2024 Re]

Options:

A.

$4v$

B.

$8v$

C.

$v$

D.

$2v$

**Answer: B**

**Solution:**

current  $i = nAv_d e$  ( $v_d$  = mean drift velocity )

$$= n \left( \frac{\pi D^2}{4} \right) v_d e$$

$$\therefore i \propto D^2 v_d$$

$$\frac{100}{200} = \frac{(d)^2}{\left(\frac{d}{2}\right)^2} \times \frac{v}{v'}$$

$$\Rightarrow v' = 2 \times 2^2 v = 8v$$

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## Question2

A uniform metal wire of length  $l$  has  $10\Omega$  resistance. Now this wire is stretched to a length  $2l$  and then bent to form a perfect circle. The equivalent resistance across any arbitrary diameter of that circle is

## [NEET 2024 Re]

**Options:**

A.

$10\Omega$

B.

$5\Omega$

C.

$40\Omega$

D.

$20\Omega$

**Answer: A**

**Solution:**

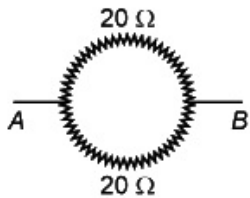
$$R_0 = 10\Omega$$

After stretching its length upto 21

$$R_1 = n^2 R_0$$

$$= 4R_0$$

$$= 40\Omega$$

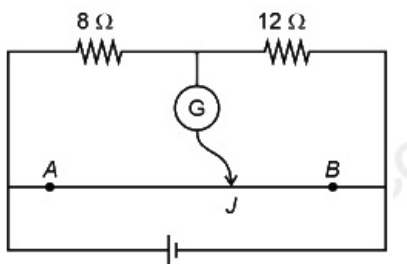


$$R_{AB} = \frac{20 \times 20}{20 + 20} = 10\Omega$$

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## Question3

The given circuit shows a uniform straight wire AB of 40 cm length fixed at both ends. In order to get zero reading in the galvanometer G, the free end of J is to be placed from B at:



## [NEET 2024 Re]

**Options:**

A.

32 cm

B.

8 cm

C.

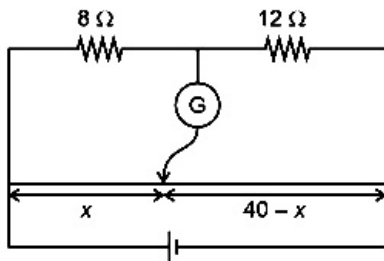
16 cm

D.

24 cm

**Answer: D**

**Solution:**



$$\frac{8}{x} = \frac{12}{40 - x}$$

$$\frac{2}{x} = \frac{3}{40 - x}$$

$$80 - 2x = 3x$$

$$16 = x$$

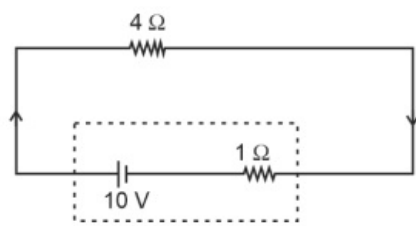
from B

$$= 40 - 16 = 24 \text{ cm}$$

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## Question4

**The terminal voltage of the battery, whose emf is 10V and internal resistance  $1\Omega$  , when connected through an external resistance of  $4\Omega$  as shown in the figure is:**



**[NEET 2024]**

**Options:**

A.

4V

B.

6V

C.

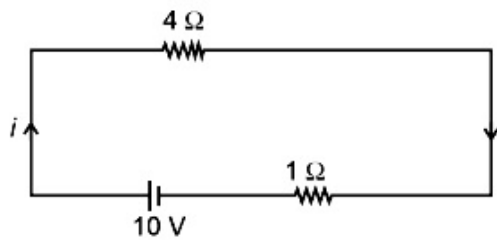
8V

D.

10V

**Answer: C**

**Solution:**



$$\text{Current in circuit } i = \frac{10}{4+1} = 2\text{A}$$

$$\text{Terminal voltage} = E - iR$$

$$= 10 - 2 \times 1 = 8\text{V}$$

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## Question5

**A wire of length 'l' and resistance  $100\Omega$  is divided into 10 equal parts. The first 5 parts are connected in series while the next 5 parts are connected in parallel. The two combinations are again connected in series. The resistance of this final combination is:**

**[NEET 2024]**

**Options:**

A.

$26\Omega$

B.

$52\Omega$

C.

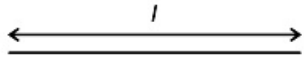
$55\Omega$

D.

$60\Omega$

**Answer: B**

**Solution:**



Divided into 10 parts

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

$$R' = \frac{\rho l}{10A} = \frac{R}{10}$$

$$R_s = 5 \times \frac{R}{10} \quad [\text{series}]$$

$$R_s = 50$$

$$R_p = \frac{R}{50} \quad [\text{parallel}]$$

$$R_{\text{eq}} = R_s + R_p$$

$$= 52\Omega$$

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## Question6

Two heaters A and B have power rating of 1 kW and 2 kW, respectively. Those two are first connected in series and then in parallel to a fixed power source. The ratio of power outputs for these two cases is:

**[NEET 2024]**

**Options:**

A.

1 : 1

B.

2 : 9

C.

1 : 2

D.

2 : 3

**Answer: B**

**Solution:**

$$\text{Power Consumed} = P = \frac{V^2}{R}$$

$$\frac{P_A}{P_B} = \frac{R_B}{R_A}$$

$$R_A = 2R_B$$

For Series Combination

$$P_s = \frac{V^2}{3R_B}$$

For Parallel Combination

$$P_P = \frac{3V^2}{2R_B}$$

$$\frac{P_s}{P_P} = \frac{2}{9}$$

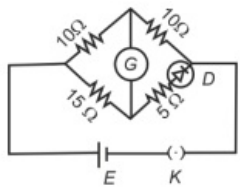
## Question7

**Choose the correct circuit which can achieve the bridge balance.**

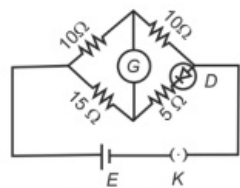
**[NEET 2024]**

**Options:**

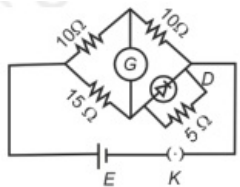
A.



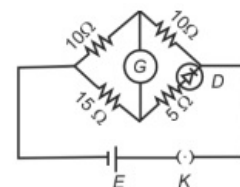
B.



C.



D.



**Answer: A**

### Solution:

In option (1),

$$\frac{10}{15} = \frac{10}{5 + R_D}$$

The diode can conduct and have resistance  $R_D = 10\Omega$  because diode have dynamic resistance. In that case bridge will be balanced.

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## Question8

**Resistance of a carbon resistor determined from colour codes is  $(22000 \pm 5\%)\Omega$ . The colour of third band must be**

**[NEET 2023]**

**Options:**

A.

Green

B.

Orange

C.

Yellow

D.

Red

**Answer: B**

### Solution:

$$\text{Sol. Resistance} = (22 \times 10^3)\Omega \pm 5\%$$

Third band corresponds to decimal multiplier.

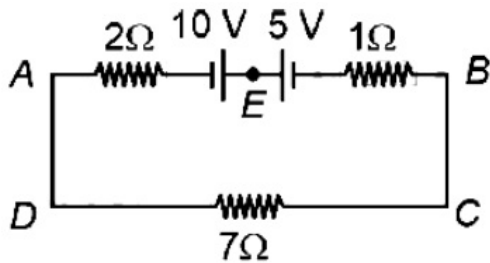
$$\text{Decimal multiplier} = 10^3$$

$\Rightarrow$  Colour  $\rightarrow$  Orange

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## Question9

**The magnitude and direction of the current in the following circuit is**



**[NEET 2023]**

**Options:**

- A.  
0.5A from A to B through E
- B.  
5/9 A from A to B through E
- C.  
1.5A from B to A through E
- D.  
0.2A from B to A through E

**Answer: A**

**Solution:**

Using Kirchhoff's law

$$i = \frac{10 - 5}{10} = \frac{5}{10}$$

$$i = 0.5\text{A}$$

In clock-wise direction (from *A* to *B* )

## Question10

**10 resistors, each of resistance R are connected in series to a battery of emf E and negligible internal resistance. Then those are connected in parallel to the same battery, the current is increased n times. The value of n is**

**[NEET 2023]**

**Options:**

- A.  
100
- B.



1

C.

1000

D.

10

**Answer: A**

**Solution:**

In series combination

$$R_{eq} = 10R$$

$$i = \frac{E}{10R}$$

In parallel combination

$$R_{eq} = \frac{R}{10}$$

$$i' = \frac{E}{\frac{R}{10}} = \frac{10E}{R}$$

$$i' = 10 \times 10i = 100i$$

$$n = 100$$

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## Question11

The resistance of platinum wire at 0°C is 2Ω and 6.8Ω at 80°C. The temperature coefficient of resistance of the wire is

**[NEET 2023]**

**Options:**

A.

$$3 \times 10^{-3}^{\circ}\text{C}^{-1}$$

B.

$$3 \times 10^{-2}^{\circ}\text{C}^{-1}$$

C.

$$3 \times 10^{-1}^{\circ}\text{C}^{-1}$$

D.

$$3 \times 10^{-4}^{\circ}\text{C}^{-1}$$

**Answer: B**

**Solution:**

Using  $R = R_0(1 + \alpha \Delta T)$

where  $\alpha$  is the thermal coefficient of resistance

$$6.8 = 2\{1 + \alpha(80 - 0)\}$$

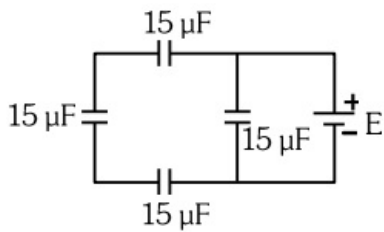
$$\frac{6.8}{2} - 1 = \alpha \times 80$$

$$\alpha = \frac{3.4 - 1}{80} = \frac{2.4}{80} = 0.03$$

$$\therefore \alpha = 3 \times 10^{-2} \text{ } ^\circ\text{C}^{-1}$$

## Question12

The equivalent capacitance of the arrangement shown in figure is :



[NEET 2023]

Options:

A.

30μF

B.

15μF

C.

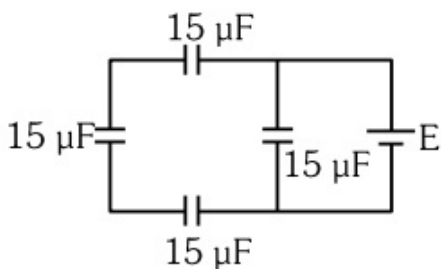
25μF

D.

20μF

**Answer: D**

**Solution:**



$$C_{eq} = 5 + 15 = 20\mu F$$

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## Question13

**A certain wire A has resistance  $81\Omega$ . The resistance of another wire B of same material and equal length but of diameter thrice the diameter of A will be :**

**[NEET 2023 mpr]**

**Options:**

A.

$81\Omega$

B.

$9\Omega$

C.

$729\Omega$

D.

$243\Omega$

**Answer: B**

**Solution:**

$R = \rho L/A$  If diameter becomes thrice then cross Section area will become 9 times so  $R \propto 1/A$  Resistance will become 1/9 times  $R' = 81\Omega/9 = 9\Omega$

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## Question14

**A copper wire of radius 1mm contains  $10^{22}$  free electrons per cubic metre. The drift velocity for free electrons when 10A current flows through the wire will be (Given, charge on electron  $= 1.6 \times 10^{-19}C$ ) :**

**[NEET 2023 mpr]**

**Options:**

A.

$$\frac{6.25 \times 10^4}{\pi} \text{ms}^{-1}$$

B.

$$\frac{6.25}{\pi} \times 10^3 \text{ms}^{-1}$$

C.

$$\frac{6.25}{\pi} \text{ms}^{-1}$$

D.

$$\frac{6.25 \times 10^5}{\pi} \text{ms}^{-1}$$

**Answer: B**

**Solution:**

$$I = neAV_d$$

$$V_d = \frac{I}{neA} = \frac{10}{10^{22} \times 1.6 \times 10^{-19} \times \pi \times 10^{-6}}$$

$$V_d = \frac{6.25}{\pi} \times 10^3 \text{m/sec}$$

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## Question15

**To produce an instantaneous displacement current of 2mA in the space between the parallel plates of a capacitor of capacitance 4μF, the rate of change of applied variable potential difference (dV/dt) must be :-**

**[NEET 2023 mpr]**

**Options:**

A.

$$800\text{V/ s}$$

B.

$$500\text{V/ s}$$

C.

$$200\text{V/ s}$$

D.

$$400\text{V/ s}$$

**Answer: B**

**Solution:**

$$Q = CV$$

$$\frac{dQ}{dt} = C \cdot \frac{dV}{dt} \Rightarrow \frac{dV}{dt} = \frac{I}{C} = \frac{2 \times 10^{-3}}{4 \times 10^{-6}}$$

$$= \frac{10^3}{2} = 500 \frac{V}{s}$$


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## Question16

The emf of a cell having internal resistance  $1\Omega$  is balanced against a length of 330cm on a potentiometer wire. When an external resistance of  $2\Omega$  is connected across the cell, the balancing length will be :

[NEET 2023 mpr]

Options:

A.

220cm

B.

330cm

C.

115cm

D.

332cm

**Answer: A**

**Solution:**

$$r = \left( \frac{\ell_o - \ell_c}{\ell_c} \right) R$$

$$1 = \left( \frac{330 - \ell_c}{\ell_c} \right) \times 2$$

$$3\ell_c = 660$$

$$\ell_c = 220 \text{ cm}$$


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## Question17

The reciprocal of resistance is:

[NEET Re-2022]

**Options:**

- A. conductance
- B. reactance
- C. mobility
- D. conductivity

**Answer: A**

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## Question18

**A cell of emf 4V and internal resistance  $0.5\Omega$  is connected to a  $7.5\Omega$  external resistance. The terminal potential difference of the cell is . [NEET Re-2022]**

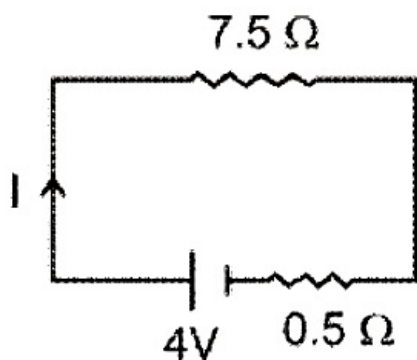
**Options:**

- A. 0.375V
- B. 3.75V
- C. 4.25V
- D. 4V

**Answer: B**

**Solution:**

**Solution:**



$$I = \frac{4}{7.5 + 0.5}$$

$$= 0.5\text{A}$$

$$\text{Terminal voltage} = E - ir$$

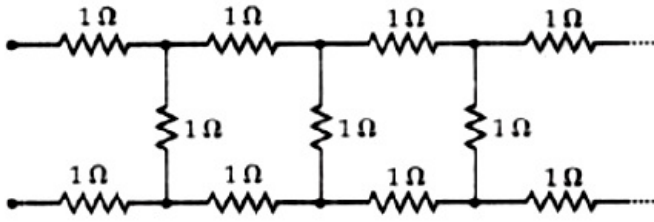
$$= 4 - 0.5 \times 0.5$$

$$= 3.75\text{V}$$


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## Question19

The equivalent resistance of the infinite network given below is:  
[NEET Re-2022]



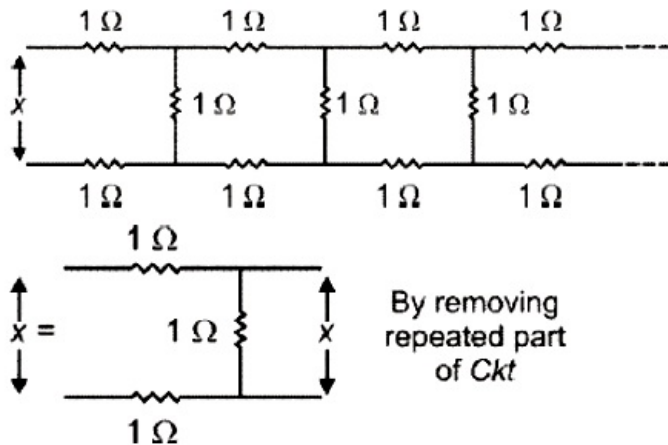
Options:

- A.  $(1 + \sqrt{5})\Omega$
- B.  $2\Omega$
- C.  $(1 + \sqrt{2})\Omega$
- D.  $(1 + \sqrt{3})\Omega$

**Answer: D**

**Solution:**

**Solution:**

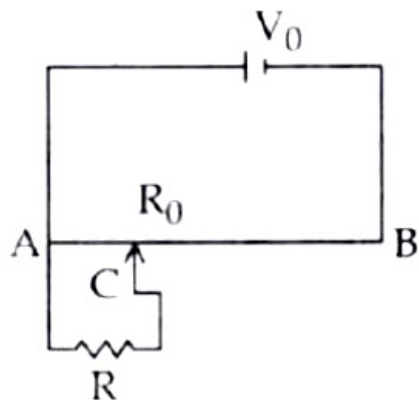


By removing  
repeated part  
of Ckt

$$\Rightarrow \frac{x \times 1}{x+1} + 2 = x \Rightarrow x^2 - 2x - 2 = 0 \Rightarrow x = \frac{2 \pm 2\sqrt{3}}{2} \Rightarrow x = 1 + \sqrt{3} \text{ (By neglecting -ve resistance)}$$

## Question20

The sliding contact C is at one fourth of the length of the potentiometer wire (AB) from A as shown in the circuit diagram. If the resistance of the wire AB is  $R_0$ , then the potential drop (V) across the resistor R is



**[NEET Re-2022]**

**Options:**

- A.  $\frac{2V_0R}{2R_0 + 3R}$
- B.  $\frac{4V_0R}{3R_0 + 16R}$
- C.  $\frac{4V_0R}{3R_0 + R}$
- D.  $\frac{2V_0R}{4R_0 + R}$

**Answer: B**

**Solution:**

**Solution:**

$$R_{eq} = \frac{\frac{R_0}{4} \times R}{\frac{R_0}{4} + R} + \frac{3R_0}{4} = \frac{R_0(16R + 3R_0)}{4(R_0 + 4R)}$$

$$\left( I = \frac{V}{R_{eq}} \right)$$

$$\therefore V_R = I \frac{\frac{R_0}{4} \times R}{\frac{R_0}{4} + R} = \left( \frac{4V_0R}{16R + 3R_0} \right)$$

## Question21

**As the temperature increases, the electrical resistance**  
**[NEET-2022]**

**Options:**

- A. Increases for both conductors and semiconductors
- B. Decreases for both conductors and semiconductors



C. Increases for conductors but decreases for semiconductors

D. Decreases for conductors but increases for semiconductors

**Answer: C**

**Solution:**

As the temperature increases the resistivity of the conductor increases hence the electrical resistance increases. However for semiconductor the resistivity decreases with the temperature. Hence electrical resistance of semiconductor decreases.

