Current Electricity

Question1

A wire of length 10cm and radius $\sqrt{7} \times 10^{-4}$m connected across the right gap of a meter bridge. When a resistance of 4.5Ω is connected on the left gap by using a resistance box, the balance length is found to be at 60cm from the left end. If the resistivity of the wire is $R \times 10^{-7}$Ωm, then value of R is :

[27-Jan-2024 Shift 1]

Options:

A.

63

B.

70

C.

66

D.

35

Answer: C

Solution:

For null point,

$$\frac{4.5}{60} = \frac{R}{40}$$

$$\text{Also, } R = \frac{\rho \ell}{A} = \frac{\rho \ell}{\pi r^2}$$

$$4.5 \times 40 = \rho \times \frac{0.1}{\pi \times 7 \times 10^{-8}} \times 60$$

$$\rho = 66 \times 10^{-7} \Omega \times \text{m}$$

Question2

A wire of resistance R and length L is cut into 5 equal parts. If these parts are joined parallely, then resultant resistance will be :

[27-Jan-2024 Shift 1]

Options:

A.

$\frac{1}{25}R$

B.

$\frac{1}{5}R$

C.

25R

D.

5R

Answer: A

Solution:

$$\text{Resistance of each part} = \frac{R}{5}$$

$$\text{Total resistance} = \frac{1}{5} \times \frac{R}{5} = \frac{R}{25}$$

Question3

A current of 200μA deflects the coil of a moving coil galvanometer through 60°. The current to cause deflection through π/10 radian is :

[27-Jan-2024 Shift 2]

Options:

A.

30μA

B.

120μA

C.

60μA

D.

180μA

Answer: D

Solution:

i ∝ θ (angle of deflection)

$$\therefore \frac{i_2}{i_1} = \frac{\theta_2}{\theta_1} \Rightarrow \frac{i_2}{200\mu A} = \frac{\pi/10}{\pi/3} = \frac{3}{10}$$

$$\Rightarrow i_2 = 60\mu A$$

Question4

Wheatstone bridge principle is used to measure the specific resistance (S1) of given wire, having length L, radius r. If X is the resistance of wire, then specific resistance is : $S_1 = X\left(\frac{\pi r^2}{L}\right)$. If the length of the wire gets doubled then the value of specific resistance will be :

[27-Jan-2024 Shift 2]

Options:

A.

$S_1/4$

B.

$2S_1$

C.

$S_1/2$

D.

S_1

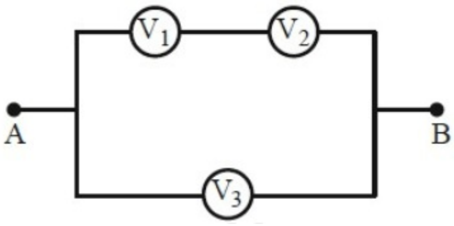
Answer: D

Solution:

As specific resistance does not depends on dimension of wire so, it will not change.

Question5

Three voltmeters, all having different internal resistances are joined as shown in figure. When some potential difference is applied across A and B, their readings are V_1,V_2 and V_3. Choose the correct option.



[27-Jan-2024 Shift 2]

Options:

A.

$V_1 = V_2$

B.

$V_1 \neq V_3 - V_2$

C.

$V_1 + V_2 > V_3$

D.

$V_1 + V_2 = V_3$

Answer: D

Solution:

From KVL,

$V_1 + V_2 - V_3 = 0 \Rightarrow V_1 + V_2 = V_3$

Question6

The electric current through a wire varies with time as $I = I_0 + \beta\, t$. where $I_0 = 20A$ and $\beta = 3A/s$. The amount of electric charge crossed through a section of the wire in 20 s is :

[29-Jan-2024 Shift 1]

Options:

A.

80C

B.

1000C

C.

800C

D.

1600C

Answer: B

Solution:

Given that

Current $I = I_0 + \beta t$

$I_0 = 20A$

$\beta = 3A/s$

$I = 20 + 3t$

$\frac{dq}{dt} = 20 + 3t$

$\int_0^q dq = \int_0^{20} (20 + 3t)\, dt$

$q = \int_0^{20} 20\, dt + \int_0^{20} 3\, tdt$

$q = \left[20t + \frac{3t^2}{2}\right]_0^{20} = 1000C$

Question7

A galvanometer having coil resistance 10Ω shows a full scale deflection for a current of 3mA. For it to measure a current of 8A, the value of the shunt should be:

[29-Jan-2024 Shift 1]

Options:

A.

$3 \times 10^{-3} \Omega$

B.

$4.85 \times 10^{-3} \Omega$

C.

$3.75 \times 10^{-3} \Omega$

D.

$2.75 \times 10^{-3} \Omega$

Answer: C

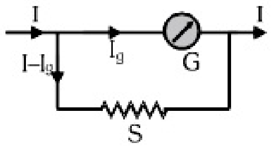
Solution:

Given $G = 10\Omega$

$I_g = 3\text{ mA}$

$I = 8A$

In case of conversion of galvanometer into ammeter.



We have $I_g G = (I - I_g)S$

$$S = \frac{I_g G}{I - I_g}$$

$$S = \frac{(3 \times 10^{-3})10}{8 - 0.003} = 3.75 \times 10^{-3}\Omega$$

Question8

The deflection in moving coil galvanometer falls from 25 divisions to 5 division when a shunt of 24Ω is applied. The resistance of galvanometer coil will be :

[29-Jan-2024 Shift 1]

Options:

A.

12Ω

B.

96Ω

C.

48Ω

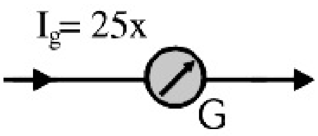
D.