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## Question22

**Two resistors of resistance,  $100\Omega$  and  $200\Omega$  are connected in parallel in an electrical circuit. The ratio of the thermal energy developed in  $100\Omega$  to that in  $200\Omega$  in a given time is [NEET-2022]**

**Options:**

A. 1 : 2

B. 2 : 1

C. 1 : 4

D. 4 : 1

**Answer: B**

**Solution:**

For parallel combination

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

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

$$\Rightarrow \frac{P_1}{P_2} = \frac{200}{100} = \frac{2}{1}$$

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## Question23

**A copper wire of length 10m and radius  $\left( \frac{10^{-2}}{\sqrt{\pi}} \right)$  m has electrical resistance of  $10\Omega$ . The current density in the wire for an electric field strength of  $10(\text{V} / \text{m})$  is**

## [NEET-2022]

**Options:**

- A.  $10^4 \text{ A / m}^2$
- B.  $10^6 \text{ A / m}^2$
- C.  $10^{-5} \text{ A / m}^2$
- D.  $10^5 \text{ A / m}^2$

**Answer: D**

**Solution:**

**Solution:**

$$\text{Resistance, } R = \rho \frac{L}{A} = \frac{L}{\sigma A}$$

$$\Rightarrow \sigma = \frac{L}{RA}$$

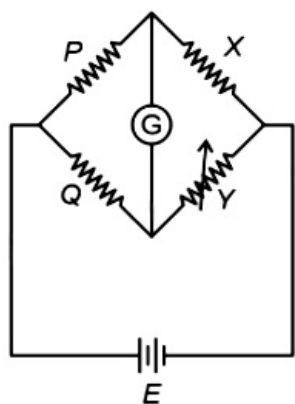
$$\text{Also current density } j = \sigma E = \frac{LE}{RA}$$

$$j = \frac{10 \times 10}{10 \times \pi \left( \frac{10^{-2}}{\sqrt{\pi}} \right)^2} = \frac{100}{10 \times \pi \times \left( \frac{10^{-4}}{\pi} \right)}$$
$$= 10^5 \text{ A / m}^2$$

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## Question24

**A wheat stone bridge is used to determine the value of unknown resistance X by adjusting the variable resistance Y as shown in the figure. For the most precise measurement of X, the resistances P and Q**



**[NEET-2022]**

**Options:**

- A. Should be approximately equal to  $2X$
- B. Should be approximately equal and are small
- C. Should be very large and unequal

D. Do not play any significant role

**Answer: B**

**Solution:**

We know, a wheat stone bridge is said to be most precise when it is most sensitive. This can be done by making ratio arms equal. Thus (2) is correct option.

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## Question25

**Column-I gives certain physical terms associated with flow of current through a metallic conductor.**

**Column-II gives some mathematical relations involving electrical quantities. Match Column-I and Column-II with appropriate relations.**

Column-I	Column-II
(A) Drift Velocity	(P) $\frac{m}{ne^2\rho}$
(B) Electrical Resistivity	(Q) $nev_d$
(C) Relaxation Period	(R) $\frac{eE}{m}\tau$
(D) Current Density	(S) $\frac{E}{J}$

**[NEET 2021]**

**Options:**

A. (A) - (R), (B) - (S), (C) - (P), (D) - (Q)

B. (A) - (R), (B) - (S), (C) - (Q), (D) - (P)

C. (A) - (R), (B) - (P), (C) - (S), (D) - (Q)

D. (A) - (R), (B) - (Q), (C) - (S), (D) - (P)

**Answer: A**

**Solution:**

Drift velocity,  $v_d = \frac{eE\tau}{m}$

Electrical resistivity,  $\rho = \frac{1}{\sigma} = \frac{E}{J}$

Relaxation period,  $\tau = \frac{m}{ne^2\rho}$

Current density,  $J = \frac{I}{A} = nev_d$

(A) - (R), (B) - (S), (C) - (P), (D) - (Q)

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## Question26

The effective resistance of a parallel connection that consists of four wires of equal length, equal area of cross-section and same material is  $0.25 \Omega$ . What will be the effective resistance if they are connected in series?

[NEET 2021]

Options:

A.  $0.25 \Omega$

B.  $0.5 \Omega$

C.  $1 \Omega$

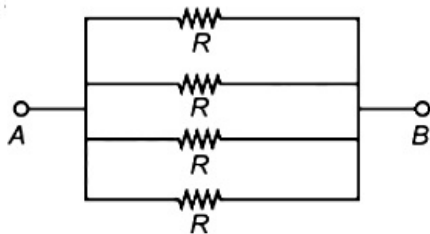
D.  $4 \Omega$

**Answer: D**

**Solution:**

**Solution:**

All the wires are identical and of same material so they will have same value of resistance. Let it be  $R$ . When these are (four) connected in parallel.



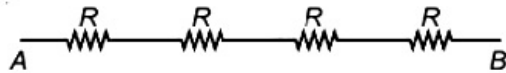
$$R_p = \frac{R}{4} \quad \left( \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} \right)$$

$$\text{Given } R_p = 0.25 \Omega$$

$$\therefore 0.25 = \frac{R}{4}$$

$$\therefore R = 1 \Omega$$

Now these four resistances are arranged in series



$$R_s = R + R + R + R = 4R$$

$$\therefore R_s = 4 \times 1 = 4 \Omega$$

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## Question27

In a potentiometer circuit a cell of EMF  $1.5 \text{ V}$  gives balance point at  $36 \text{ cm}$  length of wire. If another cell of EMF  $2.5 \text{ V}$  replaces the first cell, then at what length of the wire, the balance point occurs?

[NEET 2021]

**Options:**

- A. 60 cm
- B. 21.6 cm
- C. 64 cm
- D. 62 cm

**Answer: A**

**Solution:**

**Solution:**

From the application of potentiometer to compare two cells of emfs  $E_1$  and  $E_2$  by balancing lengths  $l_1$  and  $l_2$

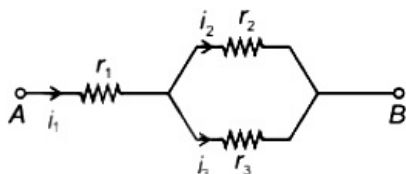
$$\frac{E_1}{E_2} = \frac{l_1}{l_2}$$

$$\Rightarrow l_2 = l_1 \left( \frac{E_2}{E_1} \right) = (36\text{cm}) \left( \frac{2.5\text{V}}{1.5\text{V}} \right)$$

$$= 60 \text{ cm}$$

## Question28

Three resistors having resistances  $r_1$ ,  $r_2$  and  $r_3$  are connected as shown in the given circuit. The ratio  $\frac{i_3}{i_1}$  of currents in terms of resistances used in the circuit is



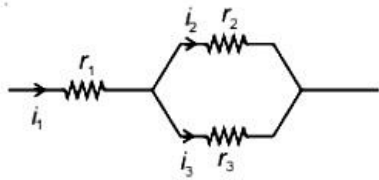
**[NEET 2021]**

**Options:**

- A.  $\frac{r_1}{r_2 + r_3}$
- B.  $\frac{r_2}{r_2 + r_3}$
- C.  $\frac{r_1}{r_1 + r_2}$
- D.  $\frac{r_2}{r_1 + r_3}$

**Answer: B**

**Solution:**



In parallel combination of resistances  $r_2$  and  $r_3$ , potential difference will be equal across both resistance.

$$\text{So, } i_2 r_2 = i_3 r_3 \Rightarrow i_2 = \frac{i_3 r_3}{r_2} \dots\dots(1)$$

As per Kirchhoff's first law

$$\Rightarrow i_1 = i_2 + i_3$$

$$\Rightarrow i_1 = \left( \frac{r_3}{r_2} + 1 \right) i_3 \text{ (from equation 1)}$$

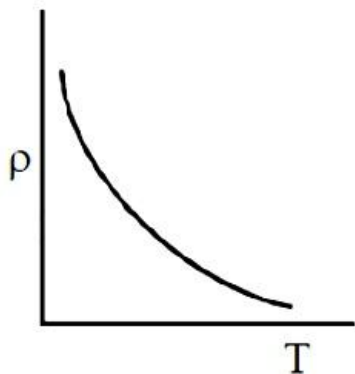
$$\Rightarrow \frac{i_3}{i_1} = \frac{r_2}{r_2 + r_3}$$

## Question29

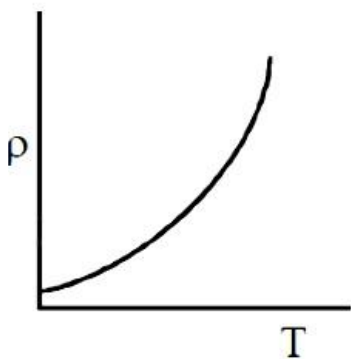
**Which of the following graph represents the variation of resistivity ( $\rho$ ) with temperature (T) for copper?  
(2020)**

**Options:**

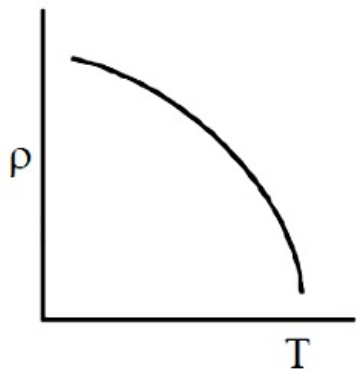
A.



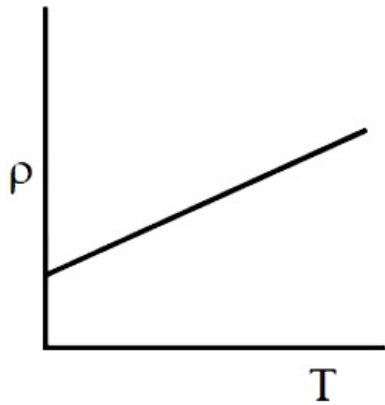
B.



C.



D.



**Answer: B**

**Solution:**

**Solution:**

(b) For metals like copper, at temperature much lower than  $0^\circ\text{C}$ , graph deviates considerably from a straight line.

## Question30

**The solids which have the negative temperature coefficient of resistance are:**

**[2020]**

**Options:**

- A. insulators only
- B. semiconductors only
- C. insulators and semiconductors
- D. metals

**Answer: C**

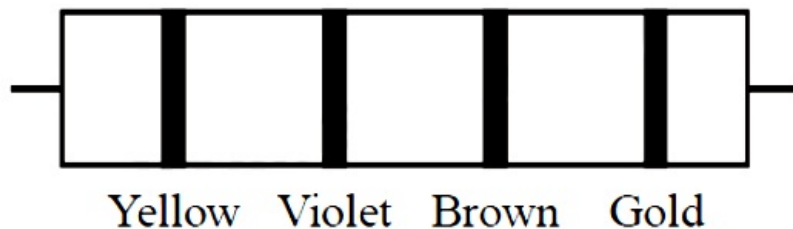
**Solution:**

(c) For metals temperature coefficient of resistance is positive while for insulators and semiconductors, temperature coefficient of resistance is negative.

---

## Question31

The color code of a resistance is given below Yellow Violet Brown Gold  
The values of resistance and tolerance, respectively, are



[2020]

Options:

- A. 47 k $\Omega$ , 10%
- B. 4.7 k $\Omega$ , 5%
- C. 470  $\Omega$ , 5%
- D. 470 k $\Omega$ , 5%

**Answer: C**

**Solution:**

**Solution:**

(c) According to colour coding -

Yellow -4

Violet-7

Brown-1

Gold-5%

First colour gives first digit, second colour gives the second digit and third colour gives the multiplier and fourth colour gives tolerance.

$\therefore$  Resistance

$$R = 47 \times 10^1 \pm 5\% = 470 \pm 5\% \Omega$$

---

## Question32

A charged particle having drift velocity of  $7.5 \times 10^{-4} \text{ ms}^{-1}$  in an electric field of  $3 \times 10^{-10} \text{ V m}^{-1}$ , has a mobility in  $\text{m}^2 \text{V}^{-1} \text{s}^{-1}$  of

[2020]

Options:

- A.  $2.5 \times 10^6$



B.  $2.5 \times 10^{-6}$

C.  $2.25 \times 10^{-15}$

D.  $2.25 \times 10^{15}$

**Answer: A**

**Solution:**

(a) Given, Drift velocity of charged particle,

$$V_d = 7.5 \times 10^{-4} \text{ m/s}$$

$$\text{Electric field, } E = 3 \times 10^{-10} \text{ V m}^{-1}$$

$$\text{Mobility, } \mu = \frac{V_d}{E} = \frac{7.5 \times 10^{-4}}{3 \times 10^{-10}} = 2.5 \times 10^6 \text{ m}^2 \text{ V}^{-1} \text{ s}^{-1}$$

## Question33

**A resistance wire connected in the left gap of a metre bridge balances a  $10\Omega$  resistance in the right gap at a point which divides the bridge wire in the ratio 3 : 2. If the length of the resistance wire is 1.5m, then the length of  $1\Omega$  of the resistance wire is:**  
[2020]

**Options:**

A.  $1.0 \times 10^{-1} \text{ m}$

B.  $1.5 \times 10^{-1} \text{ m}$

C.  $1.5 \times 10^{-2} \text{ m}$

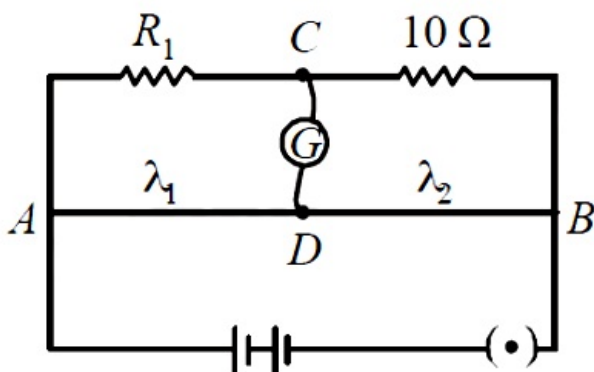
D.  $1.0 \times 10^{-2} \text{ m}$

**Answer: A**

**Solution:**

**Solution:**

Let  $R_1$  be the resistance of resistance wire.



From the balancing condition of metre bridge,

$$\frac{R_1}{10} = \frac{l_1}{l_2} = \frac{3}{2} \Rightarrow R_1 = \frac{30}{2} = 15\Omega$$

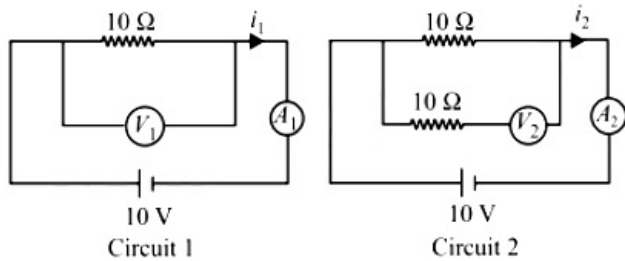
Length of  $15\Omega$  resistance wire is  $1.5\text{m}$ .

$\therefore$  Length of  $1\Omega$  resistance wire

$$= \frac{1.5}{15} = 0.1\text{m} = 1.0 \times 10^{-1}\text{m}$$

## Question 34

In the circuits shown below, the readings of the voltmeters and the ammeters will be



**(NEET 2019)**

**Options:**

A.  $V_2 > V_1$  and  $i_1 > i_2$

B.  $V_2 > V_1$  and  $i_1 = i_2$

C.  $V_1 = V_2$  and  $i_1 > i_2$

D.  $V_1 = V_2$  and  $i_1 = i_2$

**Answer: D**

**Solution:**

**Solution:**

Resistance for ideal voltmeter =  $\infty$

Resistance for ideal ammeter = 0

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

$$\frac{1}{R_{eq}} = \frac{1}{10} + \frac{1}{\infty}$$

$$\frac{1}{R_{eq}} = \frac{1}{10} + 0$$

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

$$i_1 = \frac{V}{R} = \frac{10}{10} = 1\text{A}$$

$$v_1 = 10\text{V}$$

In 2<sup>nd</sup> circuit

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

$$\frac{1}{R_{eq}} = \frac{1}{10} + \frac{1}{10 + \infty}$$

$$\frac{1}{R_{eq}} = \frac{1}{10} + 0$$

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

$$i_2 = \frac{10}{10} = 1\text{A}$$

$$v_2 = 10\text{V}$$

$$\therefore V_1 = V_2 \text{ and } i_1 = i_2$$

## Question35

Which of the following acts as a circuit protection device?  
(NEET 2019)

Options:

- A. fuse
- B. conductor
- C. inductor
- D. switch

Answer: A

Solution:

Solution:

Fuse is an electrical safety device that operates to provide overcurrent protection to an electrical circuit.

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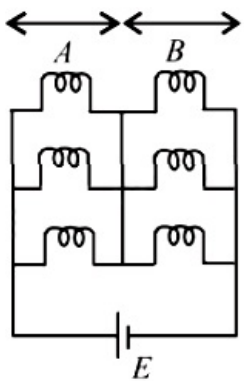
## Question36

Six similar bulbs are connected as shown in the figure with a DC source of emf  $E$ , and zero internal resistance.

The ratio of power consumption by the bulbs when

(i) all are glowing and

(ii) in the situation when two from section A and one from section B are glowing, will be



(NEET 2019)

Options:

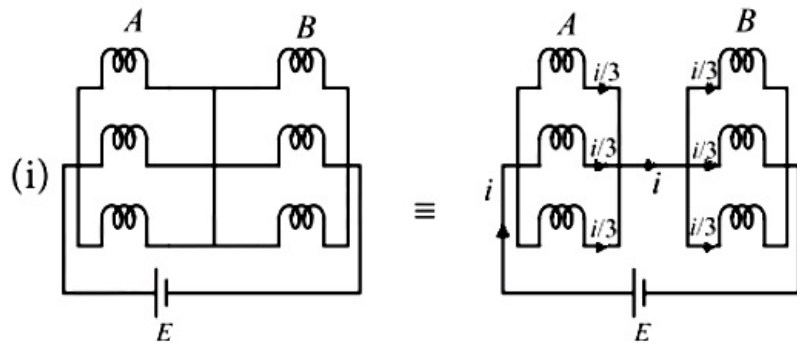
- A. 2: 1
- B. 4: 9
- C. 9: 4

D. 1: 2

**Answer: C**

**Solution:**

**Solution:**



(i) All bulbs are glowing

$$R_{\text{eq}} = \frac{R}{3} + \frac{R}{3} = \frac{2R}{3}$$

$$\text{Power } (P_i) = \frac{E^2}{R_{\text{eq}}} = \frac{3E^2}{2R} \dots (1)$$

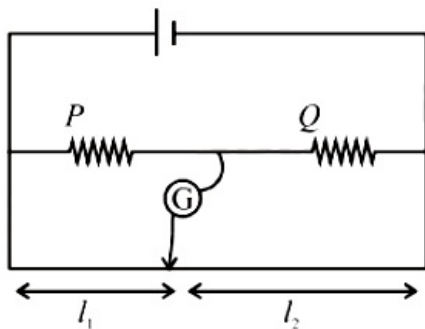
(ii) Two from section A and one from section B are glowing.

$$R_{\text{eq}} = \frac{R}{2} + R = \frac{3R}{2}$$

$$\text{Power } (P_f) = \frac{2E^2}{3R} \dots (2)$$

$$\Rightarrow \frac{P_i}{P_f} = \frac{3E^2 3R}{2R 2E^2} = 9 : 4$$

## Question37



The metre bridge shown is in balance position with  $\frac{P}{Q} = \frac{l_1}{l_2}$ . If we now interchange the positions of galvanometer and cell, will the bridge work? If yes, what will be balanced condition?  
(OD NEET 2019)

**Options:**

A. yes,  $\frac{P}{Q} = \frac{l_2 - l_1}{l_2 + l_1}$

B. no, no null point

C. yes,  $\frac{P}{Q} = \frac{l_2}{l_1}$

D. yes,  $\frac{P}{Q} = \frac{l_1}{l_2}$

**Answer: D**

**Solution:**

**Solution:**

Yes, the bridge will work. For a balanced condition, the current drawn from the battery will be zero. Also,  $P \propto l_1$  and  $Q \propto l_2$ . Therefore, the condition  $\frac{P}{Q} = \frac{l_1}{l_2}$  will remain same after interchanging the cell and galvanometer.

-----

## Question38

**A set of n equal resistors, of value R each, are connected in series to a battery of emf E and internal resistance R. The current drawn is I. Now, the n resistors are connected in parallel to the same battery. Then the current drawn from battery becomes 10I. The value of n is (NEET 2018)**

©

**Options:**

A. 10

B. 11

C. 20

D. 9

**Answer: A**

**Solution:**

**Solution:**

Current drawn from a battery when n resistors are connected in series is

$$I = \frac{E}{nR + R} \dots(i)$$

Current drawn from same battery when n resistors are connected in parallel is

$$10I = \frac{E}{\frac{R}{n} + R} \dots(ii)$$

$$\text{On dividing eqn.(ii) by (i), } 10 = \frac{(n + 1)R}{\left(\frac{1}{n} + 1\right)R}$$

After solving the equation,  $n = 10$ .

-----

## Question39

**A battery consists of a variable number n of identical cells (having internal resistance r each) which are connected in series. The terminals**

of the battery are short-circuited and the current  $I$  is measured. Which of the graphs shows the correct relationship between  $I$  and  $n$ ? (NEET 2018)

©

**Options:**

- A.
- B.
- C.
- D.

**Answer: A**

**Solution:**

Current drawn from the cell is

$$I = \frac{n\varepsilon}{nr} = \frac{\varepsilon}{r}$$

So,  $I$  is independent of  $n$  and  $I$  is constant.

---

## Question40

A carbon resistor of  $(47 \pm 4.7)\text{k}\Omega$  is to be marked with rings of different colours for its identification. The colour code sequence will be (NEET 2018)

©

**Options:**

- A. Violet - Yellow - Orange - Silver
- B. Yellow - Violet - Orange - Silver
- C. Yellow - Green - Violet - Gold
- D. Green - Orange - Violet - Gold

**Answer: B**

**Solution:**

**Solution:**

$$(47 \pm 4.7) \text{ k}\Omega = 47 \times 10^3 \pm 10\% \Omega$$

$\therefore$  Yellow - Violet - Orange - Silver

---

## Question41

**The resistance of a wire is 'R' ohm. If it is melted and stretched to 'n' times its original length, its new resistance will be (2017 NEET)**

©

**Options:**

A.  $\frac{R}{n}$

B.  $n^2R$

C.  $\frac{R}{n^2}$

D.  $nR$

**Answer: B**

**Solution:**

**Solution:**

The resistance of a wire of length  $l$  and area  $A$  and resistivity  $\rho$  is given as  $R = \frac{\rho l}{A}$

Given,  $l' = nl$

As the volume of the wire remains constant

$$\therefore Al' = Al; A' = \frac{Al}{l'} = \frac{Al}{nl} = \frac{A}{n}$$

$$\therefore R' = \frac{\rho l'}{A'} = \frac{n^2 \rho l}{A} = n^2 R$$

---

## Question42

**A potentiometer is an accurate and versatile device to make electrical measurements of EMF because the method involves (2017 NEET)**

©

**Options:**

A. potential gradients

B. a condition of no current flow through the galvanometer

C. a combination of cells, galvanometer and resistances

D. cells

**Answer: B**

**Solution:**

A potentiometer is an accurate and versatile device to make electrical measurements of emf because the method involves a condition of no current flow through the galvanometer, the device can be used to measure potential

difference, internal resistance of a cell and compare emfs of two sources.

---

## Question43

**A potentiometer wire is 100 cm long and a constant potential difference is maintained across it. Two cells are connected in series first to support one another and then in opposite direction. The balance points are obtained at 50 cm and 10 cm from the positive end of the wire in the two cases. The ratio of emf's is (2016 NEET Phase-1)**

©

**Options:**

- A. 3 : 4
- B. 3 : 2
- C. 5 : 1
- D. 5 : 4

**Answer: B**

**Solution:**

Suppose two cells have emfs  $\varepsilon_1$  and  $\varepsilon_2$  (also  $\varepsilon_1 > \varepsilon_2$  ).  
Potential difference per unit length of the potentiometer wire  
=k(say)  
When  $\varepsilon_1$  and  $\varepsilon_2$  are in series and support each other then  
 $\varepsilon_1 + \varepsilon_2 = 50 \times k \dots\dots(i)$   
When  $\varepsilon_1$  and  $\varepsilon_2$  are in opposite direction  
 $\varepsilon_1 - \varepsilon_2 = 10 \times k \dots\dots(ii)$   
On adding eqn. (i) and eqn. (ii)  
 $2\varepsilon_1 = 60k \Rightarrow \varepsilon_1 = 30k$  and  
 $\varepsilon_2 = 50k - 30k = 20k$   
 $\therefore \frac{\varepsilon_1}{\varepsilon_2} = \frac{30k}{20k} = \frac{3}{2}$

---

## Question44

**The charge flowing through a resistance R varies with time t as  $Q = at - bt^2$ , where a and b are positive constants. The total heat produced in R is (2016 NEET Phase-1)**

©

**Options:**



A.  $\frac{a^3 R}{2b}$

B.  $\frac{a^3 R}{b}$

C.  $\frac{a^3 R}{6b}$

D.  $\frac{a^3 R}{3b}$

**Answer: C**

**Solution:**

**Solution:**

Given,  $Q = at - bt^2$

$\therefore I = \frac{dQ}{dt} = a - 2bt$

At  $t = 0$ ,  $Q = 0 \Rightarrow I = 0$

Also,  $I = 0$  at  $t = \frac{a}{2b}$

$\therefore$  Total heat produced in resistance  $R$ ,

$$H = \int_0^{\frac{a}{2b}} I^2 R dt = R \int_0^{\frac{a}{2b}} (a - 2bt)^2 dt$$

$$= R \int_0^{\frac{a}{2b}} (a^2 + 4b^2 t^2 - 4abt) dt$$

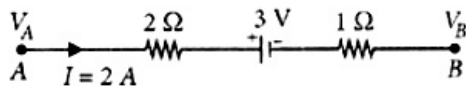
$$= R \left[ a^2 t + 4b^2 \frac{t^3}{3} - 4ab \frac{t^2}{2} \right]_0^{\frac{a}{2b}}$$

$$= R \left[ a^2 \times \frac{a}{2b} + \frac{4b^2}{3} \times \frac{a^3}{8b^3} - \frac{4ab}{2} \times \frac{a^2}{4b^2} \right]$$

$$= \frac{a^3 R}{b} \left[ \frac{1}{2} + \frac{1}{6} - \frac{1}{2} \right] = \frac{a^3 R}{6b}$$

## Question45

The potential difference ( $V_A - V_B$ ) between the points A and B in the given figure is  
(2016 NEET Phase-II)



**Options:**

A.  $-3 \text{ V}$

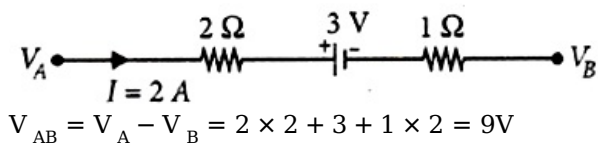
B.  $+3 \text{ V}$

C.  $+6 \text{ V}$

D.  $+9 \text{ V}$

**Answer: D**

**Solution:**



## Question46

**A filament bulb (500 W, 100 V) is to be used in a 230 V main supply. When a resistance R is connected in series, it works perfectly and the bulb consumes 500 W. The value of R is (2016 NEET Phase-II)**

**Options:**

- A. 230  $\Omega$
- B. 46  $\Omega$
- C. 26  $\Omega$
- D. 13  $\Omega$

**Answer: C**

**Solution:**

**Solution:**

$$\text{Resistance of bulb, } R_B = \frac{V^2}{P} = \frac{(100)^2}{500} = 20\Omega$$

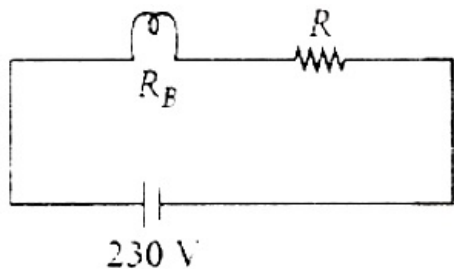
Power of the bulb in the circuit.

$$P = VI$$

$$I + \frac{P}{V_B} = \frac{500}{100} = 5A$$

$$V_R = IR \Rightarrow (230 - 100) = 5 \times R$$

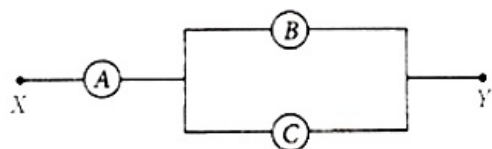
$$\therefore R = 26\Omega$$



## Question47

**A, B and C are voltmeters of resistance R, 1.5R and 3R respectively as shown in the figure. When some potential difference is applied between**

**X and Y, the voltmeter reading are  $V_A$ ,  $V_B$  and  $V_C$  respectively. Then**



**(2015)**

**Options:**

A.  $V_A = V_B \neq V_C$

B.  $V_A \neq V_B \neq V_C$

C.  $V_A = V_B = V_C$

D.  $V_A \neq V_B = V_C$

**Answer: C**

**Solution:**

**Solution:**

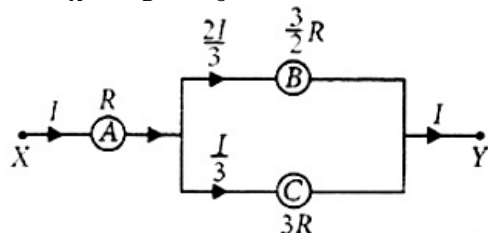
The current flowing in the different branches of circuit is indicated in the figure

$$V_A = IR$$

$$V_B = \frac{2I}{3} \times \frac{3}{2}R = IR$$

$$V_C = \frac{I}{3} \times 3R = IR$$

$$\text{Thus, } V_A = V_B = V_C$$



## Question48

**Across a metallic conductor of non-uniform cross section a constant potential difference is applied. The quantity which remains constant along the conductor is**

**(2015)**

**Options:**

A. drift velocity

B. electric field

C. current density

D. current

**Answer: D**

**Solution:**

**Solution:**

The area of cross section of conductor is non uniform so current density will be different but the flow of electrons will be uniform so current will be constant.

---

## Question49

**A potentiometer wire has length 4 m and resistance  $8\Omega$  The resistance that must be connected in series with the wire and an accumulator of e.m.f. 2 V, so as to get a potential gradient 1 mV per cm on the wire is (2015)**

**Options:**

A.  $44\ \Omega$

B.  $48\ \Omega$

C.  $32\ \Omega$

D.  $40\ \Omega$

**Answer: C**

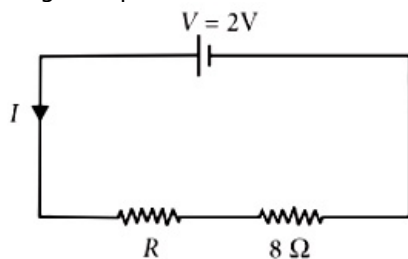
**Solution:**

**Solution:**

Required potential gradient =  $1\ \text{mV cm}^{-1}$

$$= \frac{1}{10}\ \text{V m}^{-1}$$

Length of potentiometer wire,  $l = 4\ \text{m}$



So potential difference across potentiometer wire =  $\frac{1}{10} \times 4 = 0.4\ \text{V} \dots(i)$

In the circuit, potential difference across  $8\Omega$

$$= I \times 8 = \frac{2}{8 + R} \times 8 \dots(ii)$$

Using equation (i) and (ii), we get,  $0.4 = \frac{2}{8 + R} \times 8$

$$\frac{4}{10} = \frac{16}{8 + R}, 8 + R = 40$$

$$\therefore R = 32\Omega$$

---

## Question50

**Two metal wires of identical dimensions are connected in series. If  $\sigma_1$  and  $\sigma_2$  are the conductivities of the metal wires respectively, the effective conductivity of the combination is (2015)**

**Options:**

A.  $\frac{\sigma_1 + \sigma_2}{\alpha_1 \sigma_2}$

B.  $\frac{\sigma_1 \sigma_2}{\alpha_1 + \sigma_2}$

C.  $\frac{2\sigma_1 \sigma_2}{\alpha_1 + \sigma_2}$

D.  $\frac{\sigma_1 + \sigma_2}{2\alpha_1 \sigma_2}$

**Answer: C**

**Solution:**

**Solution:**

As both metal wires are of identical dimensions, so their length and area of cross-section will be same. Let them be  $l$  and  $A$  respectively. Then

The resistance of the first wire is

$$R_1 = \frac{l}{\sigma_1 A} \dots \dots \dots (i)$$

and that of the second wire is



$$R_2 = \frac{l}{\sigma_2 A} \dots \dots \dots (ii)$$

As they are connected in series, so their effective resistance is  $R_s = R_1 + R_2$

$$= \frac{l}{\sigma_1 A} + \frac{l}{\sigma_2 A} \quad (\text{Using (i) and (ii)})$$

$$= \frac{l}{A} \left( \frac{1}{\sigma_1} + \frac{1}{\sigma_2} \right) \dots \dots \dots (iii)$$

If  $\sigma_{\text{eff}}$  is the effective conductivity of the combination, then

$$R_s = \frac{2l}{\sigma_{\text{eff}} A}$$

Equating eqns. (iii) and (iv), we get

$$\frac{2l}{\sigma_{\text{eff}} A} = \frac{l}{A} \left( \frac{1}{\sigma_1} + \frac{1}{\sigma_2} \right)$$

$$\Rightarrow \frac{2}{\sigma_{\text{eff}}} = \frac{\sigma_2 + \sigma_1}{\sigma_2 \sigma_1} \Rightarrow \sigma_{\text{eff}} = \frac{2\sigma_1 \sigma_2}{\sigma_1 + \sigma_2}$$

## Question51

**A circuit contains an ammeter, a battery of 30 V and a resistance 40.8 ohm all connected in series. If the ammeter has a coil of resistance 480 ohm and a shunt of 20 ohm, the reading in the ammeter will be (2015)**

**Options:**

- A. 2 A
- B. 1 A
- C. 0.5 A
- D. 0.25 A

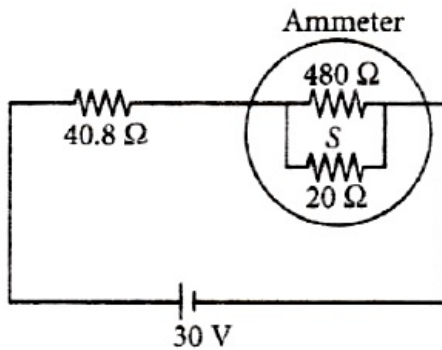
**Answer: C**

### Solution:

#### Solution:

The circuit is shown in the figure.

Resistance of the ammeter is



$$R_A = \frac{(480\Omega)(20\Omega)}{(480\Omega + 20\Omega)} = 19.2\Omega$$

(As 480 Ω and 20 Ω are in parallel)

As ammeter is in series with 40.8 Ω

∴ Total resistance of the circuit is

$$R = 40.8\Omega + R_A = 40.8\Omega + 19.2\Omega = 60\Omega$$

By Ohm's law,

Current in the circuit is

$$I = \frac{V}{R} = \frac{30V}{60\Omega} = \frac{1}{2}A = 0.5A$$

Thus the reading in the ammeter will be 0.5 A.

## Question52

**A potentiometer wire of length L and a resistance r are connected in series with a battery of e.m.f  $E_0$  and a resistance  $r_1$ . An unknown e.m.f. E is balanced at a length l of the potentiometer wire. The e.m.f. E will be given by (2015)**

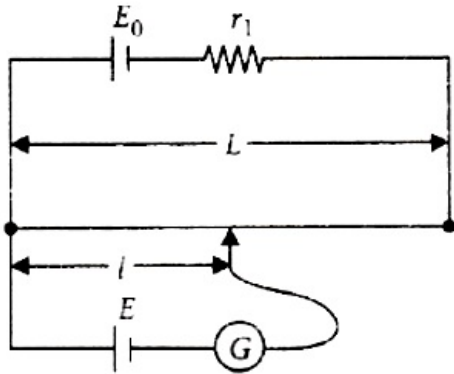
**Options:**

- A.  $\frac{E_0 l}{L}$
- B.  $\frac{LE_0 r}{(r + r_1)l}$
- C.  $\frac{LE_0 r}{lr_1}$
- D.  $\frac{E_0 r}{(r_1 + r_2)} \cdot \frac{1}{L}$

**Answer: D**

**Solution:**

**Solution:**



The current through the potentiometer wire is

$$I = \frac{E_0}{(r + r_1)}$$

and the potential difference across the wire is

$$V = I r = \frac{E_0 r}{(r + r_1)}$$

The potential gradient along the potentiometer wire is

$$k = \frac{V}{L} = E_0 \frac{r}{(r + r_1)L}$$

As the unknown e.m.f.  $E$  is balanced against length  $l$  of the potentiometer wire,

$$\therefore E = kl = \frac{E_0 r}{(r + r_1)L} l$$

---

## Question53

**Two cities are 150 km apart. Electric power is sent from one city to another city through copper wires. The fall of potential per km is 8 volt and the average resistance per km is  $0.5 \Omega$ .The power loss in the wire is (2014)**

**Options:**

- A. 19.2 W
- B. 19.2 kW
- C. 12.2 W
- D. 12.2 kW

**Answer: B**

**Solution:**

**Solution:**

Here,

Distance between two cities = 150km

Resistance of the wire,  $R = (0.5\Omega\text{km}^{-1})(150\text{km}) = 75\Omega$

Voltage drop across the wire,

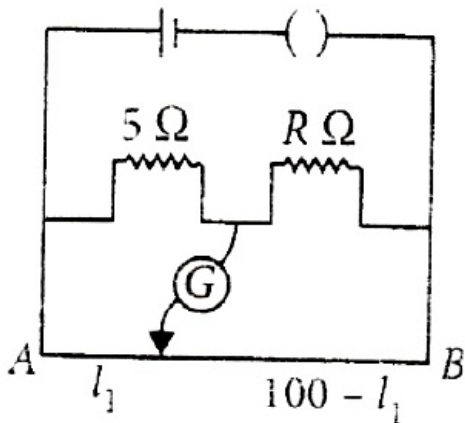
$$V = (8\text{V km}^{-1})(150\text{km}) = 1200\text{V}$$

Power loss in the wire is

$$P = \frac{V^2}{R} = \frac{(1200\text{V})^2}{75\Omega} = 19200\text{W} = 19.2\text{kW}$$

## Question54

The resistances in the two arms of the meter bridge are  $5\ \Omega$  and  $R\ \Omega$  respectively. When the resistance  $R$  is shunted with an equal resistance, the new balance point is at  $1.6l_1$ . The resistance  $R$  is (2014)



**Options:**

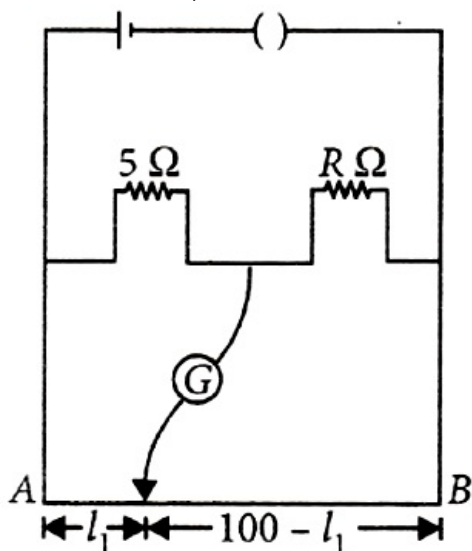
- A.  $10\ \Omega$
- B.  $15\ \Omega$
- C.  $20\ \Omega$
- D.  $25\ \Omega$

**Answer: B**

**Solution:**

**Solution:**

In the first case,

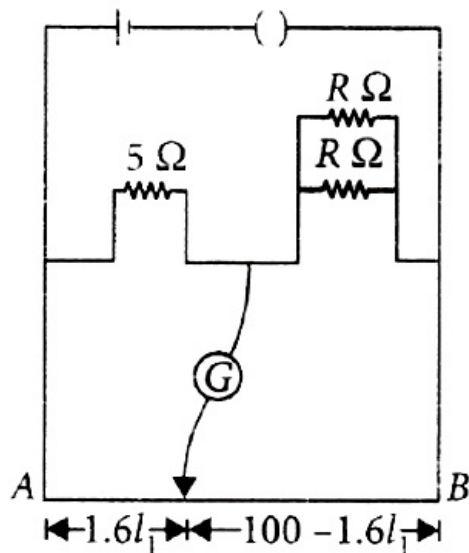


At balance point



$$\frac{5}{R} = \frac{l_1}{100 - l_1}$$

In the second case,



At balance point

$$\frac{5}{\left(\frac{R}{2}\right)} = \frac{1.6l_1}{100 - 1.6l_1}$$

Divide eqn. (i) by eqn. (ii), we get

$$\frac{1}{2} = \frac{100 - 1.6l_1}{1.6(100 - l_1)}$$

$$160 - 1.6l_1 = 200 - 3.2l_1$$

$$1.6l_1 = 40 \text{ or } l_1 = \frac{40}{1.6} = 25\text{cm}$$

Substituting this value in eqn. (i), we get

$$\frac{5}{R} = \frac{25}{75}$$

$$R = \frac{375}{25} \Omega = 15\Omega$$

## Question 55

A potentiometer circuit has been set up for finding the internal resistance of a given cell. The main battery, used across the potentiometer wire, has an emf of 2.0 V and a negligible internal resistance. The potentiometer wire itself is 4 m long. When the resistance R, connected across the given cell, has values of

(i) infinity                      (ii) 9.5  $\Omega$

the balancing lengths on the potentiometer wire are found to be 3 m and 2.85 m, respectively. The value of internal resistance of the cell is (2014)

Options:

- A. 0.25
- B. 0.95  $\Omega$
- C. 0.5  $\Omega$
- D. 0.75  $\Omega$

**Answer: C**

**Solution:**

**Solution:**

The internal resistance of the cell is

$$r = \left( \frac{l_1}{l_2} - 1 \right) R$$

Here,  $l_1 = 3\text{m}$ ,  $l_2 = 2.85\text{m}$ ,  $R = 9.5\Omega$

$$\therefore r = \left( \frac{3}{2.85} - 1 \right) (9.5\Omega) = \frac{0.15}{2.85} \times 9.5\Omega = 0.5\Omega$$

## Question56

The resistances of the four arms P, Q, R and S in a Wheatstone's bridge are 10 ohm, 30 ohm, 30 ohm and 90 ohm, respectively. The e.m .f. and internal resistance of the cell are 7 volt and 5 ohm respectively. If the galvanometer resistance is 50 ohm, the current drawn from the cell will be  
(2013 NEET)

**Options:**

A. 0.1 A

B. 2.0 A

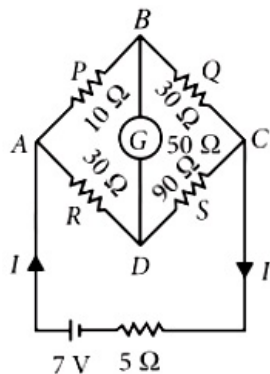
C. 1.0 A

D. 0.2 A

**Answer: D**

**Solution:**

**Solution:**



The situation is as shown in the figure. For a balanced Wheatstone's bridge

$$\frac{P}{Q} = \frac{R}{S}$$

$$\therefore \frac{10\Omega}{30\Omega} = \frac{30\Omega}{90\Omega} \text{ or } \frac{1}{3} = \frac{1}{3}$$

It is a balanced Wheatstone's bridge. Hence no current flows in the galvanometer arm. Hence, resistance  $50\Omega$  becomes ineffective.