100Ω

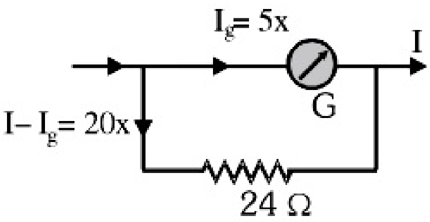
Answer: B

Solution:

Let $x =$ current/division



After applying shunt



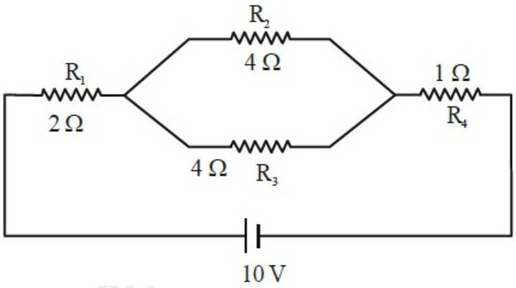
Now $5x \times G = 20x \times 24$

$G = 4 \times 24$

$G = 96\Omega$

Question9

In the given circuit, the current in resistance R_3 is :



[29-Jan-2024 Shift 2]

Options:

A.

1A

B.

1.5A

C.

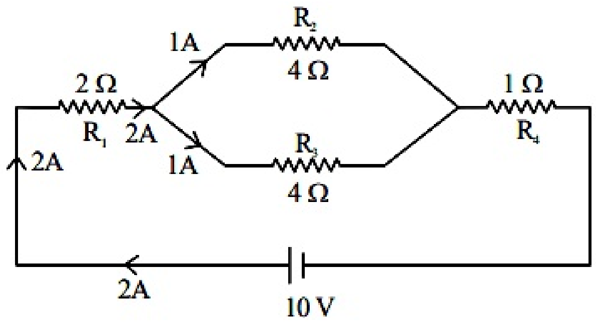
2A

D.

2.5A

Answer: A

Solution:



$R_{eq} = 2\Omega + 2\Omega + 1\Omega = 5\Omega$

$i = \frac{V}{R_{eq}} = \frac{10}{5} = 2A$

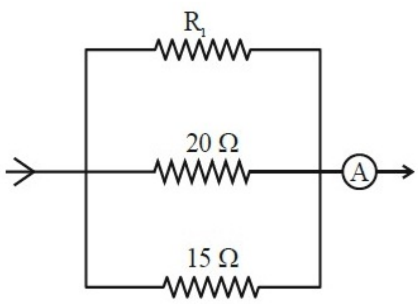
Current in resistance $R_3 = 2 \times \left(\frac{4}{4+4}\right)$

$= 2 \times \frac{4}{8}$

$= 1A$

Question10

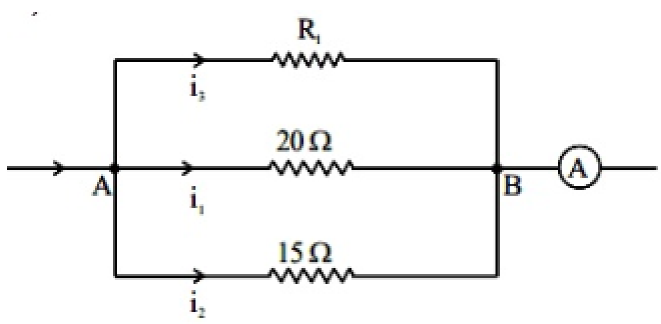
In the given circuit, the current flowing through the resistance 20Ω is 0.3A, while the ammeter reads 0.9 A. The value of R1 is_____ Ω.



[29-Jan-2024 Shift 2]

Answer: 30

Solution:



Given, $i_1 = 0.3A$, $i_1 + i_2 + i_3 = 0.9A$

So, $V_{AB} = i_1 \times 20\Omega = 20 \times 0.3V = 6V$

$$i_2 = \frac{6V}{15\Omega} = \frac{2}{5}A$$

$$i_1 + i_2 + i_3 = \frac{9}{10}A$$

$$\frac{3}{10} + \frac{2}{5} + i_3 = \frac{9}{10}$$

$$\frac{7}{10} + i_3 = \frac{9}{10}$$

$$i_3 = 0.2A$$

So, $i_3 \times R_1 = 6V$

$$(0.2)R_1 = 6$$

$$R_1 = \frac{6}{0.2} = 30\Omega$$

Question11

An electric toaster has resistance of 60Ω at room temperature (27°C). The toaster is connected to a 220V supply. If the current flowing through it reaches 2.75A, the temperature attained by toaster is around : (if $\alpha = 2 \times 10^{-4}/°C$)

[30-Jan-2024 Shift 1]

Options:

A.

694°C

B.

1235°C

C.

1694°C

D.

1667°C

Answer: C

Solution:

$R_{T=27} = 60\Omega,\ R_T = \frac{220}{2.75} = 80\Omega$

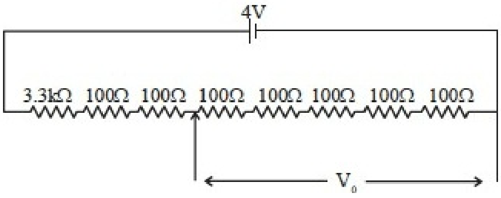
$R = R_0(1 + \alpha \Delta T)$

$80 = 60[1 + 2 \times 10^{-4}(T - 27)]$

$T \approx 1694^\circ C$

Question12

A potential divider circuit is shown in figure. The output voltage V_0 is



[30-Jan-2024 Shift 1]

Options:

A.

4V

B.

2mV

C.

0.5V

D.