$\therefore$  The equivalent resistance of the circuit is

$$R_{eq} = 5\Omega + \frac{(10\Omega + 30\Omega)(30\Omega + 90\Omega)}{(10\Omega + 30\Omega) + (30\Omega + 90\Omega)}$$

$$= 5\Omega + \frac{(40\Omega)(120\Omega)}{40\Omega + 120\Omega} = 5\Omega + 30\Omega = 35\Omega$$

$$\text{Current drawn from the cell is } I = \frac{7V}{35\Omega} = \frac{1}{5} A = 0.2 A$$

## Question 57

The internal resistance of a 2.1 V cell which gives a current of 0.2 A through a resistance of  $10\Omega$  is (2013 NEET)

Options:

A.  $0.8\Omega$

B.  $1.0\Omega$

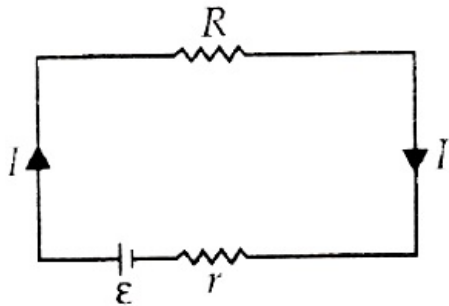
C.  $0.2$

D.  $0.5\Omega$

**Answer: D**

**Solution:**

**Solution:**



$$I = \frac{\varepsilon}{R + r}$$

$$\text{or } IR + Ir = \varepsilon$$

$$\text{Here, } R = 10\Omega, r = ?$$

$$\varepsilon = 2.1V, I = 0.2A$$

$$\therefore 0.2 \times 10 + 0.2 \times r = 2.1$$

$$2 + 0.2r = 2.1$$

$$0.2r = 0.1 \text{ or } r = \frac{1}{2} = 0.5\Omega$$

## Question 58

A wire of resistance  $4\Omega$  is stretched to twice its original length. The resistance of stretched wire would be (2013 NEET)

Options:

A.  $8\Omega$

- B.  $16\ \Omega$
- C.  $2\ \Omega$
- D.  $4\ \Omega$

**Answer: B**

**Solution:**

Resistance of a wire,  $R = \rho \frac{l}{A} = 4\ \Omega$ .....(i)

When wire is stretched twice, its new length be  $l'$ . Then  $l' = 2l$

On stretching volume of the wire remains constant.

$\therefore lA = l'A'$  where  $A'$  is the new cross-sectional area

$$\text{or } A' = \frac{l}{l'} = A = \frac{1}{2l}A = \frac{A}{2}$$

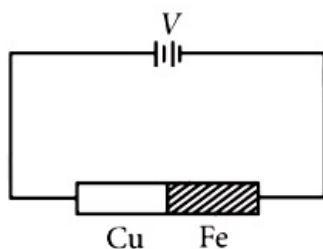
$\therefore$  Resistance of a stretched wire is

$$R' = \rho \frac{l'}{A'} = \rho \frac{2l}{\left(\frac{A}{2}\right)} = 4\rho \frac{l}{A}$$

$$4(4\ \Omega) = 16\ \Omega \quad (\text{Using (i)})$$

## Question59

**Two rods are joined end to end, as shown.**



**Both have a cross-sectional area of  $0.01\text{cm}^2$  Each is 1 meter long. One rod is of copper with a resistivity of  $1.7 \times 10^{-6}$  ohm-centimeter, the other is of iron with a resistivity of  $10^{-5}$  ohm-centimeter. How much voltage is required to produce a current of 1 ampere in the rods? (KN NEET 2013)**

**Options:**

- A. 0.00145V
- B. 0.0145V
- C.  $1.7 \times 10^{-6}\text{V}$
- D. 0.117V

**Answer: D**

**Solution:**

Here, Length of each rod,  $l = 1\text{ m}$

Area of cross-section of each rod,

$$A = 0.01 \text{ cm}^2 = 0.01 \times 10^{-4} \text{ m}^2$$

Resistivity of copper rod,

$$\rho_{\text{Cu}} = 1.7 \times 10^{-6} \Omega \text{cm} = 1.7 \times 10^{-6} \times 10^{-2} \Omega \text{m}$$

$$= 1.7 \times 10^{-8} \Omega \text{m}$$

Resistivity of iron rod,

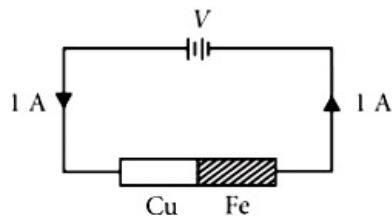
$$\rho_{\text{Fe}} = 10^{-5} \Omega \text{cm} = 10^{-5} \times 10^{-2} \Omega \text{m} = 10^{-7} \Omega \text{m}$$

$\therefore$  Resistance of copper rod,

$$R_{\text{Cu}} = \rho_{\text{Cu}} \frac{1}{A}$$

and resistance of iron rod,

$$R_{\text{Fe}} = \rho_{\text{Fe}} \frac{1}{A}$$



As copper and iron rods are connected in series, therefore equivalent resistance is

$$R = R_{\text{Cu}} + R_{\text{Fe}} = \rho_{\text{Cu}} \frac{1}{A} + \rho_{\text{Fe}} \frac{1}{A}$$

$$= (\rho_{\text{Cu}} + \rho_{\text{Fe}}) \frac{1}{A}$$

Voltage required to produce 1 A current in the rods is

$$V = IR = (1)(R_{\text{Cu}} + R_{\text{Fe}})$$

$$= (\rho_{\text{Cu}} + \rho_{\text{Fe}}) \left( \frac{1}{A} \right)$$

$$= (1.7 \times 10^{-8} + 10^{-7}) \left( \frac{1}{0.01 \times 10^{-4}} \right) \text{V}$$

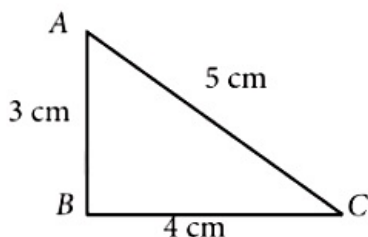
$$= 10^{-7} (0.17 + 1) (10^6) \text{V} = 1.17 \times 10^{-1} \text{V}$$

$$= 0.117 \text{ V}$$

---

## Question60

A 12 cm wire is given a shape of a right angled triangle ABC having sides 3cm, 4cm and 5cm as shown in the figure.



The resistance between two ends (AB, BC, CA) of the respective sides are measured one by one by a multimeter. The resistances will be in the ratio

(KN NEET 2013)

Options:

A. 9: 16: 25

B. 27: 32: 35

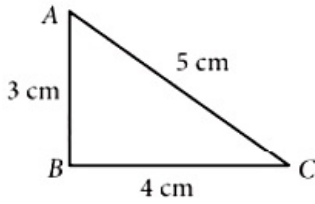
C. 21: 24: 25

D. 3: 4: 5

**Answer: B**

## Solution:

### Solution:



Let  $\rho$  and  $A$  be resistivity and area of cross-section of the wire respectively. The wire is bent in the form of right triangle as shown in figure.

$$\text{Resistance of side AB is } R_1 = \frac{3\rho}{A}$$

$$\text{Resistance of side BC is } R_2 = \frac{4\rho}{A}$$

$$\text{Resistance of side AC is } R_3 = \frac{5\rho}{A}$$

$\therefore$  The resistance between the ends A and B is

$$R_{AB} = \frac{R_1(R_2 + R_3)}{R_1 + R_2 + R_3} = \frac{\frac{3\rho}{A} \left( \frac{4\rho}{A} + \frac{5\rho}{A} \right)}{\frac{3\rho}{A} + \left( \frac{4\rho}{A} + \frac{5\rho}{A} \right)} = \frac{27\rho}{12A}$$

The resistance between the ends B and C is

$$R_{BC} = \frac{R_2(R_1 + R_3)}{R_2 + R_1 + R_3} = \frac{\frac{4\rho}{A} \left( \frac{3\rho}{A} + \frac{5\rho}{A} \right)}{\frac{4\rho}{A} + \frac{3\rho}{A} + \frac{5\rho}{A}} = \frac{32\rho}{12A}$$

The resistance between the ends A and C is

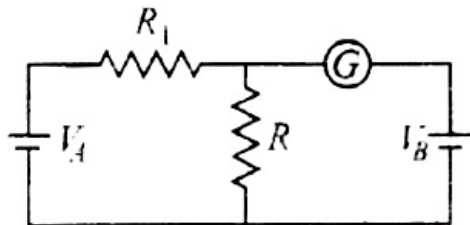
$$R_{AC} = \frac{R_3(R_1 + R_2)}{R_3 + R_1 + R_2} = \frac{\frac{5\rho}{A} \left( \frac{3\rho}{A} + \frac{4\rho}{A} \right)}{\frac{5\rho}{A} + \frac{3\rho}{A} + \frac{4\rho}{A}} = \frac{35\rho}{12A}$$

$$\therefore R_{AB} : R_{BC} : R_{AC} = \frac{27}{12} : \frac{32}{12} : \frac{35}{12} = 27 : 32 : 35$$

---

## Question61

In the circuit shown, the cells A and B have negligible resistances. For  $V_A = 12\text{V}$ ,  $R_1 = 500\Omega$  and  $R = 100\Omega$ , the galvanometer (G) shows no deflection. The value of  $V_B$  is (2012)



### Options:

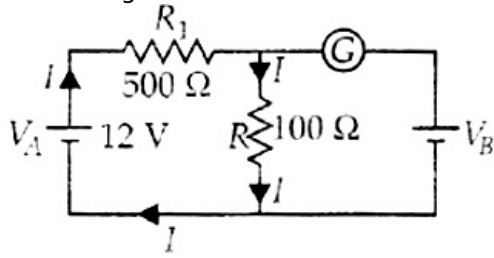
- A. 4 V
- B. 2 V
- C. 12 V
- D. 6v

**Answer: B**

**Solution:**

**Solution:**

Since the galvanometer shows no deflection so current will flow as shown in the figure.



$$\text{Current, } I = \frac{V_A}{R_1 + R} = \frac{12\text{V}}{(500 + 100)\Omega} = \frac{12}{600}\text{A}$$

$$V_B = I R = \left(\frac{12}{600}\text{A}\right)(100\Omega) = 2\text{V}$$

---

## Question62

**If voltage across a bulb rated 220 volt-100 watt drops by 2.5% of its rated value, the percentage of the rated value by which the power would decrease is (2012)**

**Options:**

- A. 20%
- B. 2.5%
- C. 5%
- D. 10%

**Answer: C**

**Solution:**

**Solution:**

$$\text{Power, } P = \frac{V^2}{R}$$

As the resistance of the bulb is constant

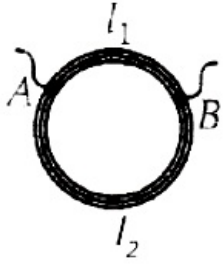
$$\therefore \frac{\Delta P}{P} = \frac{2\Delta V}{V}$$

$$\begin{aligned}\% \text{ decrease in power} &= \frac{\Delta P}{P} \times 100 = \frac{2\Delta V}{V} \times 100 \\ &= 2 \times 2.5\% = 5\%\end{aligned}$$

---

## Question63

**A ring is made of a wire having a resistance  $R_0 = 12\Omega$ . Find the points A and B, as shown in the figure, at which a current carrying conductor should be connected so that the resistance R of the sub circuit between these points is equal to  $\frac{8}{3}\Omega$  (2012)**



**Options:**

A.  $\frac{l_1}{l_2} = \frac{5}{8}$

B.  $\frac{l_1}{l_2} = \frac{1}{3}$

C.  $\frac{l_1}{l_2} = \frac{3}{8}$

D.  $\frac{l_1}{l_2} = \frac{1}{2}$

**Answer: D**

**Solution:**

**Solution:**

Let x be resistance per unit length of the wire. Then,

the resistance of the upper portion is,  $R_1 = xl_1$

the resistance of the lower portion is,  $R_2 = xl_2$

Equivalent resistance between A and B is

$$R = \frac{R_1 R_2}{R_1 + R_2} = \frac{(xl_1)(xl_2)}{xl_1 + xl_2}$$

$$\frac{8}{3} = \frac{xl_1 l_2}{l_1 + l_2} \text{ or } \frac{8}{3} = \frac{xl_1 l_2}{l_2 \left( \frac{l_1}{l_2} + 1 \right)} \text{ or } \frac{8}{3} = \frac{xl_1}{\left( \frac{l_1}{l_2} + 1 \right)} \dots\dots(i)$$

(i) Also  $R_0 = xl_1 + xl_2$

$$12 = x(l_1 + l_2)$$

$$12 = xl_2 \left( \frac{l_1}{l_2} + 1 \right) \dots\dots(ii)$$

Divide (i) by (ii), we get

$$\frac{\frac{8}{3}}{12} = \frac{\frac{xl_1}{\left( \frac{l_1}{l_2} + 1 \right)}}{xl_2 \left( \frac{l_1}{l_2} + 1 \right)} \text{ or } \frac{8}{36} = \frac{l_1}{l_2 \left( \frac{l_1}{l_2} + 1 \right)^2}$$

$$\left( \frac{l_1}{l_2} + 1 \right)^2 \frac{8}{36} = \frac{l_1}{l_2} \text{ or } \left( \frac{l_1}{l_2} + 1 \right)^2 \frac{2}{9} = \frac{l_1}{l_2}$$

Let  $y = \frac{l_1}{l_2}$

$$\therefore 2(y + 1)^2 = 9y \text{ or } 2y^2 + 2 + 4y = 9y$$



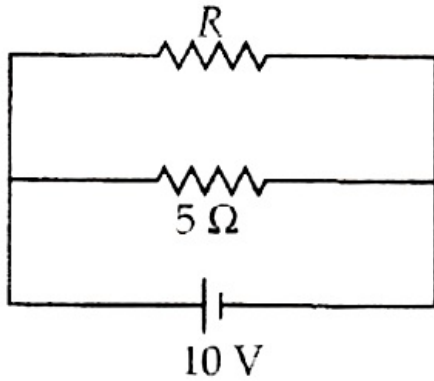
$$\text{or } 2y^2 - 5y + 2 = 0$$

Solving this quadratic equation, we get

$$y = \frac{1}{2} \text{ or } 2 \therefore \frac{1}{\frac{1}{2}} = \frac{1}{2}$$

## Question64

The power dissipated in the circuit shown in the figure is 30 watts. The value of R is



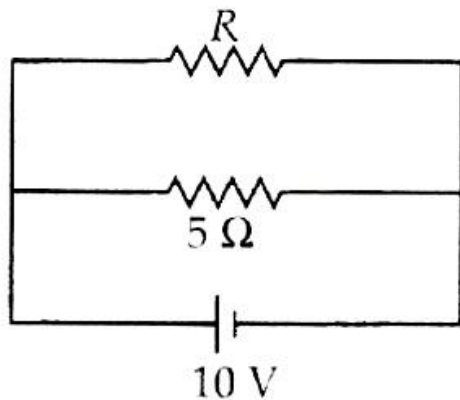
(2012 Mains)

Options:

- A. 20 Ω
- B. 15 Ω
- C. 10 Ω
- D. 30 Ω

**Answer: C**

**Solution:**



The equivalent resistance of the given circuit is

$$R_{eq} = \frac{5R}{5 + R}$$

Power dissipated in the given circuit is

$$P = \frac{V^2}{R_{eq}} \text{ or } 30 = \frac{(10)^2}{\left( \frac{5R}{5 + R} \right)}$$

$$150R = 100(5 + R)$$

$$150R = 500 + 100R$$

$$50R = 500$$

$$R = \frac{500}{50} = 10\Omega$$

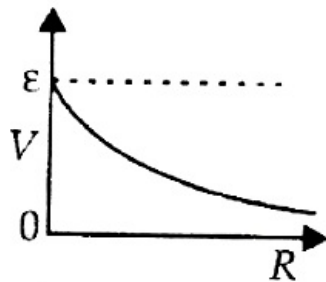

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## Question65

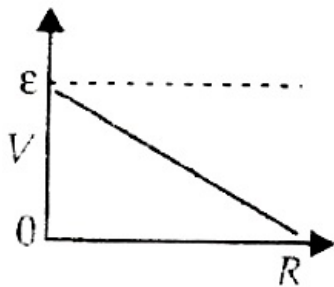
A cell having an emf  $e$  and internal resistance  $r$  is connected across a variable external resistance  $R$ . As the resistance  $R$  is increased, the plot of potential difference  $V$  across  $R$  is given by (2012 Mains)

Options:

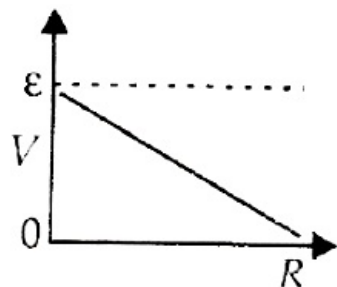
A.



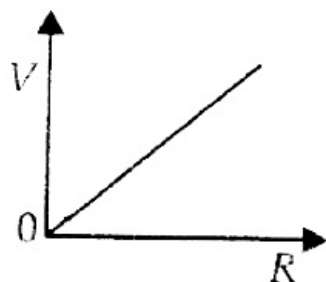
B.



C.

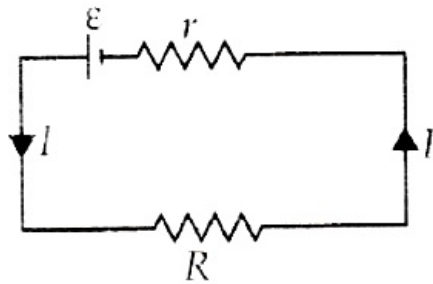


D.



**Answer: C**

### Solution:



Current in the circuit,

$$I = \frac{\varepsilon}{R + r}$$

Potential difference across R,

$$V = IR = \left( \frac{\varepsilon}{R + r} \right) R$$

$$V = \frac{\varepsilon}{1 + \frac{r}{R}}$$

When  $R = 0$ ,  $V = 0$

$R = \infty$ ,  $V = \varepsilon$

Hence, option (c) represents the correct graph.

---

## Question66

**A current of 2 A flows through a  $2 \Omega$  resistor when connected across a battery. The same battery supplies a current of 0.5 A when connected across a  $9 \Omega$  resistor. The internal resistance of the battery is (2011)**

**Options:**

A.  $0.5 \Omega$

B.  $\frac{1}{3} \Omega$

C.  $\frac{1}{4} \Omega$

D.  $1 \Omega$

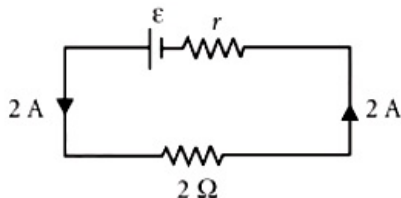
**Answer: B**

### Solution:

**Solution:**

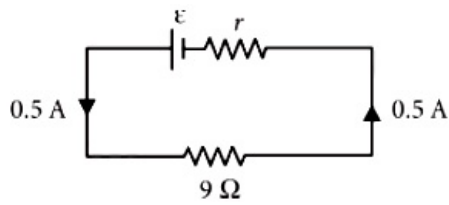
Let  $\varepsilon$  be the emf and  $r$  be internal resistance of the battery.

In the first case,



$$2 = \frac{\varepsilon}{2 + r} \dots\dots(i)$$

In the second case,



$$0.5 = \frac{\varepsilon}{9 + r} \dots\dots(ii)$$

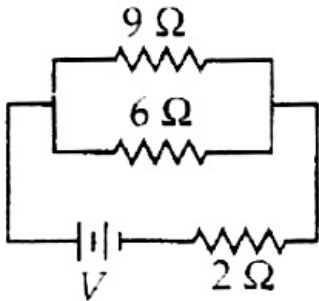
Divide(i) by (ii), we get

$$\frac{2}{0.5} = \frac{9 + r}{2 + r} \Rightarrow 4 + 2r = 4.5 + 0.5r$$

$$1.5r = 0.5 \Rightarrow r = \frac{0.5}{1.5} = \frac{1}{3} \Omega$$

## Question67

**If power dissipated in the  $9 \Omega$  resistor in the circuit shown is 36 watt, the potential difference across the  $2 \Omega$  resistor is**



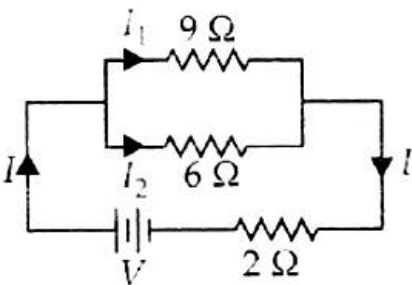
**(2011)**

**Options:**

- A. 4 volt
- B. 8 volt
- C. 10 volt
- D. 2 volt

**Answer: C**

**Solution:**



Current flows through the  $9 \Omega$  resistor is

$$I_1^2 = \frac{36}{9} = 4 \quad (\text{As } P = I^2 R)$$

$$I_1 = 2A$$

As the resistors  $9 \Omega$  and  $6 \Omega$  are connected in parallel, therefore potential difference across them is same.

$$\therefore 9I_1 = 6I_2; I_2 = \frac{9 \times 2}{6} = 3A$$

Current drawn from the battery is

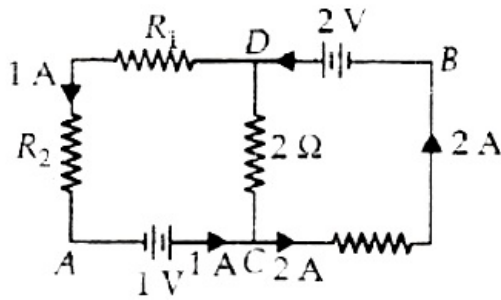
$$I = I_1 + I_2 = (2 + 3)A = 5A$$

The potential difference across the  $2\ \Omega$  resistor is

$$= (5A)(2\Omega) = 10V$$

## Question 68

In the circuit shown in the figure, if the potential at point A is taken to be zero, the potential at point B is



(2011 Mains)

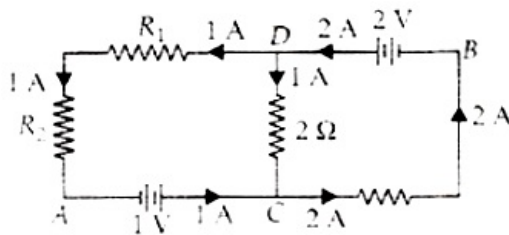
Options:

- A. +1 V
- B. -1 V
- C. +2 V
- D. -2 V

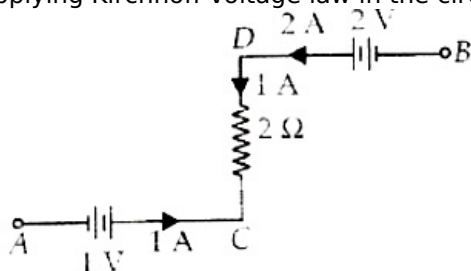
**Answer: A**

**Solution:**

**Solution:**



Applying Kirchhoff voltage law in the circuit as shown in the figure below.



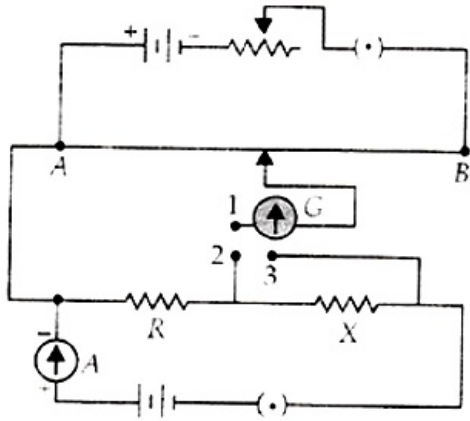
$$\therefore V_A + 1 + 2(1) - 2 = V_B$$

$$0 + 1 = V_B \quad (\because V_A = 0V \text{ (Given)})$$

$$V_B = +1V$$

## Question69

A potentiometer circuit is set up as shown. The potential gradient, across the potentiometer wire, is  $k$  volt/cm and the ammeter, present in the circuit, reads  $1.0$  A when two way key is switched off. The balance points, when the key between the terminals (i) 1 and 2 (ii) 1 and 3, is plugged in, are found to be at lengths  $l_1$  cm and  $l_2$  cm respectively. The magnitudes, of the resistors  $R$  and  $X$ , in ohms, are then, equal, respectively, to



(2010)

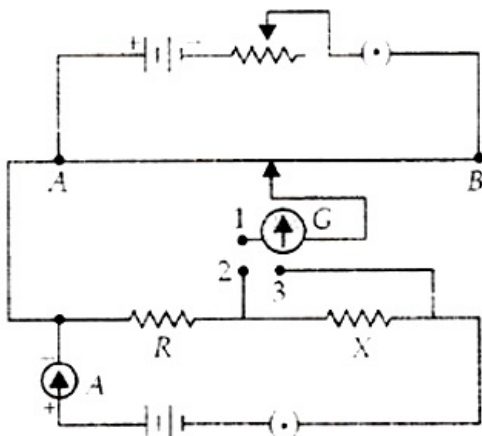
Options:

- A.  $k(l_2 - l_1)$  and  $kl_2$
- B.  $kl_1$  and  $k(l_2 - l_1)$
- C.  $k(l_2 - l_1)$  and  $kl_1$
- D.  $kl_1$  and  $kl_2$

**Answer: B**

**Solution:**

**Solution:**



When the two way key is switched off, then The current flowing in the resistors  $R$  and  $X$  is  $I = 1\text{A}$ .....(i)

When the key between the terminals 1 and 2 is plugged in, then

Potential difference across  $R = IR = kl_1 \dots \dots \dots (ii)$

where  $k$  is the potential gradient across the potentiometer wire.

When the key between the terminals 1 and 3 is plugged in, then Potential difference across  $(R + X) = I(R + X) = kl_2 \dots \dots \dots (iii)$

From equation (ii), we get

$$R = \frac{kl_1}{I} = \frac{kl_1}{1} = kl_1 \Omega \dots \dots \dots (iv)$$

From equation (iii), we get

$$R + X = \frac{kl_2}{I} = \frac{kl_2}{1} = kl_2 \quad (\text{Using (i)})$$

$$X = kl_2 - R$$

$$= kl_2 - kl_1 = k(l_2 - l_1) \Omega \quad (\text{Using (iv)})$$

---

## Question70

Consider the following two statements.

**(A) Kirchhoff's junction law follows from the conservation of charge.**

**(B) Kirchhoff's loop law follows from the conservation of energy.**

**Which of the following is correct?**

**(2010)**

**Options:**

- A. Both (A) and (B) are wrong.
- B. (A) is correct and (B) is wrong.
- C. (A) is wrong and (B) is correct.
- D. Both (A) and (B) are correct.

**Answer: D**

**Solution:**

**Solution:**

Kirchhoff's junction law or Kirchhoff's first law is based on the conservation of charge.

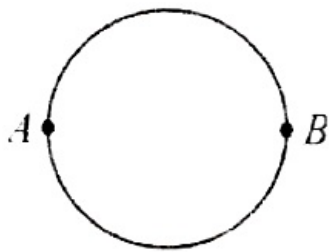
Kirchhoff's loop law or Kirchhoff's second law is based on the conservation of energy.

Hence, both statements (A) and (B) are correct.

---

## Question71

**A wire of resistance 12 ohms per meter is bent to form a complete circle of radius 10 cm. The resistance between its two diametrically opposite points, A and B as shown in the figure is**



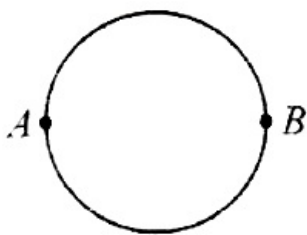
**(2009)**

**Options:**

- A. 3
- B.  $6\pi\Omega$
- C.  $6\Omega$
- D.  $0.6\Omega$

**Answer: D**

**Solution:**



Wire of length  $2\pi \times 0.1\text{m}$  of  $12\frac{\Omega}{\text{m}}$  is bent to a circle.

Resistance of each part  
 $= 12 \times \pi \times 0.1 = 1.2\pi\Omega$

$\therefore$  Total resistance  $= 0.6\pi\Omega$

## Question72

**A student measures the terminal potential difference (V) of a cell (of emf  $\varepsilon$  and internal resistance  $r$ ) as a function of the current (I) flowing through it. The slope, and intercept, of the graph between V and I, then, respectively, equal**

**(2009)**

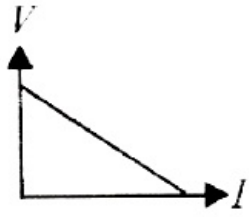
**Options:**

- A.  $-r$  and  $\varepsilon$
- B.  $r$  and  $-\varepsilon$
- C.  $-\varepsilon$  and  $r$
- D.  $\varepsilon$  and  $-r$

**Answer: A**



## Solution:



$$V = \varepsilon - I r, y = c - mx$$

$\therefore$  Slope  $= -r$ , internal resistance

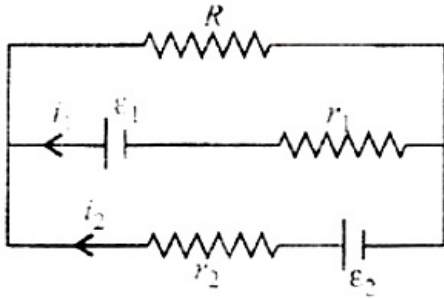
$V_{\max} = \text{emf } \varepsilon$ . This is intercept of the y-axis

$\therefore$  Slope is negative

$\therefore I$  decreases as  $R$  increases

## Question 73

See the electrical circuit shown in this figure. Which of the following equations is a correct equation for it?



(2009)

Options:

A.  $\varepsilon_2 - i_2 r_2 - \varepsilon_1 - i_1 r_1 = 0$

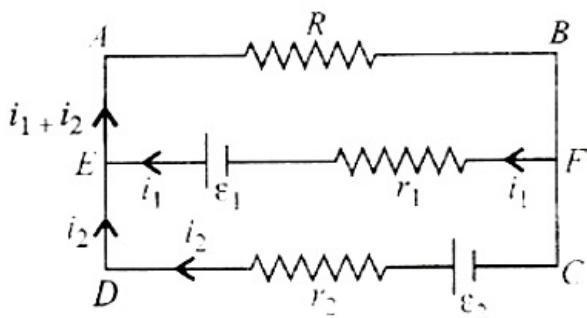
B.  $-\varepsilon_2 - (i_1 + i_2)R + i_2 r_2 = 0$

C.  $\varepsilon_1 - (i_1 + i_2)R + i_1 r_1 = 0$

D.  $\varepsilon_1 - (i_1 + i_2)R - i_1 r_1 = 0$

Answer: D

Solution:



Applying Kirchhoff's second law to the closed loop ABFEA,

$$-(i_1 + i_2)R - i_1 r_1 + \varepsilon_1 = 0$$

$$\text{or } \varepsilon_1 - (i_1 + i_2)R - i_1 r_1 = 0$$


---

## Question74

The mean free path of electrons in a metal is  $4 \times 10^{-8} \text{ m}$ . The electric field which can give on an average 2 eV energy to an electron in the metal will be in units V/m (2009)

**Options:**

- A.  $5 \times 10^{-11}$
- B.  $8 \times 10^{-11}$
- C.  $5 \times 10^7$
- D.  $8 \times 10^7$

**Answer: C**

**Solution:**

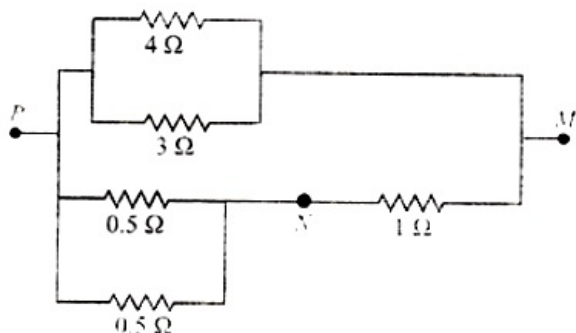
$$\text{Energy} = 2\text{eV} = eE\lambda$$

$$\therefore E = \frac{V}{\lambda} = \frac{2}{4 \times 10^{-8}} = 5 \times 10^7 \text{ V/m}$$


---

## Question75

In the circuit shown, the current through the 4  $\Omega$  resistor is 1 amp when the points P and M are connected to a d.c. voltage source. The potential difference between the points M and N is (2008)



**Options:**

- A. 0.5 volt

B. 3.2 volt

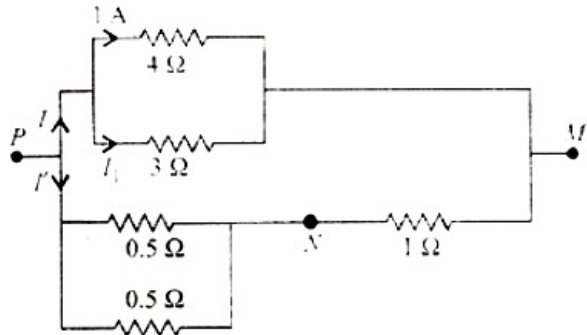
C. 1.5 volt

D. 1.0 volt

**Answer: B**

**Solution:**

**Solution:**



As  $4\Omega$  and  $3\Omega$  are in parallel, the potential difference is same across them. If  $I_1$  is the current through  $3\Omega$  resistance, then  $4 \times 1 = 3 \times I_1$

$$\text{or } I_1 = \frac{4}{3}\text{A}$$

$$\text{Total resistance of } 4\Omega \text{ and } 3\Omega = \frac{4 \times 3}{4 + 3} = \frac{12}{7}\Omega$$

$$\begin{aligned} \text{Total current in the upper portion of the circuit from P to M} \\ = I = 1 + \frac{4}{3} = \frac{7}{3}\text{A} \end{aligned}$$

$$\text{Potential difference between P and M} = \frac{7}{3} \times \frac{12}{7} = 4\text{V}$$

Current in the arm PNM is

$$I' = \frac{\frac{4}{0.5 + 0.5}}{1} + 1 = \frac{16}{5}\text{A}$$

$$\text{Potential difference across N and M} = I' \times 1 = \frac{16}{5} \times 1 = 3.2\text{V}$$

## Question76

**A wire of a certain material is stretched slowly by ten percent. Its new resistance and specific resistance become respectively (2008)**

**Options:**

A. both remain the same

B. 1.1 times, 1.1 times

C. 1.2 times, 1.1 times

D. 1.21 times, same

**Answer: D**

### Solution:

$$R = \frac{\rho l}{A}$$
$$\text{Now, } 1 = 1 + \frac{1}{10} = \frac{11}{10}$$
$$\text{and therefore, } A = \frac{10A}{11}$$
$$\text{So } R' = \frac{\rho \times \left(\frac{11l}{10}\right)}{\frac{10A}{11}} = \frac{\rho l}{A} \times \frac{(11)^2}{(10)^2} = 1.21R$$

Now resistance becomes 1.21 times of initial and specific resistance is the intrinsic property so remains same.