12mV

Answer: C

Solution:

$R_{eq} = 4000\Omega$

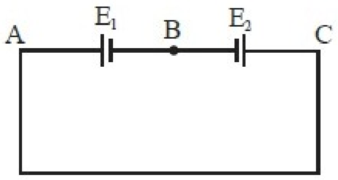
$i = \frac{4}{4000} = \frac{1}{1000}\text{A}$

$V_0 = i\,.\,R = \frac{1}{1000} \times 500 = 0.5\text{V}$

Question13

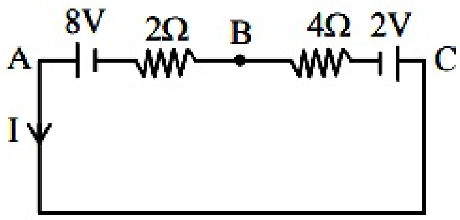
Two cells are connected in opposition as shown. Cell E_1 is of 8V emf

and 2Ω internal resistance; the cell E_2 is of 2V emf and 4Ω internal resistance. The terminal potential difference of cell E_2 is:



[30-Jan-2024 Shift 1]

Solution:



$I = \frac{8-2}{2+4} = \frac{6}{6} = 1A$

Applying Kirchhoff from C to B

$V_C - 2 - 4 \times 1 = V_B$

$V_C - V_B = 6V$

$= 6V$

Question14

When a potential difference V is applied across a wire of resistance R, it dissipates energy at a rate W. If the wire is cut into two halves and these halves are connected mutually parallel across the same supply, the same supply, the energy dissipation rate will become:

[30-Jan-2024 Shift 2]

Options:

A.

1/4W

B.

1/2W

C.

2W

D.

4W

Answer: D

Solution:

$$\frac{v^2}{R} = W \text{ ....(i)}$$

$$\frac{v^2}{\frac{1}{2}\left(\frac{R}{2}\right)} = W' \text{ ....(ii)}$$

From (i) & (ii), we get

$W' = 4W$

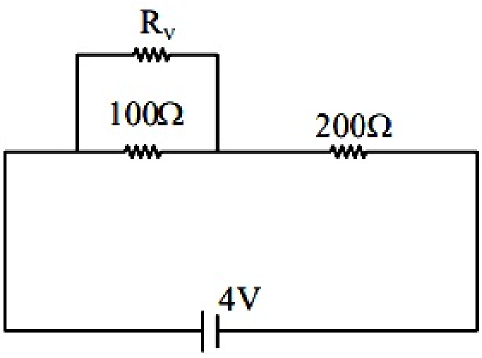
Question15

Two resistance of 100Ω and 200Ω are connected in series with a battery of 4V and negligible internal resistance. A voltmeter is used to measure voltage across 100Ω resistance, which gives reading as 1V. The resistance of voltmeter must be ______Ω

[30-Jan-2024 Shift 2]

Answer: 200

Solution:



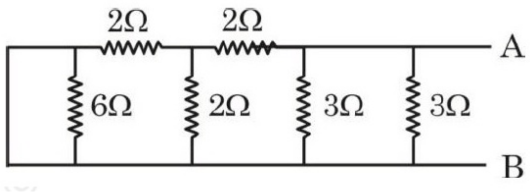
$$\frac{R_v 100}{R_v + 100} = \frac{200}{3}$$

$3R_v = 2R_v + 200$

$R_v = 200$

Question16

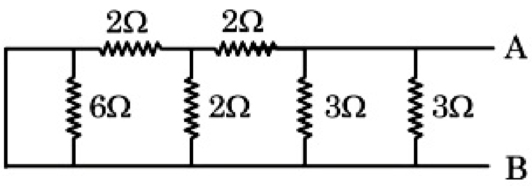
Equivalent resistance of the following network is Ω.



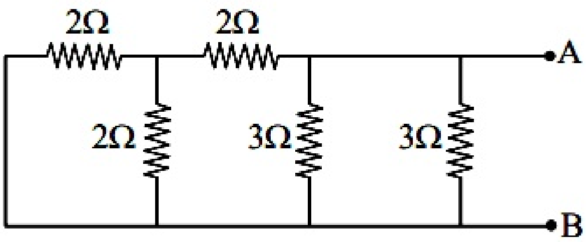
[31-Jan-2024 Shift 1]

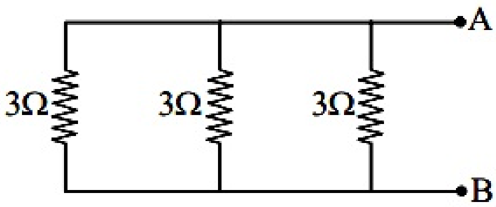
Answer: 1

Solution:



6Ω is short circuit





$R_{eq} = 3 \times \frac{1}{3} = 1\Omega$

Question17

The resistance per centimeter of a meter bridge wire is r, with XΩ resistance in left gap. Balancing length from left end is at 40cm with 25Ω resistance in right gap. Now the wire is replaced by another wire of 2r resistance per centimeter. The new balancing length for same settings will be at

[31-Jan-2024 Shift 2]

Options:

A.

20 cm

B.

10 cm

C.

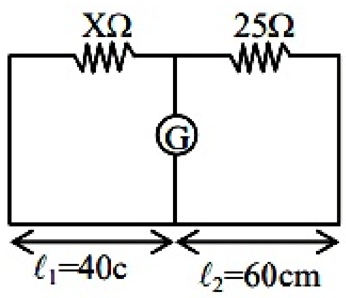
80 cm

D.

40 cm

Answer: D

Solution:



$$\frac{25}{r\ell_1} = \frac{X}{r\ell_2} \text{ ....(i)}$$

$$\frac{25}{2r\ell_1'} = \frac{X}{2r\ell_2'} \text{ ....(ii)}$$

From (i) and (ii)

$\ell_2' = \ell_2 = 40 \text{ cm}$

Question18

By what percentage will the illumination of the lamp decrease if the current drops by 20% ?