-----

## Question77

**A cell can be balanced against 110 cm and 100 cm of potentiometer wire, respectively with and without being short circuited through a resistance of 10Ω. Its internal resistance is (2008)**

### Options:

- A. 2.0 ohm
- B. zero
- C. 1.0 ohm
- D. 0.5 ohm

**Answer: C**

### Solution:

**Solution:**  
Here  $l_1 = 110\text{cm}$ ,  $l_2 = 100\text{cm}$ ;  $R = 10\Omega$

$$r = \left( \frac{l_1 - l_2}{l_2} \right) R = \left( \frac{110 - 100}{100} \right) \times 10 = 1.0\Omega$$

-----

## Question78

**An electric kettle takes 4 A current at 220 V . How much time will it take to boil 1 kg of water from temperature 20° C ? The temperature of boiling water is 100° C . (2008)**

### Options:

- A. 12.6 min
- B. 4.2 min
- C. 6.3 min
- D. 8.4 min

**Answer: C**

**Solution:**

**Solution:**

$$\text{Power} = 220\text{V} \times 4\text{ A} = 880\text{ watts}$$

$$= 880\text{J} / \text{s}$$

Heat needed to raise the temperature of 1 kg water through  $80^{\circ}\text{C}$

$$= ms \cdot \Delta T \times 4.2\text{ J} / \text{cal}$$

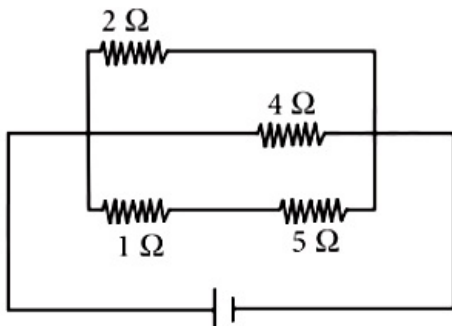
$$= 1000\text{ g} \times 1\text{ cal} / \text{g} \times 80 \times 4.2\text{ J} / \text{cal}$$

$$\therefore \text{Time taken} = \frac{1000 \times 1 \times 80 \times 4.2}{880} = \frac{336 \times 10^3}{880}$$

$$= 382\text{ s} = 6.3\text{ min}$$

## Question79

**A current 3 amp. flows through the  $2\Omega$  resistor r shown in the circuit. The power dissipated in the  $5\Omega$  resistor is**



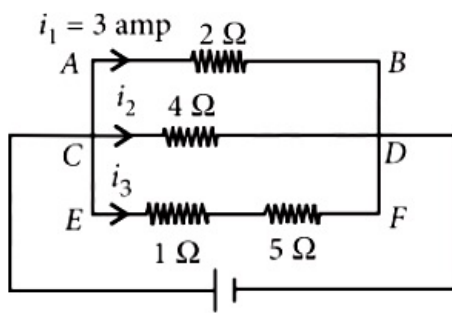
**(2008)**

**Options:**

- A. 1 watt
- B. 5 watt
- C. 4 watt
- D. 2 watt

**Answer: B**

**Solution:**



$2\Omega$ ,  $4\Omega$  and  $(1\Omega + 5\Omega)$  are in parallel. So potential difference is the same.

$$V = 2\Omega \cdot i_1 = 4\Omega \cdot i_2 = 6\Omega \cdot i_3$$

$$2 \cdot 3 = 6\Omega \cdot i_3 \Rightarrow i_3 = \frac{1}{a} \text{ amp.}$$

$$\text{Total P.D.} = 5 \times 1 + 1 \times 1 = 6 \text{ V.}$$

$$\therefore \text{Power dissipated in } 5\Omega \text{ resistance} = \frac{V'^2}{R}$$

where  $V'$  is the P.D. across  $5\Omega = 5\text{V}$ .

$$\therefore \text{Power} = \frac{25}{5\Omega} = 5 \text{ watt}$$

## Question80

**Three resistances P, Q, R each of  $2\Omega$  and an unknown resistance S form the four arms of a Wheatstone bridge circuit. When a resistance of  $6\Omega$  is connected in parallel to S the bridge gets balanced. What is the value of S?**

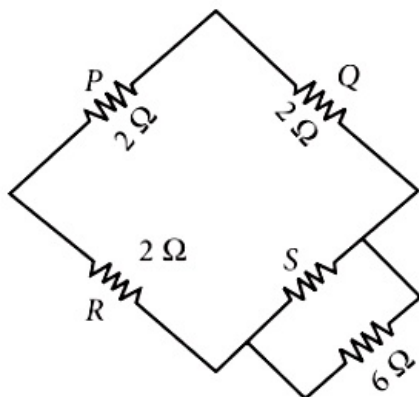
**(2007)**

**Options:**

- A.  $3\Omega$
- B.  $6\Omega$
- C.  $1\Omega$
- D.  $2\Omega$

**Answer: A**

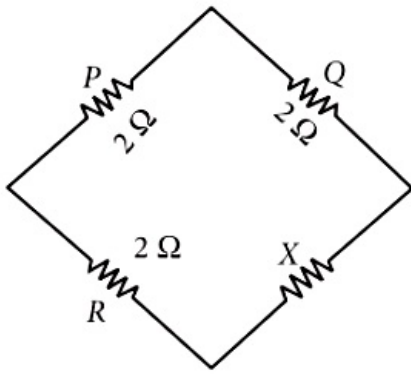
**Solution:**



Let  $X$  be the equivalent resistance between S and  $6\Omega$

$$\therefore \frac{1}{X} = \frac{1}{S} + \frac{1}{6} \dots\dots(i)$$

Therefore, the equivalent circuit diagram drawn below.



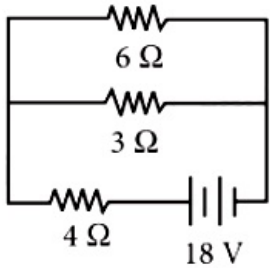
For a balanced Wheatstone's bridge, we get  $\frac{P}{Q} = \frac{R}{X}$  or  $\frac{2}{2} = \frac{2}{X} \Rightarrow X = 2\Omega$

From eqn. (i), we get

$$\frac{1}{2} = \frac{1}{S} + \frac{1}{6} \text{ or } \frac{1}{S} = \frac{2}{6} \text{ or } S = 3\Omega$$

## Question81

The total power dissipated in watt in the circuit shown here is



(2007)

Options:

- A. 40
- B. 54
- C. 4
- D. 16 .

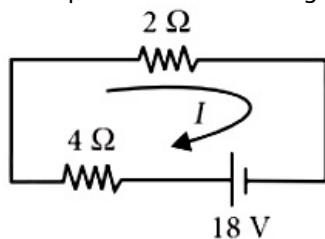
**Answer: B**

**Solution:**

**Solution:**

In the given circuit  $6\Omega$  and  $3\Omega$  are in parallel, and hence its equivalent resistance is given by  $\frac{1}{R_p} = \frac{1}{6} + \frac{1}{3}$  or  $R_p = 2\Omega$

The equivalent circuit diagram is given in figure. Total current in the circuit,

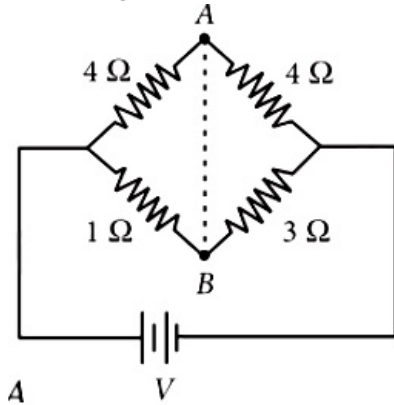


$$I = \frac{18}{2 + 4} = 3 \text{ A}$$

$$\text{Power in the circuit} = VI = 18 \times 3 = 54 \text{ watt.}$$

## Question82

In the circuit shown, if a conducting wire is connected between points A and B, the current in this wire will



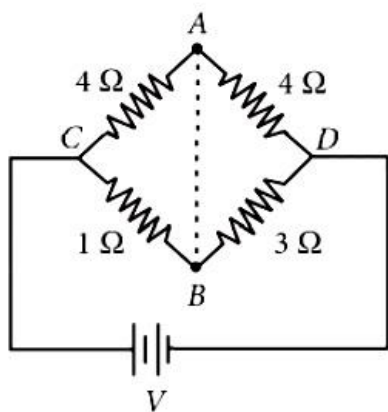
(2006)

Options:

- A. flow from B to A
- B. flow from A to B
- C. flow in the direction which will be decided by the value of V
- D. be zero.

**Answer: A**

**Solution:**



Current through arm CAD,  $I = \frac{V}{8}$  amp

Potential difference between C and A =  $V_C - V_A$   
 $= \frac{V}{8} \times 4 = \frac{V}{2}$  volt

Current through CBD,  $I' = \frac{V}{4}$  amp

Potential difference between C and B =  $V_C - V_B$   
 $= \frac{V}{4} \times 1 = \frac{V}{4}$  volt.

Potential between A and B =  $V_A - V_B$

$\therefore V_A - V_B = V_C - V_B - (V_C - V_A) = \frac{V}{4} - \frac{V}{2} = -\frac{V}{4}$

$\Rightarrow V_A - V_B < 0$  or,  $V_A < V_B$  As  $V_A < V_B$



## Question83

**Kirchhoff's first and second laws of electrical circuits are consequences of**  
**(2006)**

©

**Options:**

- A. conservation of energy and electric charge respectively
- B. conservation of energy
- C. conservation of electric charge and energy respectively
- D. conservation of electric charge.

**Answer: C**

**Solution:**

**Solution:**

Kirchhoff's first law of electrical circuit is based on conservation of charge and Kirchhoff's second law of electrical circuit is based on conservation of energy.

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## Question84

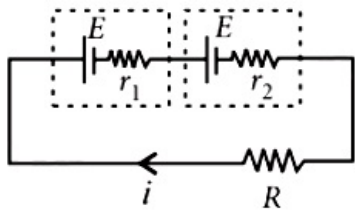
**Two cells, having the same e.m.f. are connected in series through an external resistance R. Cells have internal resistances  $r_1$  and  $r_2$  ( $r_1 > r_2$ ) respectively. When the circuit is closed, the potential difference across the first cell is zero. The value of R is**  
**(2006)**

**Options:**

- A.  $r_1 + r_2$
- B.  $r_1 - r_2$
- C.  $\frac{r_1 + r_2}{2}$
- D.  $\frac{r_1 - r_2}{2}$

**Answer: B**

**Solution:**



Kirchhoff's law has to be applied to the whole loop,

$$\text{while } i = \frac{2E}{(r_1 + r_2 + R)}$$

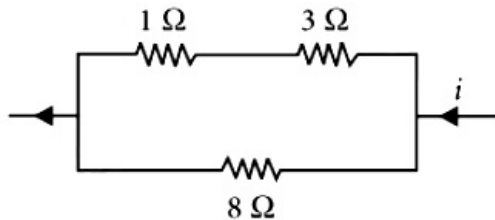
As per question,  $E - ir_1 = 0$

$$i = \frac{E}{r_1} \text{ or } \frac{2E}{r_1 + r_2 + R} = \frac{E}{r_1}$$

$$\text{or, } 2r_1 = r_1 + r_2 + R \text{ or } R = r_1 - r_2$$

## Question85

**Power dissipated across the  $8\Omega$  resistor in the circuit shown here is 2 watt. The power dissipated in watt units across the  $3\Omega$  resistor is**



**(2006)**

**Options:**

- A. 3.0
- B. 2.0
- C. 1.0
- D. 0.5

**Answer: A**

**Solution:**

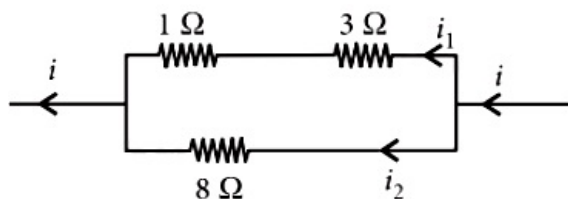
**Solution:**

Resistance of series combination of  $3\Omega$  and  $1\Omega$  is  $R_1 = 3 + 1 = 4\Omega$ ,  $R_2 = 8\Omega$

Let  $i$  be the total current in the circuit.

Current through  $R_1$  is

$$i_1 = \frac{i \times R_2}{R_1 + R_2} = \frac{i \times 8}{12} = \frac{2i}{3}$$



Current through  $R_2$  is

$$i_2 = \frac{i \times R_1}{R_1 + R_2} = \frac{i \times 4}{12} = \frac{i}{3}$$

Power dissipated in  $3\Omega$  resistor is  $P_1 = i_1^2 \times 3$

Power dissipated in  $8\Omega$  resistor is

$$P_2 = i_2^2 \times 8$$

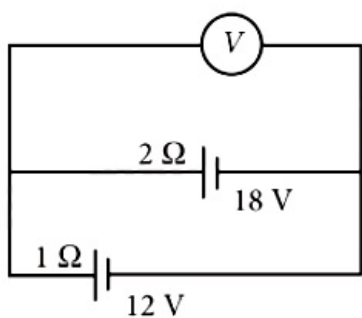
$$\therefore \frac{P_1}{P_2} = \frac{i_1^2 \times 3}{i_2^2 \times 8} \text{ or, } \frac{P_1}{P_2} = \frac{(2i/3)^2 \times 3}{(i/3)^2 \times 8} = \frac{12}{8} = \frac{3}{2}$$

$$P_1 = \frac{3}{2} \times P_2 = \frac{3}{2} \times 2 = 3 \text{ watt}$$

$\therefore$  Power dissipated across  $3\Omega$  resistor is 3 watt.

## Question 86

Two batteries, one of emf 18 volts and internal resistance  $2\Omega$  and the other of emf 12 volts and internal resistance  $1\Omega$ , are connected as shown. The voltmeter V will record a reading of



(2005)

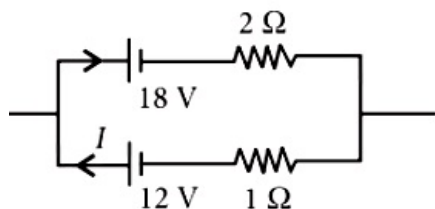
**Options:**

- A. 30 volt
- B. 18 volt
- C. 15 volt
- D. 14 volt.

**Answer: D**

**Solution:**

**Solution:**



From Kirchhoff's law,

$$I \times 2 + I \times 1 = 18 - 12$$

Current in the circuit,

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

Voltage drop across  $2\Omega$ ,

$$V_1 = 2 \times 2 = 4 \text{ V}$$

$$\text{Voltmeter reading} = 18 - 4 = 14 \text{ V}$$

## Question87

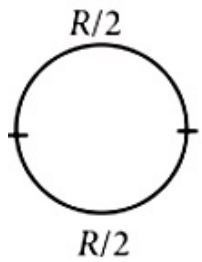
When a wire of uniform cross-section  $a$ , length  $l$  and resistance  $R$  is bent into a complete circle, resistance between any two of diametrically opposite points will be  
(2005)

Options:

- A.  $\frac{R}{4}$
- B.  $4R$
- C.  $\frac{R}{8}$
- D.  $\frac{R}{2}$ .

Answer: A

Solution:



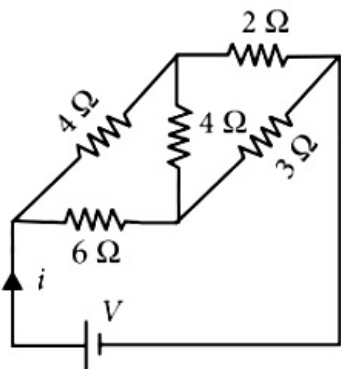
Both are in parallel.

$$\frac{1}{R'} = \frac{2}{R} + \frac{2}{R} = \frac{4}{R} \Rightarrow R' = \frac{R}{4}$$

---

## Question88

For the network shown in the figure the value of the current  $i$  is



(2005)

Options:

- A.  $\frac{9V}{35}$

B.  $\frac{18V}{5}$

C.  $\frac{5V}{9}$

D.  $\frac{5V}{18}$

**Answer: D**

**Solution:**

since given circuit is in the form of Wheatstone bridge,

$$\frac{1}{R_{eq}} = \frac{1}{(4 + 2)} + \frac{1}{(6 + 3)}; R_{eq} = \frac{18}{5} \Omega$$

$$V = iR_{eq} \Rightarrow i = \frac{V}{R_{eq}} = \frac{5V}{18}$$

## Question89

**A 5-ampere fuse wire can withstand a maximum power of 1 watt in the circuit. The resistance of the fuse wire is (2005)**

**Options:**

A. 0.04 ohm

B. 0.2 ohm

C. 5 ohm

D. 0.4 ohm.

**Answer: A**

**Solution:**

$$P = i^2 R \text{ or } 1 = 25 \times R$$

$$R = \frac{1}{25} = 0.04 \Omega$$

## Question90

**The electric resistance of a certain wire of iron is R. If its length and radius are both doubled, then (2004)**

**Options:**

- A. The resistance will be doubled and the specific resistance will be halved.
- B. The resistance will be halved and the specific resistance will remain unchanged.
- C. The resistance will be halved and the specific resistance will be doubled.
- D. The resistance and the specific resistance, will both remain unchanged.

**Answer: B****Solution:**

$$\text{Resistance of wire} = \rho \frac{l}{A}$$

$$R \propto \frac{l}{A} = \frac{l}{\pi r^2}$$

When length and radius are both doubled

$$R_1 \propto \frac{2l}{\pi(2r)^2} \Rightarrow R_1 \propto \frac{1}{2}R$$

The specific resistance of wire is independent of geometry of the wire, it only depends on the material of the wire.

## Question91

**Resistance n, each of r ohm, when connected in parallel give an equivalent resistance of R ohm. If these resistances were connected in series, the combination would have a resistance in ohms, equal to (2004)**

**Options:**

- A.  $n^2R$
- B.  $\frac{R}{n^2}$
- C.  $\frac{R}{n}$
- D.  $nR$

**Answer: A****Solution:****Solution:**

When n resistance of r ohm connected in parallel then their equivalent resistance is

$$\frac{1}{R} = \frac{1}{r} + \frac{1}{r} + \frac{1}{r} + \dots \text{ n times}$$

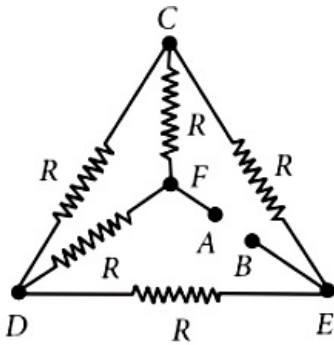
$$\therefore \frac{1}{R} = \frac{n}{r} \Rightarrow R = \frac{r}{n} \Rightarrow r = nR$$

When these resistance connected in series

$$\begin{aligned} R_s &= r + r + \dots \text{ n times} \\ &= nr = n \times nR = n^2R \end{aligned}$$

## Question92

Five equal resistances each of resistance  $R$  are connected as shown in the figure. A battery of  $V$  volts is connected between  $A$  and  $B$ . The current flowing in  $AFCEB$  will be



(2004)

Options:

A.  $\frac{3V}{R}$

B.  $\frac{V}{R}$

C.  $\frac{V}{2R}$

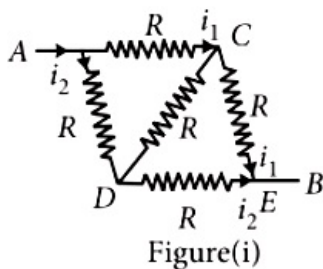
D.  $\frac{2V}{R}$

Answer: C

Solution:

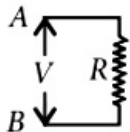
**Solution:**

Equivalent circuit of given circuit is shown in figure (i).



Figure(i)

Also this is equivalent to a balanced Wheatstone bridge  $C$  and  $D$  are at equal potential level, no current will flow in this resistance therefore this resistance can be neglected.



Figure(ii)

Thus equivalent resistance of this remaining circuit shown in figure (ii) is  $R$ .

Then current in  $AFCEB$  branch is

$$i_1 = \frac{V}{R} \times \frac{2R}{2R + 2R} = \frac{V}{2R}$$

## Question93

**A 6 volt battery is connected to the terminals of a three metre long wire of uniform thickness and resistance of 100 ohm. The difference of potential between two points on the wire separated by a distance of 50 cm will be (2004)**

**Options:**

- A. 2 volt
- B. 3 volt
- C. 1 volt
- D. 1.5 volt

**Answer: C**

**Solution:**

**Solution:**

According to given parameters in question

$$R = \rho \frac{l}{A} \Rightarrow 100\Omega = \rho \frac{3}{A} \Rightarrow \frac{\rho}{A} = \frac{100}{3}$$

Thus total resistance of 50 cm wire is

$$R_1 = \frac{\rho}{A} l = \frac{100}{3} \times 0.5 = \frac{50}{3}\Omega$$

The total current in the wire is  $I = \frac{6}{100}$  A

Therefore potential difference across the two points on the wire separated by a distance of 50 m is

$$(V) = I R_1 = \frac{50}{3} \times \frac{6}{100} = 1 \text{ V}$$

---

## Question94

**When three identical bulbs of 60 watt, 200 volt rating are connected in series to a 200 volt supply, the power drawn by them will be (2004)**

**Options:**

- A. 60 watt
- B. 180 watt
- C. 10 watt
- D. 20 watt

**Answer: D**



## Solution:

$$\text{The resistance of each bulb} = \frac{V^2}{P} = \frac{(200)^2}{60} \Omega$$

$$\text{When three bulbs are connected in series their resultant resistance} = \frac{3 \times (200)^2}{60}$$

Thus power drawn by bulb when connected across 200 V supply

$$P = \frac{V^2}{R_{\text{re}}} = \frac{(200)^2}{3 \times (200)^2 / 60} = 20 \text{ W}$$

---

## Question95

**In India electricity is supplied for domestic use at 220 V . It is supplied at 110 V in USA. If the resistance of a 60 W bulb for use in India is R, the resistance of a 60 W bulb for use in USA will be (2004)**

### Options:

A. R

B. 2R

C.  $\frac{R}{4}$

D.  $\frac{R}{2}$

**Answer: C**

## Solution:

### Solution:

$$\text{In India, } P_I = \frac{(220)^2}{R}$$

$$\text{In U SA, } P_U = \frac{(110)^2}{R_U}$$

$$\text{as } P_I = P_U \Rightarrow \frac{(220)^2}{R} = \frac{(110)^2}{R_U}$$

$$\Rightarrow R_U = \frac{110 \times 110}{220 \times 220} R = \frac{R}{4}$$

---

## Question96

**In a Wheatstone's bridge all the four arms have equal resistance R. If the resistance of the galvanometer arm is also R, the equivalent resistance of the combination as seen by the battery is (2003)**

**Options:**

A.  $\frac{R}{4}$

B.  $\frac{R}{2}$

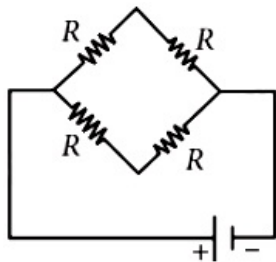
C.  $R$

D.  $2R$

**Answer: C**

**Solution:**

**Solution:**



In balance Wheatstone bridge, the galvanometer arm can be neglected. So equivalent resistance will be

$$\frac{2R \times 2R}{2R + 2R} = \frac{4R^2}{4R} = R$$

---

## Question97

**Two 220 volt, 100 watt bulbs are connected first in series and then in parallel. Each time the combination is connected to a 220 volt a.c. supply line. The power drawn by the combination in each case respectively will be (2003)**

**Options:**

A. 50 watt, 100 watt

B. 100 watt, 50 watt

C. 200 watt, 150 watt

D. 50 watt, 200 watt

**Answer: D**

**Solution:**

$$R = \frac{V^2}{P} = \frac{220 \times 220}{100} = 484\Omega$$

$$\text{In series, } R_{\text{eq}} = 484 + 484 = 968\Omega$$

$$\therefore P_{\text{eq}} = \frac{V^2}{968} = \frac{220 \times 220}{968} = 50 \text{ watt}$$

In parallel,  $R_{\text{eq}} = 242\Omega$

$$\therefore P_{\text{eq}} = \frac{V^2}{242} = \frac{220 \times 220}{242} = 200 \text{ watt}$$

## Question98

**An electric kettle has two heating coils. When one of the coils is connected to ana.c. source, the water in the kettle boils in 10 minutes. When the other coil is used the water boils in 40 minutes. If both the coils are connected in parallel, the time taken by the same quantity of water to boil will be (2003)**

**Options:**

- A. 8 minutes
- B. 4 minutes
- C. 25 minutes
- D. 15 minutes

**Answer: A**

**Solution:**

**Solution:**

Let  $R_1$  and  $R_2$  be the resistance of the two coils and  $V$  be the voltage supplied.

Effective resistance of two coils in parallel =  $\frac{R_1 R_2}{R_1 + R_2}$

Let  $H$  be the heat required to begin boiling in kettle.

Then  $H = \text{Power} \times \text{time} = \frac{V^2 t_1}{R_1} = \frac{V^2 t_2}{R_2}$

For parallel combination,  $H = \frac{V^2 (R_1 + R_2) t_p}{R_1 R_2}$

$$\Rightarrow \frac{1}{t_p} = \left( \frac{t_2 + t_1}{t_2 t_1} \right)$$

$$\therefore t_p = \frac{t_1 t_2}{t_1 + t_2} = \frac{10 \times 40}{10 + 40} = 8 \text{ minute}$$

## Question99

**Fuse wire is a wire of (2003)**

**Options:**

- A. high resistance and high melting point
- B. high resistance and low melting point
- C. low resistance and low melting point
- D. low resistance and high melting point

**Answer: B**

**Solution:**

Fuse wire should have high resistance and low melting point.

## Question100

**For a cell terminal potential difference is 2.2 V when circuit is open and reduces to 1.8 V when cell is connected to a resistance of  $R = 5\Omega$ .**

**Determine internal resistance of cell (r)  
(2002)**

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**Options:**

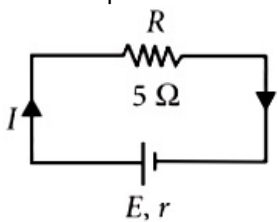
- A.  $\frac{10}{9}\Omega$
- B.  $\frac{9}{10}\Omega$
- C.  $\frac{11}{9}\Omega$
- D.  $\frac{5}{9}\Omega$

**Answer: A**

**Solution:**

**Solution:**

Terminal potential difference is 2.2 V when circuit is open.



$\therefore$  e.m.f. of the cell =  $E = 2.2$  volt

Now, when the cell is connected to the external resistance, circuit current  $I$  is given by

$$I = \frac{E}{R + r} = \frac{2.2}{5 + r} \text{ ampere, where } r \text{ is the internal resistance of the cell.}$$

Potential difference across the cell =  $IR$

$$= \frac{2.2}{5 + r} \times 5 = 1.8$$

$$\therefore 5 + r = \frac{11}{1.8}$$

$$\therefore r = \frac{11}{1.8} - 5 = \frac{110 - 90}{18} = \frac{10}{9} \Omega$$


---

## Question101

**Specific resistance of a conductor increases with (2002)**

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**Options:**

- A. increase in temperature
- B. increase in cross-section area
- C. increase in cross-section and decrease in length
- D. decrease in cross-section area.

**Answer: A**

**Solution:**

**Solution:**

Resistance of a conductor is given by  $R = \rho \frac{l}{A}$ , where  $\rho$  is the specific resistance,  $l$  is the length and  $A$  is the cross-sectional area of the conductor.

Now, when  $l = 1$  and  $A = 1$ ,  $R = \rho$

So specific resistance or resistivity of a material may be defined as the resistance of a specimen of the material having unit length and unit cross-section. Hence, specific resistance is a property of a material and it will increase with the increase of temperature, but will not vary with the dimensions (length, cross-section) of the conductor.

---

## Question102

**Copper and silicon is cooled from 300 K to 60 K , the specific resistance (2001)**

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**Options:**

- A. decrease in copper but increase in silicon
- B. increase in copper but decrease in silicon
- C. increase in both
- D. decrease in both.

**Answer: A**

**Solution:**

For metals specific resistance decrease with decrease in temperature whereas for semiconductors specific resistance increases with decrease in temperature.

---

## Question103

**The resistance of each arm of the Wheatstone's bridge is 10 ohm. A resistance of 10 ohm is connected in series with a galvanometer then the equivalent resistance across the battery will be (2001)**

**Options:**

- A. 10 ohm
- B. 15 ohm
- C. 20 ohm
- D. 40 ohm.

**Answer: A**

---

## Question104

**If specific resistance of a potentiometer wire is  $10^{-7} \Omega \text{ m}$  and current flow through it is 0.1 amp., cross-sectional area of wire is  $10^{-6} \text{ m}^2$  then potential gradient will be (2001)**

**Options:**

- A.  $10^{-2}$  volt / m
- B.  $10^{-4}$  volt / m
- C.  $10^{-6}$  volt / m
- D.  $10^{-8}$  volt / m.

**Answer: A**

**Solution:**

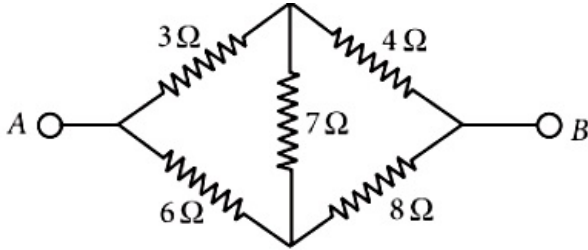
$$\frac{V}{l} = \frac{IR}{l} = \frac{I\rho l}{Al} = \frac{0.1 \times 10^{-7}}{10^{-6}}$$

$$= 0.01 = 10^{-2} \text{ V / m}$$


---

## Question105

The net resistance of the circuit between A and B is (2000)



**Options:**

- A.  $\frac{8}{3}\Omega$
- B.  $\frac{14}{3}\Omega$
- C.  $\frac{16}{3}\Omega$
- D.  $\frac{22}{3}\Omega$

**Answer: B**

**Solution:**

**Solution:**

This is a balanced Wheatstone's bridge so no current flows through the  $7\Omega$  resistor.

$$\therefore \frac{1}{R_{eq}} = \frac{1}{4+3} + \frac{1}{6+8} \text{ or } R_{eq} = \frac{14}{3}\Omega$$


---

## Question106

A car battery of emf 12 V and internal resistance  $5 \times 10^{-2}\Omega$ , receives a current of 60 amp from external source, then terminal potential difference of battery is (2000)

**Options:**

- A. 12 V
- B. 9 V
- C. 15 V

D. 20 V .

**Answer: C**

**Solution:**

$$\frac{V - E}{r} = I \Rightarrow \frac{V - 12}{5 \times 10^{-2}} = 60$$
$$\Rightarrow V = 15 \text{ V}$$

---

## Question107

**Two bulbs of (40 W , 200 V ) , and (100 W , 200 V ) . Then correct relation for their resistances (2000)**

**Options:**

A.

$$R_{40} < R_{100}$$

B.  $R_{40} > R_{100}$

C.  $R_{40} = R_{100}$

D. no relation can be predicted.

**Answer: B**

**Solution:**

$$P = \frac{V^2}{R} \text{ or, } R \propto \frac{1}{P}$$

$$\therefore R_{40} > R_{100}$$

---

## Question108

**The potentiometer is best for measuring voltage, as (2000)**

**Options:**

A. it has a sensitive galvanometer and gives null deflection

B. it has wire of high resistance

C. it measures p.d. in closed circuit



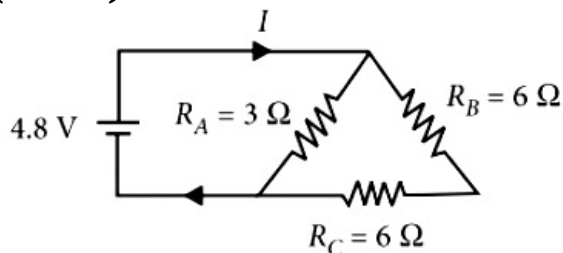
D. it measures p.d in open circuit.

**Answer: A**

---

## Question109

**The current in the given circuit is (1999)**



**Options:**

A. 4.9 A

B. 6.8 A

C. 8.3 A

D. 2.0 A

**Answer: D**

**Solution:**

In given circuit  $R_B$  and  $R_C$  are in series.

$$\therefore R_{BC} = 6 + 6 = 12\Omega$$

Now,  $R_A$  and  $R_{BC}$  are in parallel.

Therefore, equivalent resistance of circuit,

$$R_{eq} = \frac{12 \times 3}{12 + 3} = \frac{36}{15}$$

$$\text{Using Ohm's law, } I = \frac{V}{R_{eq}} = \frac{4.8}{36/15} = 2 \text{ A}$$

---

## Question110

**The internal resistance of a cell of e.m.f.**

**2 V is  $0.1\Omega$ . It is connected to a resistance of  $3.9\Omega$ . The voltage across the cell will be (1999)**

**Options:**

- A. 1.95 V
- B. 1.9 V
- C. 0.5 V
- D. 2 V

**Answer: A**

**Solution:**

$$i = \frac{2}{4} = 0.5 \text{ Ampere}$$

$$V = \varepsilon - ir$$

$$\text{or } V = 2 - 0.5 \times 0.1 = 1.95 \text{ V}$$

---

## Question111

**In a meter bridge, the balancing length from the left end (standard resistance of one ohm is in the right gap) is found to be 20 cm. The value of the unknown resistance is (1999)**

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**Options:**

- A.  $0.8\Omega$
- B.  $0.5\Omega$
- C.  $0.4\Omega$
- D.  $0.25\Omega$

**Answer: D**

**Solution:**

**Solution:**

Metre bridge works on the principle of Wheatstone's bridge.

$$\therefore \frac{P}{Q} = \frac{1}{100-1}$$

$$\text{or, } P = \frac{1}{100-1} \times Q = \frac{20}{80} \times 1 = 0.25\Omega$$

---

## Question112

**A potentiometer consists of a wire of length 4 m and resistance  $10\Omega$ . It is connected to a cell of e.m.f. 2 V . The potential difference per unit**

**length of the wire will be  
(1999)**

**Options:**

- A. 5 V / m
- B. 2 V / m
- C. 0.5 V / m
- D. 10 V / m

**Answer: C**

**Solution:**

$$i = \frac{2}{10} = 0.2 \text{ A}, \quad \frac{R}{l} = \frac{10}{4}$$

Potential difference per unit length

$$= 0.2 \times \left( \frac{10}{4} \right) = 0.5 \text{ V / m}$$

---

## Question113

**The resistance of a discharge tube is  
(1999)**

**Options:**

- A. non-ohmic
- B. ohmic
- C. zero
- D. both (b) and (c)

**Answer: A**

---

## Question114

**Three equal resistors connected in series across a source of e.m.f. together dissipate 10 watt of power. What will be the power dissipated**

**in watt if the same resistors are connected in parallel across the same source of e.m.f.?  
(1998)**

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**Options:**

A. 30

B.  $\frac{10}{3}$

C. 10

D. 90

**Answer: D**

**Solution:**

For series,  $R_{eq} = 3r$

$$\text{Power} = \frac{V^2}{3r} = 10 \Rightarrow \frac{V^2}{r} = 30$$

For parallel  $R_{eq} = \frac{r}{3}$

$$\text{Power} = \frac{V^2}{\frac{r}{3}} = \frac{3V^2}{r} = 3 \times 30 = 90 \text{ watt}$$

---

## Question115

**A 5°C rise in temperature is observed in a conductor by passing a current. When the current is doubled the rise in temperature will be approximately  
(1998)**

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**Options:**

A. 20°C

B. 16°C

C. 10°C

D. 12°C

**Answer: A**

**Solution:**

$$H = I^2 R t = ms \Delta T$$

$$\frac{I_1^2}{I_2^2} = \frac{\Delta T_1}{\Delta T_2} \text{ or, } \Delta T_2 = \frac{\Delta T_1 I_2^2}{I_1^2}$$

$$\Delta T_2 = 5 \times \frac{(2I_1)^2}{I_1^2} = 20; \Delta T_2 = 20^\circ\text{C}$$

## Question 116

Three copper wires of lengths and crosssectional areas are  $(l, A)$ ,  $(2l, \frac{A}{2})$  and  $(\frac{l}{2}, 2A)$ . Resistance is minimum in (1997)

**Options:**

- A. wire of cross-sectional area  $2A$
- B. wire of cross-sectional area  $\frac{A}{2}$
- C. wire of cross-sectional area  $A$
- D. same in all three cases.

**Answer: A**

**Solution:**

**Solution:**

Three wires of lengths and cross-sectional areas =  $(l, A)$ ,  $(2l, \frac{A}{2})$  and  $(\frac{l}{2}, 2A)$ .

Resistance of a wire  $(R) \propto \frac{l}{A}$

For I<sup>st</sup> wire,  $R_1 \propto \frac{l}{A} = R$

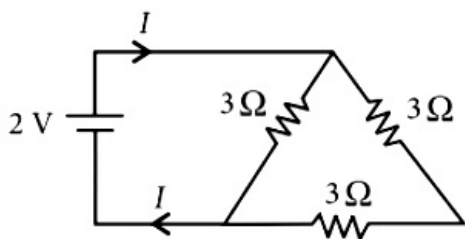
For II<sup>nd</sup> wire,  $R_2 \propto \frac{2l}{\frac{A}{2}} = 4R$

For III<sup>rd</sup> wire,  $R_3 \propto \frac{\frac{l}{2}}{2A} = \frac{R}{4}$

Therefore resistance of the wire will be minimum for III<sup>rd</sup> wire.

## Question 117

The current in the following circuit is (1997)



**Options:**

- A.  $\frac{2}{3}$  A
- B. 1 A
- C.  $\frac{1}{8}$  A
- D.  $\frac{2}{9}$  A.

**Answer: B**

**Solution:**

**Solution:**

Applied voltage (V) = 2 V and resistances =  $3\Omega$ ,  $3\Omega$ ,  $3\Omega$ .

From the given circuit, we find that two resistances are in series and third resistance is in parallel. Therefore equivalent resistance for series resistances =  $3 + 3 = 6\Omega$ . Now it is connected parallel with  $3\Omega$  resistance. Therefore

$$\frac{1}{R} = \frac{1}{3} + \frac{1}{6} = \frac{3}{6} = \frac{1}{2} \text{ or } R = 2\Omega$$

And current flowing in the circuit (I)

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

## Question118

**Kirchhoff's first law, i.e.  $\sum i = 0$  at a junction, deals with the conservation of (1997, 1992)**

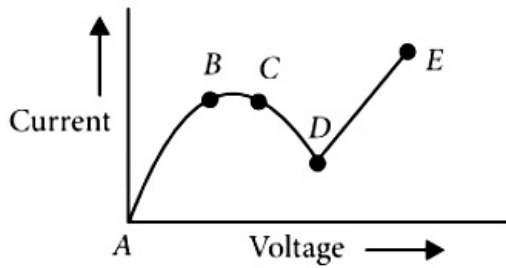
**Options:**

- A. momentum
- B. angular momentum
- C. charge
- D. energy

**Answer: C**

## Question119

From the graph between current (I ) and voltage (V ) is shown. Identify the portion corresponding to negative resistance



(1997)

Options:

- A. CD
- B. DE
- C. AB
- D. BC

**Answer: A**

**Solution:**

**Solution:**

For the negative resistance, when we increase the voltage, the current will decrease. Therefore from the graph, we find that the current in CD is decreased when voltage is increased.

-----

## Question120

A (100 W , 200 V ) bulb is connected to a 160 volts supply. The power consumption would be  
(1997)

Options:

- A. 100 W
- B. 125 W
- C. 64 W
- D. 80 W

**Answer: C**

**Solution:**

Power = 100 W; Voltage of bulb = 200 V and supply voltage ( $V_s$ ) = 160V .

Therefore resistance of bulb (R)

$$= \frac{V^2}{P} = \frac{(200)^2}{100} = 400\Omega$$

and power consumption (P)

$$= \frac{V_s^2}{R} = \frac{(160)^2}{400} = 64W$$

---

## Question121

**One kilowatt hour is equal to (1997)**

**Options:**

A.  $36 \times 10^{-5} \text{ J}$

B.  $36 \times 10^{-4} \text{ J}$

C.  $36 \times 10^5 \text{ J}$

D.  $36 \times 10^3 \text{ J}$

**Answer: C**

**Solution:**

$$\begin{aligned} 1\text{kW h} &= 1000\text{W h} \\ &= (1000\text{W}) \times (3600\text{s}) = 36 \times 10^5\text{J} \end{aligned}$$

---

## Question122

**If two bulbs, whose resistances are in the ratio of 1: 2 are connected in series, the power dissipated in them has the ratio of (1997)**

**Options:**

A. 2: 1

B. 1: 4

C. 1: 1

D. 1: 2 .

**Answer: D**



## Solution:

Ratio of resistance  $R_1 : R_2 = 1 : 2$

$$\text{or } \frac{R_1}{R_2} = \frac{1}{2}$$

In series combination, power dissipated ( $P$ ) =  $I^2 R$

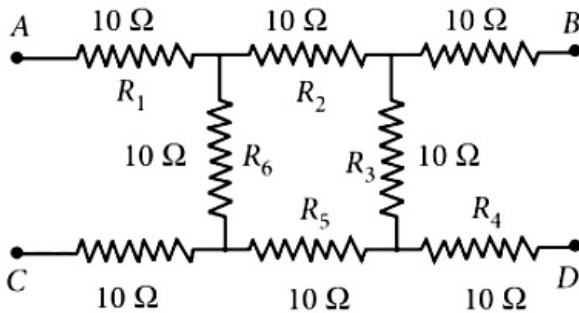
$$\Rightarrow P \propto R. \text{ Therefore } \frac{P_1}{P_2} = \frac{R_1}{R_2} = \frac{1}{2}$$

$$\text{or } P_1 : P_2 = 1 : 2$$

---

## Question123

What will be the equivalent resistance between the two points A and D?



(1996)

Options:

- A.  $30\Omega$
- B.  $40\Omega$
- C.  $20\Omega$
- D.  $10\Omega$ .