[31-Jan-2024 Shift 2]

Options:

A.

46%

B.

26%

C.

36%

D.

56%

Answer: C

Solution:

$P = i^2R$

$P_{int} = I_{int}{}^2R$

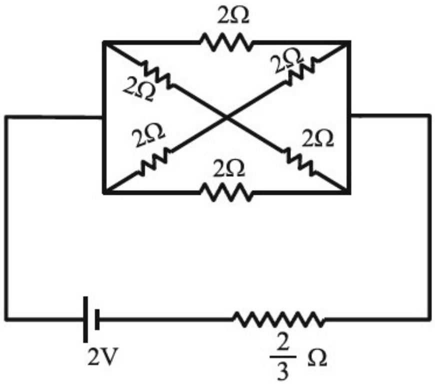
$P_{final} = (0.8I_{int})^2R$

% change in power =

$\frac{P_{final} - P_{int}}{P_{int}} \times 100 = (0.64 - 1) \times 100 = -36\%$

Question19

In the following circuit, the battery has an emf of 2 V and an internal resistance of 2/3Ω. The power consumption in the entire circuit is_______ W.



[31-Jan-2024 Shift 2]

Answer: 3

Solution:

$R_{eq} = \frac{4}{3}\Omega$

$\therefore P = \frac{V^2}{R_{eq}} = \frac{4}{4/3} = 3W$

Question20

A galvanometer has a resistance of 50Ω and it allows maximum current of 5mA. It can be converted into voltmeter to measure upto 100V by connecting in series a resistor of resistance

[1-Feb-2024 Shift 1]

Options:

A.

5975Ω

B.

20050Ω

C.

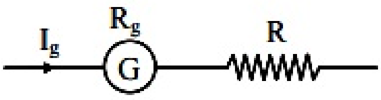
19950Ω

D.

19500Ω

Answer: C

Solution:



$$R = \frac{V}{I_g} - R_g = \frac{100}{5 \times 10^{-3}} - 50$$

$$= 20000 - 50$$

$$= 19950\Omega$$

Question21

The current in a conductor is expressed as $I = 3t^2 + 4t^3$, where I is in Ampere and t is in second. The amount of electric charge that flows through a section of the conductor during t = 1 s to t = 2 s is ______C.

[1-Feb-2024 Shift 1]

Answer: 22

Solution:

$$q = \int_1^2 i\,dt = \int_1^2 (3t^2 + 4t^3)\,dt$$

$$q = (t^3 + t^4)_1^2$$

$$q = 22C$$

Question22

In an ammeter, 5% of the main current passes through the galvanometer. If resistance of the galvanometer is G, the resistance of ammeter will be :

[1-Feb-2024 Shift 2]

Options:

A.

G/20

B.

G/199

C.

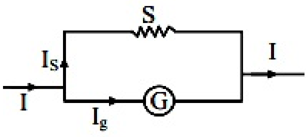
199G

D.

200G

Answer: A

Solution:



$I_S S = I_g G$

$\frac{95}{100} I S = \frac{5I}{100} G$

$S = \frac{G}{19}$

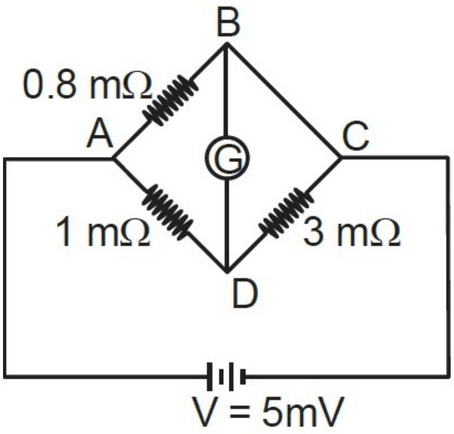
$R_A = \frac{SG}{S+G} = \frac{\frac{G^2}{19}}{\frac{20G}{19}}$

$R_A = \frac{G}{20}$

Question23

To measure the temperature coefficient of resistivity α of a semiconductor, an electrical arrangement shown in the figure is prepared. The arm BC is made up of the semiconductor. The experiment is being conducted at 25°C and resistance of the semiconductor arm is 3mΩ. Arm BC is cooled at a constant rate of 2°C/ s. If the

galvanometer G shows no deflection after 10 s, then α is :



[1-Feb-2024 Shift 2]

Options:

A.

$-2 \times 10 - 2°C^{-1}$

B.

$-1.5 \times 10^{-2}°C^{-1}$

C.

$-1 \times 10^{-2}°C^{-1}$

D.

$-2.5 \times 10^{-2}°C^{-1}$

Answer: C

Solution:

For no deflection $\frac{0.8}{1} = \frac{R}{3}$

$\Rightarrow R = 2.4 m\Omega$

Temperature fall in $10\ s = 20°C$

$\Delta R = R\alpha \Delta t$

$\alpha = \frac{\Delta R}{R \Delta t} = \frac{-0.6}{3 \times 20}$

$= -10^{-2} C^{-1}$

Question24

In a metre-bridge when a resistance in the left gap is 2Ω and unknown resistance in the right gap, the balance length is found to be 40cm. On shunting the unknown resistance with 2Ω, the balance length changes

by :

[1-Feb-2024 Shift 2]

Options:

A.

22.5 cm

B.

20 cm

C.

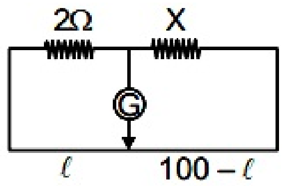
62.5 cm

D.

65 cm

Answer: A

Solution:



First case $\frac{2}{40} = \frac{X}{60} \Rightarrow X = 3\Omega$

In second case $X' = \frac{2 \times 3}{2+3} = 1.2\Omega$

$\frac{2}{\ell} = \frac{1.2}{100-\ell}$

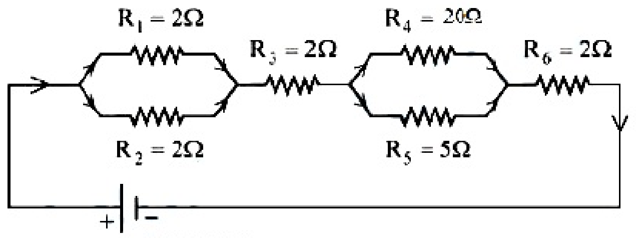
$200 - 2\ell = 1.2\ell$

$\ell = \frac{200}{3.2} = 62.5\text{ cm}$

Balance length changes by 22.5 cm

Question25

As shown in the figure, a network of resistors is connected to a battery of 24V with an internal resistance of 3Ω. The currents through the resistors R_4 and R_5 are I_4 and I_5 respectively. The values of I_4 and I_5 are :



(24V, 3Ω)
[24-Jan-2023 Shift 1]

Options:

A. $I_4 = \frac{8}{5}A$ and $I_5 = \frac{2}{5}A$

B. $I_4 = \frac{24}{5}A$ and $I_5 = \frac{6}{5}A$

C. $I_4 = \frac{6}{5}A$ and $I_5 = \frac{24}{5}A$

D. $I_4 = \frac{2}{5}A$ and $I_5 = \frac{8}{5}A$

Answer: D

Solution:

Solution:
Equivalent resistance of circuit
$R_{eq} = 3 + 1 + 2 + 4 + 2$
$= 12\Omega$
Current through battery $i = \frac{24}{12} = 2A$
$$I_4 = \frac{R_5}{R_4 + R_5} \times 2 = \frac{5}{20 + 5} \times 2 = \frac{2}{5}A$$
$$I_5 = 2 - \frac{2}{5} = \frac{8}{5}A$$

Question26

A hollow cylindrical conductor has length of 3.14 m, while its inner and outer diameters are 4 mm and 8 mm respectively. The resistance of the conductor is $n \times 10^{-3}\Omega$.

If the resistivity of the material is $2.4 \times 10^{-8}\Omega m$. The value of n is___
[24-Jan-2023 Shift 1]

Answer: 2

Solution:

$R = \rho \frac{\ell}{A}$, the cross-sectional area is $\pi(b^2 - a^2)$

$$R = \rho \frac{\ell}{\pi(b^2 - a^2)} = \frac{2.4 \times 10^{-8} \times 3.14}{3.14 \times (4^2 - 2^2) \times 10^{-6}}$$

$= 2 \times 10^{-3} \Omega$

$\rightarrow n = 2$

Question27

A cell of emf 90V is connected across series combination of two resistors each of 100Ω resistance. A voltmeter of resistance 400Ω is used to measure the potential difference across each resistor. The reading of the voltmeter will be :
[24-Jan-2023 Shift 2]

Options:

A. 40V

B. 45V

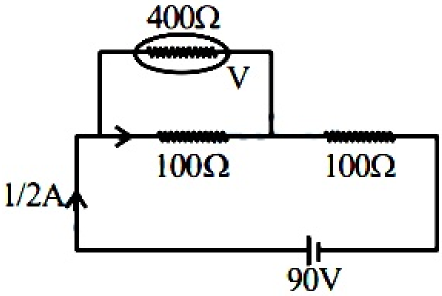
C. 80V

D. 90V

Answer: A

Solution:

Solution:



$$R_{eq} = \frac{400 \times 100}{500} + 100$$

$= 180\Omega$

$$i = \frac{90}{180} = \frac{1}{2} A$$

$$\text{Reading} = \frac{1}{2} \times \frac{400}{500} \times 100$$

$= 40$ volt

Question28

If a copper wire is stretched to increase its length by 20%. The percentage increase in resistance of the wire is___ %.
[24-Jan-2023 Shift 2]

Answer: 44

Solution:

Solution:
As volume is constant,
So resistance ∝ $(\text{length})^2$
$\Rightarrow\%$ change in resistance $= 20 + 20 + \frac{400}{100} = 44\%$

Question29

A uniform metallic wire carries a current 2A. when 3.4V battery is connected across it. The mass of uniform metallic wire is 8.92×10^{-3} kg. density is 8.92×10^{3} kg / m^3 and resistivity is $1.7 \times 10^{-8}\Omega - m$. The length of wire is :
[25-Jan-2023 Shift 1]

Options:

A. $l = 6.8m$

B. $l = 10m$

C. $l = 5m$

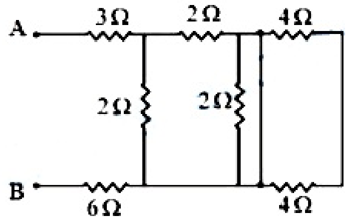
D. $l = 100m$

Answer: B

Solution:

Solution:
$I = 2A$
$\Delta V = 3.4V$
Using Ohm's Law
$R = \frac{3.4}{2} = 1.7\Omega$
$1.7 = \frac{\rho L}{A}$
$L = \frac{1.7(A)}{\rho}$
$M = (\text{ density volume })$
$\text{Volume} = \frac{8.92 \times 10^{-3}}{8.92 \times 10^{3}} = 10^{-6}$
$L^2 = \frac{1.7}{\rho}(10^{-6}) = \frac{1.7}{1.7} \times 10^{2}$
$L = 10m$

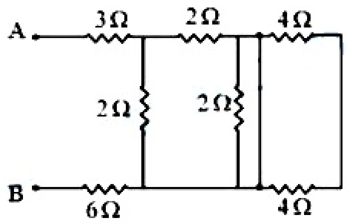
In the given circuit, the equivalent resistance between the terminal A and B is_______Ω.