Answer: A

## Solution:

**Solution:**

Lower resistance on extreme left and upper resistance on extreme right are ineffective. The resistance  $R_2$  and  $R_3$  are in series combination. Therefore their equivalent resistance,

$$R' = R_2 + R_3 = 10 + 10 = 20\Omega$$

Similarly, the resistance  $R_5$  and  $R_6$  are in series combination. Therefore their equivalent resistance,

$$R'' = R_5 + R_6 = 10 + 10 = 20\Omega$$

Now the equivalent resistances  $R'$  and  $R''$  are in parallel combination. Therefore their equivalent resistance,

$$R''' = \frac{R'R''}{R' + R''} = \frac{20 \times 20}{20 + 20} = \frac{400}{40} = 10\Omega$$

Thus equivalent resistance between A and D,

$$R = R_1 + R''' + R_4 = 10 + 10 + 10 = 30\Omega (\because \text{series combination})$$

---

## Question124

**Two wires of the same metal have same length, but their cross-sections are in the ratio 3 : 1. They are joined in series. The resistance of thicker wire is  $10\Omega$ . The total resistance of the combination will be (1995)**

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**Options:**

- A.  $40\Omega$
- B.  $100\Omega$
- C.  $\left(\frac{5}{2}\right)\Omega$
- D.  $\left(\frac{40}{3}\right)\Omega$ .

**Answer: A**

**Solution:**

Ratio of cross-sectional areas of the wires = 3 : 1  
and resistance of thick wire ( $R_1$ ) =  $10\Omega$ .

$$\text{Resistance (R)} = \rho \frac{l}{A} \propto \frac{1}{A}$$

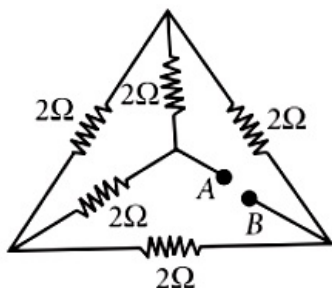
$$\text{Therefore } \frac{R_1}{R_2} = \frac{A_2}{A_1} = \frac{1}{3} \text{ or } R_2 = 3R_1 = 3 \times 10 = 30\Omega$$

and equivalent resistance of these two resistances in series combination  
=  $R_1 + R_2 = 30 + 10 = 40\Omega$

---

## Question 125

**In the network shown in the figure, each of the resistance is equal to  $2\Omega$ . The resistance between the points A and B is**



**(1995)**

**Options:**

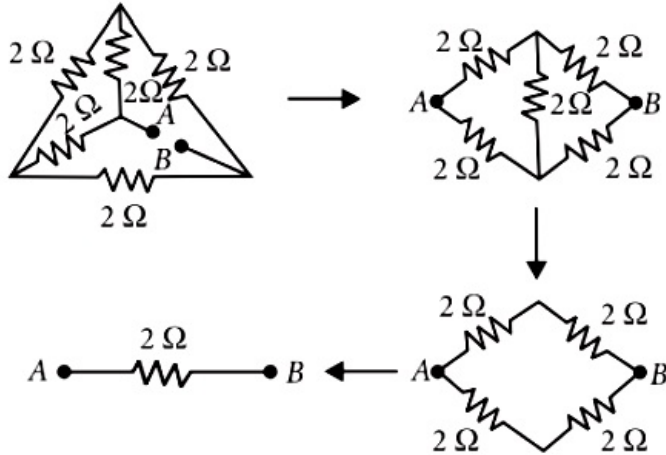
- A.  $3\Omega$
- B.  $4\Omega$
- C.  $1\Omega$

D.  $2\Omega$ .

**Answer: D**

**Solution:**

The circuit is equivalent to a balanced Wheatstone bridge. Therefore resistance between A and B is  $2\Omega$ .



---

## Question126

**In good conductors of electricity, the type of bonding that exists is (1995)**

**Options:**

- A. metallic
- B. vander Waals
- C. ionic
- D. covalent.

**Answer: A**

---

## Question127

**A heating coil is labelled  $100\text{ W}$ ,  $220\text{ V}$ . The coil is cut in half and the two pieces are joined in parallel to the same source. The energy now liberated per second is (1995)**

**Options:**

- A. 200 W
- B. 400 W
- C. 25 W
- D. 50 W

**Answer: B****Solution:****Solution:**

Power of heating coil = 100 W and voltage (V) = 220 volts. When the heating coil is cut into two equal parts and these parts are joined in parallel, the resistance of the coil is reduced to one-fourth of the previous value. Therefore energy liberated per second becomes 4 times. i.e.  $4 \times 100 = 400$  W .

## Question128

**A  $4\mu\text{F}$  capacitor is charged to 400 V . If its plates are joined through a resistance of  $2\text{ k}\Omega$ , then heat produced in the resistance is (1995)**

**Options:**

- A. 0.64 J
- B. 1.28 J
- C. 0.16 J
- D. 0.32 J

**Answer: D****Solution:**

Capacitance (C) =  $4\mu\text{F} = 4 \times 10^{-6} \text{ F}$  ;  
 Voltage (V) = 400 volts and resistance  
 (R) =  $2\text{ k}\Omega = 2 \times 10^3 \Omega$

$$\begin{aligned} \text{Heat produced} &= \text{Electrical energy stored} = \frac{1}{2}CV^2 \\ &= \frac{1}{2} \times (4 \times 10^{-6}) \times (400)^2 = 0.32 \text{ J} \end{aligned}$$

## Question129

**A wire 50 cm long and  $1\text{ mm}^2$  in crosssection carries a current of 4 A**

when connected to a 2 V battery. The resistivity of the wire is (1994)

**Options:**

- A.  $4 \times 10^{-6} \Omega \text{m}$
- B.  $1 \times 10^{-6} \Omega \text{m}$
- C.  $2 \times 10^{-7} \Omega \text{m}$
- D.  $5 \times 10^{-7} \Omega \text{m}$

**Answer: B**

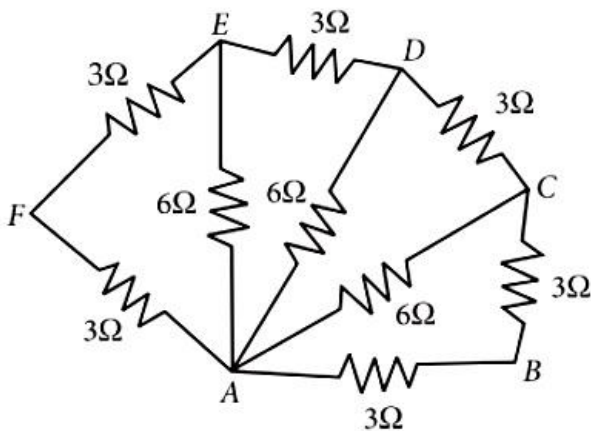
**Solution:**

Length ( $l$ ) = 50 cm = 0.5 m;  
Area ( $A$ ) =  $1 \text{ mm}^2 = 1 \times 10^{-6} \text{ m}^2$ ;  
Current ( $I$ ) = 4 A and voltage ( $V$ ) = 2 volts.  
Resistance ( $R$ ) =  $\frac{V}{I} = \frac{2}{4} = 0.5 \Omega$   
Resistivity ( $\rho$ ) =  $R \times \frac{A}{l} = 0.5 \times \frac{1 \times 10^{-6}}{0.5}$   
 $= 1 \times 10^{-6} \Omega \text{m}$

---

## Question130

Six resistors of  $3\Omega$  each are connected along the sides of a hexagon and three resistors of  $6\Omega$  each are connected along AC, AD and AE as shown in the figure. The equivalent resistance between A and B is equal to (1994)



**Options:**

- A.  $2\Omega$
- B.  $6\Omega$
- C.  $3\Omega$

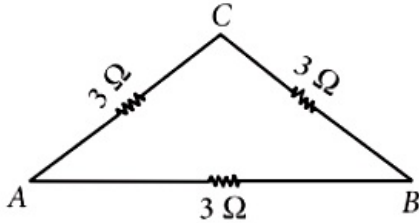
D.  $9\Omega$

**Answer: A**

**Solution:**

Resistances  $R_{AF}$  and  $R_{FE}$  are in series combination. Therefore their equivalent resistance  $R' = R_{AF} + R_{FE} = 3 + 3 = 6\Omega$ . Now the resistance  $R_{AE}$  and equivalent resistance  $R'$  are in parallel combination. Therefore relation for their equivalent resistance

$$\frac{1}{R''} = \frac{1}{R'} + \frac{1}{R_{AE}} = \frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3} \Rightarrow R'' = 3\Omega$$



We can calculate in the same manner for  $R_{ED}$ ,  $R_{AC}$ ,  $R_{DC}$  etc. and finally the circuit reduces as shown in the figure. Therefore, the equivalent resistance between A and B

$$= \frac{(3 + 3) \times 3}{(3 + 3) + 3} = \frac{18}{9} = 2\Omega$$

---

## Question131

**A flow of  $10^7$  electrons per second in a conducting wire constitutes a current of (1994)**

**Options:**

A.  $1.6 \times 10^{-12}$  A

B.  $1.6 \times 10^{26}$  A

C.  $1.6 \times 10^{-26}$  A

D.  $1.6 \times 10^{12}$  A.

**Answer: A**

**Solution:**

Flow of electrons,  $\frac{n}{t} = 10^7 / \text{sec.}$

$$\begin{aligned} \text{Therefore, current (I)} &= \frac{q}{t} = \frac{ne}{t} = \frac{n}{t} \times e \\ &= 10^7 \times (1.6 \times 10^{-19}) = 1.6 \times 10^{-12} \text{ A} \end{aligned}$$

---

## Question132

**Identify the set in which all the three materials are good conductors of electricity (1994)**

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**Options:**

- A. Cu, Hg and NaCl
- B. Cu, Ge and Hg
- C. Cu, Ag and Au
- D. Cu, Si and diamond.

**Answer: C**

---

## Question133

**An electric bulb is rated 60 W , 220 V . The resistance of its filament is (1994)**

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**Options:**

- A.  $870\ \Omega$
- B.  $780\ \Omega$
- C.  $708\ \Omega$
- D.  $807\Omega$

**Answer: D**

**Solution:**

Power (P) = 60W and voltage (V) = 220 volts. Resistance of the filament,

$$R = \frac{V^2}{P} = \frac{(220)^2}{60} = 807\Omega$$

---

## Question134

**Three resistances each of  $4\Omega$  are connected to form a triangle. The resistance between any two terminals is**

**(1993)****Options:**A.  $12\Omega$ B.  $2\Omega$ C.  $6\Omega$ D.  $\frac{8}{3}\Omega$ **Answer: D****Solution:****Solution:**

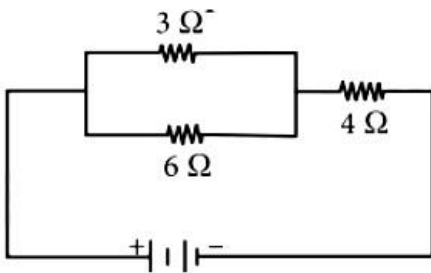
The two resistances are connected in series and the resultant is connected in parallel with the third resistance.

$$\therefore R = 4\Omega + 4\Omega = 8\Omega \text{ and } \frac{1}{R''} = \frac{1}{8} + \frac{1}{4} = \frac{3}{8}$$

$$\text{or } R'' = \frac{8}{3}\Omega$$

## Question 135

**Current through  $3\Omega$  resistor is 0.8 ampere, then potential drop through  $4\Omega$  resistor is**

**(1993)****Options:**

A. 9.6 V

B. 2.6 V

C. 4.8 V

D. 1.2 V

**Answer: C****Solution:**

Current across  $3\Omega = 0.8 \text{ A}$



$6\Omega$  is in parallel, current across  $6\Omega = 0.4\text{A}$   
Total current =  $1.2\text{ A}$   
 $\therefore$  Potential difference across  $4\Omega$  resistor  
=  $1.2\text{ A} \times 4\Omega = 4.8\text{ V}$

---

## Question136

**A battery of e.m.f  $10\text{ V}$  and internal resistance  $0.5\Omega$  is connected across a variable resistance  $R$ . The value of  $R$  for which the power delivered in it is maximum is given by (1992)**

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**Options:**

- A.  $0.5\Omega$
- B.  $1.0\Omega$
- C.  $2.0\Omega$
- D.  $0.25\Omega$

**Answer: A**

**Solution:**

**Solution:**

The output power of a cell is given by

$$P = \frac{V^2}{(r + R)^2} R$$

Maximum power is delivered to the load only when the internal resistance of the source is equal to the load resistance ( $R$ ). Then

$$P_{\max} = \frac{V^2}{4R} = \frac{V^2}{4r} (r = R)$$

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## Question137

**The velocity of charge carriers of current (about  $1\text{ ampere}$ ) in a metal under normal conditions is of the order of (1991)**

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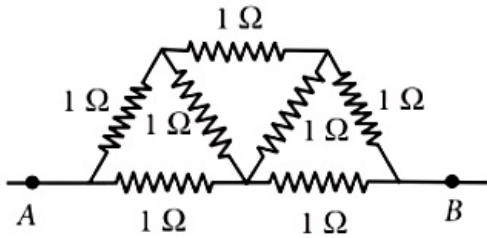
**Options:**

- A. a fraction of  $\text{mm / sec}$
- B. velocity of light
- C. several thousand metres/second
- D. a few hundred metres per second

Answer: A

## Question 138

In the network shown in figure each resistance is  $1\Omega$ . The effective resistance between A and B is (1990)

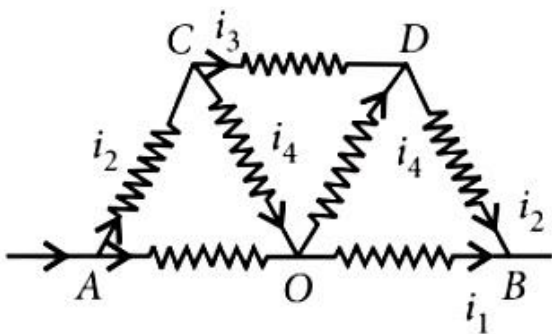


Options:

- A.  $\frac{4}{3}\Omega$
- B.  $\frac{3}{2}\Omega$
- C.  $7\Omega$
- D.  $\frac{8}{7}\Omega$

Answer: D

Solution:



By symmetry, currents  $i_1$  and  $i_2$  from A is the same as  $i_1$  and  $i_2$  reaching B. As the same current is flowing from A to O and O to B, O can be treated as detached from AB. Now CO and OD will be in series, hence its total resistance  $= 2\Omega$ . It is in parallel with CD, so equivalent resistance

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

This equivalent resistance is in series with AC and DB. So total resistance  $= \frac{2}{3} + 1 + 1 = \frac{8}{3}\Omega$

Now  $\frac{8}{3}\Omega$  is parallel to AB that is  $2\Omega$ . So total resistance

$$= \frac{\left(\frac{8}{3}\right) \times 2}{\left(\frac{8}{3}\right) + 2} = \frac{\frac{16}{3}}{\frac{14}{3}} = \frac{16}{14} = \frac{8}{7} \Omega$$


---

## Question139

Two identical batteries each of e.m.f 2 V and internal resistance  $1\Omega$  are available to produce heat in an external resistance by passing a current through it. The maximum power that can be developed across R using these batteries is (1990)

**Options:**

- A. 3.2 W
- B. 2.0 W
- C. 1.28 W
- D.  $\frac{8}{9}$  W

**Answer: B**

**Solution:**

**Solution:**

For maximum current, the two batteries should be connected in series. The current will be maximum when external resistance is equal to the total internal resistance of cells i.e.  $2\Omega$ . Hence power developed across the resistance R will be

$$I^2 R = \left( \frac{2E}{R + 2r} \right)^2 R = \left( \frac{2 \times 2}{2 + 2} \right)^2 \times 2 = 2 \text{ W}$$


---

## Question140

You are given several identical resistances each of value  $R = 10\Omega$  and each capable of carrying a maximum current of one ampere. It is required to make a suitable combination of these resistances of  $5\Omega$  which can carry a current of 4 ampere. The minimum number of resistances of the type R that will be required for this job is (1990)

**Options:**

- A. 4
- B. 10

C. 8

D. 20

**Answer: C**

**Solution:**

To carry a current of 4 ampere, we need four paths, each carrying a current of one ampere. Let  $r$  be the resistance of each path. These are connected in parallel. Hence their equivalent resistance will be  $\frac{r}{4}$ . According to the given problem

$$\frac{r}{4} = 5 \text{ or } r = 20\Omega$$

For this purpose two resistances should be connected. There are four such combinations. Hence, the total number of resistance  
 $= 4 \times 2 = 8$

---

## Question 141

**A current of 2 A, passing through a conductor produces 80 J of heat in 10 seconds. The resistance of the conductor in ohm is (1989)**

**Options:**

A. 0.5

B. 2

C. 4

D. 20

**Answer: B**

**Solution:**

$$H = I^2 R t \text{ or } R = \frac{H}{(I^2 t)} = \frac{80}{(2^2 \times 10)} = 2\Omega$$

---

## Question 142

**40 electric bulbs are connected in series across a 220 V supply. After one bulb is fused the remaining 39 are connected again in series across the same supply. The illumination will be (1989)**

**Options:**

- A. more with 40 bulbs than with 39
- B. more with 39 bulbs than with 40
- C. equal in both the cases
- D. in the ratio  $40^2 : 39^2$

**Answer: B**

**Solution:**

**Solution:**

since, the voltage is same for the two combinations, the resistance is less for 39 bulbs. Hence the combination of 39 bulbs will glow more as current is more.

-----

## Question 143

**n equal resistors are first connected in series and then connected in parallel. What is the ratio of the maximum to the minimum resistance? (1989)**

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**Options:**

- A. n
- B.  $\frac{1}{n^2}$
- C.  $n^2$
- D.  $\frac{1}{n}$

**Answer: C**

**Solution:**

In series  $R_s = nR$

In parallel  $\frac{1}{R_p} = \frac{1}{R} + \frac{1}{R} + \dots \dots n \text{ terms} = \frac{n}{R}$

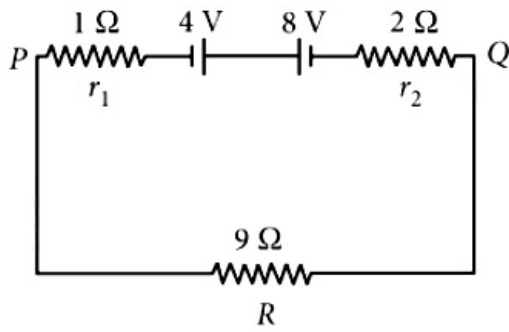
$$\Rightarrow R_p = \frac{R}{n} \therefore \frac{R_s}{R_p} = \frac{n^2}{1}$$

-----

## Question 144

**Two batteries of emf 4 V and 8 V with internal resistance  $1\Omega$  and  $2\Omega$  are connected in a circuit with resistance of  $9\Omega$  as shown in figure. The**

current and potential difference between the points P and Q are  
(1988)



**Options:**

- A.  $\frac{1}{3}$  A and 3 V
- B.  $\frac{1}{6}$  A and 4 V
- C.  $\frac{1}{9}$  A and 9 V
- D.  $\frac{1}{12}$  A and 12 V

**Answer: A**

**Solution:**

$$:I = \frac{8 - 4}{1 + 2 + 9} = \frac{4}{12} = \frac{1}{3} \text{ A}$$

$$V_P - V_Q = 4 - \frac{1}{3} \times 3 = 3 \text{ volt}$$

## Question145

The masses of the wires of copper is in the ratio of 1: 3: 5 and their lengths are in the ratio of 5 : 3 : 1. The ratio of their electrical resistance is  
(1988)

**Options:**

- A. 1: 3: 5
- B. 5: 3: 1
- C. 1: 25: 125
- D. 125: 15: 1

**Answer: D**

**Solution:**

$m = l \times \text{area} \times \text{density}$   
 $\text{Area} \propto \frac{m}{l}$

$R \propto l \text{Area} \propto \frac{l^2}{m}$

$R_1 : R_2 : R_3 = \frac{l_1^2}{m_1} : \frac{l_2^2}{m_2} : \frac{l_3^2}{m_3}$

$R_1 : R_2 : R_3 = \frac{25}{1} : \frac{9}{3} : \frac{1}{5} = 125 : 15 : 1$

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