[25-Jan-2023 Shift 1]

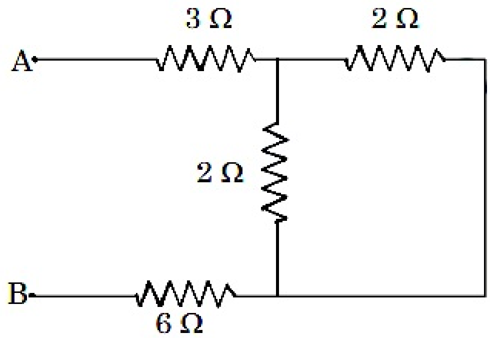
Solution:

Solution:



Both 4Ω resistance gets short.

Remove the resistors that have no current.



$R_{eq} = 3 - (2 | 2) + 6$

$R_{eq} = 3 - 1 + 6$

$R_{eq} = 10\Omega$

Question31

The resistance of a wire is 5Ω. It's new resistance in ohm if stretched to 5 times of it's original length will be :
[25-Jan-2023 Shift 2]

Options:

A. 625

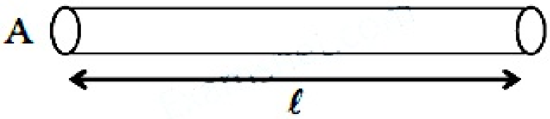
B. 5

C. 125

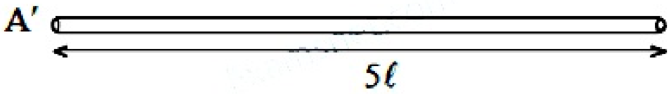
D. 25

Answer: C

Solution:



$R_{\text{initial}} = \frac{\rho\ell}{A} = 5\Omega$



∵ Volume of wire is constant in stretching

$V_i = V_f$

$A_i\ell_i = A_f\ell_f$

$A\ell = A'(5\ell)$

$A' = \frac{A}{5}$

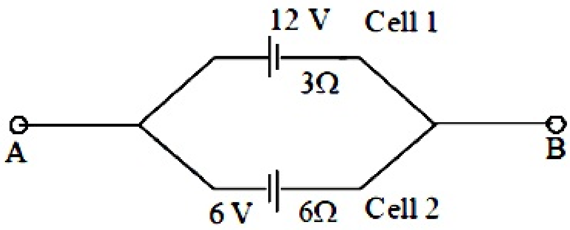
$R_f = \frac{\rho\ell_f}{A_f} = \frac{\rho(5\ell)}{\left(\frac{A}{5}\right)}$

$= 25\left(\frac{\rho\ell}{A}\right)$

$= 25 \times 5 = 125\Omega$

Question32

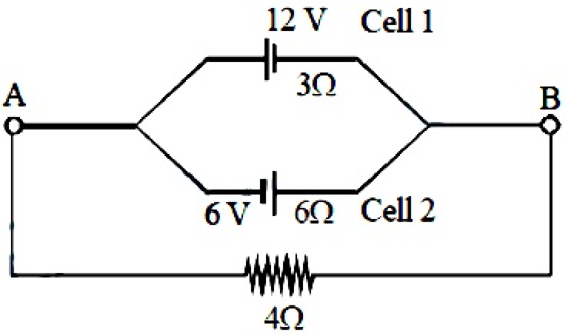
Two cells are connected between points A and B as shown. Cell 1 has emf of 12V and internal resistance of 3Ω. Cell 2 has emf of 6V and internal resistance of 6Ω. An external resistor R of 4Ω is connected across A and B. The current flowing through R will be _______ A.



[25 Jan 2023 Shift 2]

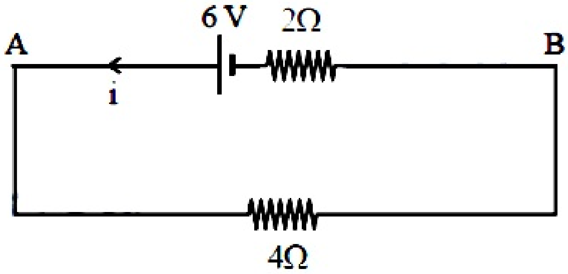
Answer: 1

Solution:



$$E_{eq} = \frac{\frac{12}{3} - \frac{6}{6}}{\frac{1}{3} + \frac{1}{6}}$$

$E_{eq} = 6V$
$r_{eq} = 2\Omega$
$R = 4\Omega$



So, $i = \frac{6}{2+4} = 1A$

Question33

With the help of potentiometer, we can determine the value of emf of a given cell. The sensitivity of the potentiometer is
(A) directly proportional to the length of the potentiometer wire
(B) directly proportional to the potential gradient of the wire
(C) inversely proportional to the potential gradient of the wire
(D) inversely proportional to the length of the potentiometer wire
Choose the correct option for the above statements:
[29-Jan-2023 Shift 2]

Options:

A. B and D only

B. A and C only

C. A only

D. C only

Answer: B

Solution:

Solution:
Sensitivity of potentiometer wire is inversely proportional to potential gradient.

Question34

When two resistance R_1 and R_2 connected in series and introduced into the left gap of a meter bridge and a resistance of 10Ω is introduced into the right gap, a null point is found at 60 cm from left side. When R_1 and R_2 are connected in parallel and introduced into the left gap, a resistance of 3Ω is introduced into the right-gap to get null point at 40 cm from left end. The product of R_1R_2 is ______ Ω^2
[29-Jan-2023 Shift 2]

Answer: 30

Solution:

Solution:
$$\frac{R_1 + R_2}{10} = \frac{60}{40} = \frac{3}{2} \Rightarrow R_1 + R_2 = 15$$
Now $$\frac{R_1R_2}{(R_1 + R_2) \times 3} = \frac{40}{60} = \frac{2}{3} \Rightarrow R_1R_2 = 30$$

Question35

The charge flowing in a conductor changes with time as $Q(t) = \alpha t - \beta t^2 + \gamma t^3$. Where α, β and γ are constants. Minimum value of current is :
[30-Jan-2023 Shift 1]

Options:

A. $\alpha - \frac{3\beta^2}{\gamma}$

B. $\alpha - \frac{\gamma^2}{3\beta}$

C. $\beta - \frac{\alpha^2}{3\gamma}$

D. $\alpha - \frac{\beta^2}{3\gamma}$

Answer: D

Solution:

Solution:
$$Q = (\alpha t - \beta t^2 + \gamma t^3)$$
$$i = \frac{dQ}{dt} = (\alpha - 2\beta t + 3\gamma t^2)$$

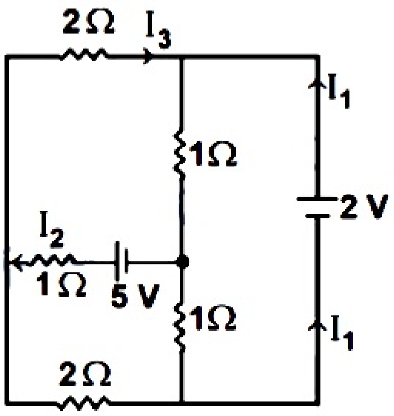
$\frac{di}{dt} = (3\gamma t - 2\beta) = 0$

$\Rightarrow t = \frac{\beta}{3\gamma}$

$i = (\alpha - 2\beta t + 3\gamma t^2) = \left(\alpha - \frac{\beta^2}{3\gamma}\right)$

Question36

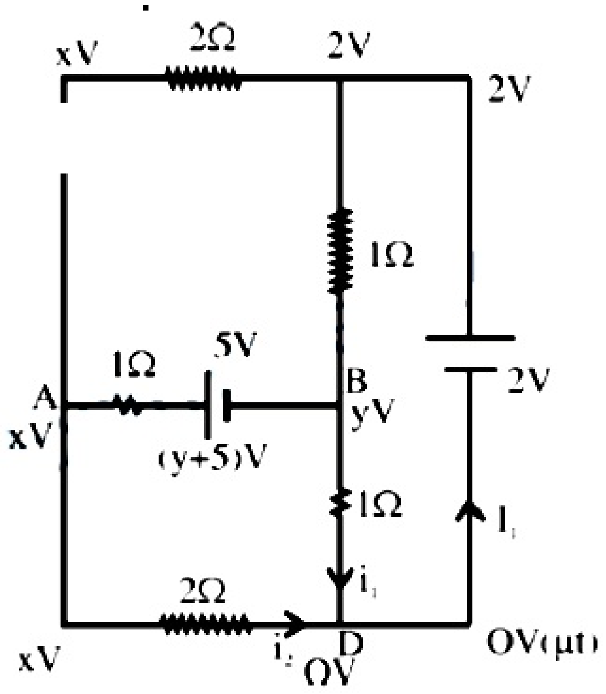
In the following circuit, the magnitude of current I_1, is ______ A.



[30-Jan-2023 Shift 1]

Solution:

:



Junction law at A,

$\frac{x - (y + 5)}{1} + \frac{x - 2}{2} + \frac{x - 0}{2} = 0 \ldots (1)$

Junction law at B,

$\frac{y + 5 - x}{1} + \frac{y - 0}{1} + \frac{y - 2}{1} = 0 \ldots (2)$

On solving equation (1) and Equation (2)

$x = 3$

\& $y = 0$

At D junction

$I_1 = i_1 + i_2$

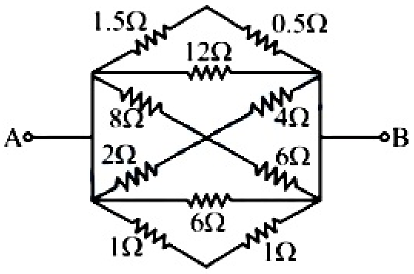
$I_1 = \frac{y-0}{1} + \frac{x-0}{2}$

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

$I_1 = 1.5A$

Question37

The equivalent resistance between A and B is



[30-Jan-2023 Shift 2]

Options:

A. $\frac{2}{3}\Omega$

B. $\frac{1}{2}\Omega$

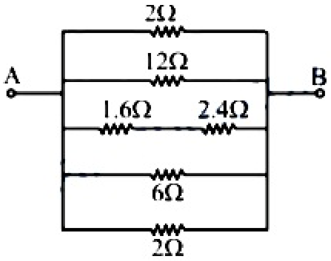
C. $\frac{3}{2}\Omega$

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

Answer: A

Solution:

Solution:



$\frac{1}{R_{eq}} = \frac{1}{2} + \frac{1}{12} + \frac{1}{4} + \frac{1}{6} + \frac{1}{2}$

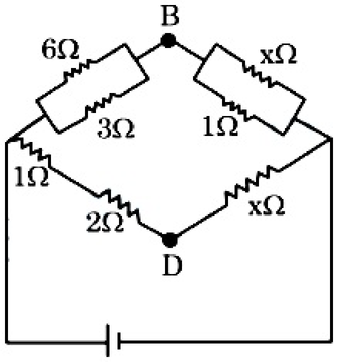
$= \frac{6+1+3+2+6}{12} = \frac{18}{12} = \frac{3}{2}$

$\Rightarrow R_{eq} = \frac{2}{3}\Omega$

Question38

If the potential difference between B and D is zero, the value of x is $\frac{1}{n}\Omega$.

The value of n is ______



[30-Jan-2023 Shift 2]

Answer: 2

Solution:

Solution:

$$\frac{2}{3} = \frac{\frac{x}{x+1}}{x}$$

$$\Rightarrow \frac{2}{3} = \frac{1}{x+1}$$

$$\Rightarrow \quad x = 0.5 = \frac{1}{2}$$

n = 2

Question39

The drift velocity of electrons for a conductor connected in an electrical circuit is V_d. The conductor in now replaced by another conductor with same material and same length but double the area of cross section. The applied voltage remains same. The new drift velocity of electrons will be
[31-Jan-2023 Shift 1]

Options:

A. V_d

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

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

D. $2V_d$

Answer: A

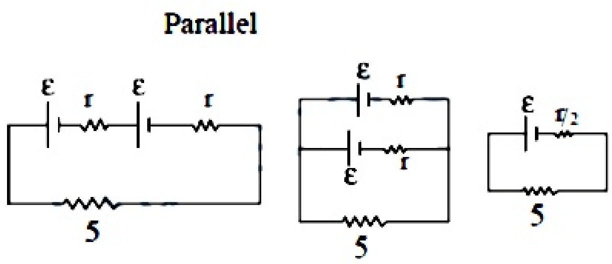
Solution:

$V_d = \frac{eE}{m}\tau$ that is independent of area

Question40

Two identical cells, when connected either in parallel or in series gives same current in an external resistance 5Ω. The internal resistance of each cell will be ________ Ω.
[31-Jan-2023 Shift 1]

Solution:



$i = \frac{2\varepsilon}{5 + 2r}(1)$ $i = \frac{\varepsilon}{\frac{r}{2} + 5}$ . . . (2)

Equating (1) and (2)

$\frac{2\varepsilon}{5 + 2r} = \frac{\varepsilon}{\frac{r}{2} + 5} \Rightarrow r + 10 = 5 + 2r$

$r = 5$ Ans. 5

Question41

The H amount of thermal energy is developed by a resistor in 10 s when a current of 4A is passed through it. If the current is increased to 16A, the thermal energy developed by the resistor in 10 s will be:
[31-Jan-2023 Shift 2]

Options:

A. H

B. 16H

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

D. 4H

Answer: B

Solution:

onstant

$\Rightarrow \frac{}{H'} = \left(\frac{}{16} \right)$

$\Rightarrow H' = 16H$

Question42

The number of turns of the coil of a moving coil galvanometer is increased in order to increase current sensitivity by 50%. The percentage change in voltage sensitivity of the galvanometer will be: [31-Jan-2023 Shift 2]

Options:

A. 100%

B. 50%

C. 75%

D. 0%

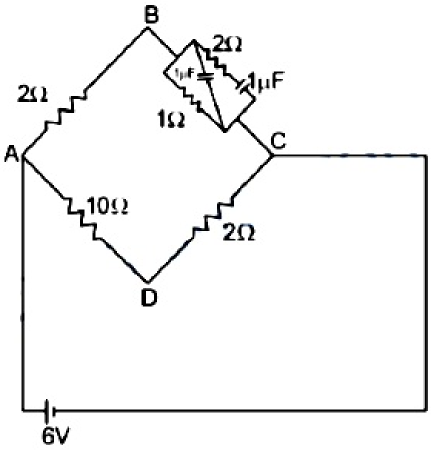
Answer: D

Solution:

Solution:
Current sensitivity = Voltage sensitivity $\times R$
Current sensitivity is made 1.5 times.
R also increase 1.5 times.
Hence voltage sensitivity $= \frac{1.5 \times \text{ current sensitivity}}{1.5 \times R}$
= no change

Question43

For the given circuit, in the steady state, $|V_B - V_D| =$

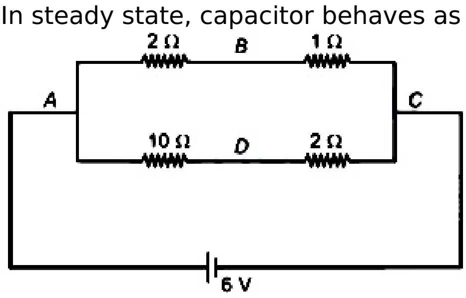


[31-Jan-2023 Shift 2]

Solution:

Solution:

In steady state, capacitor behaves as an open circuit. Circuit is :



$\Rightarrow i_{AB} = \frac{6}{3} = 2A$

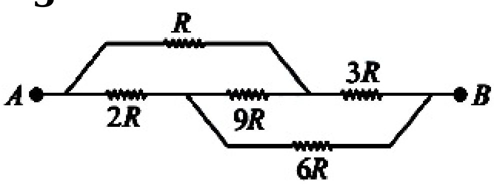
$i_{AD} = \frac{6}{12} = 0.5A$

$\Rightarrow V_B + 2 \times 2 - 10 \times 0.5 = V_D$

$\Rightarrow V_B - V_D = 1$ volt

Question44

The equivalent resistance between A and B of the network shown in figure:



[1-Feb-2023 Shift 1]

Options:

A. $11\frac{2R}{3}$

B. 14R

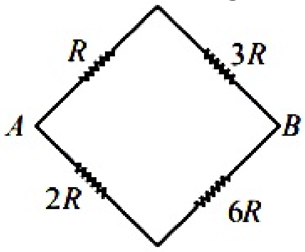
C. 21R

D. $\frac{8}{3}$R

Answer: D

Solution:

ɔne bridge is in balanced condition.



$$\frac{1}{R_{eq}} = \frac{1}{4R} + \frac{1}{8R}$$

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

Question45

Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R.
Assertion A : For measuring the potential difference across a resistance of 600Ω, the voltmeter with resistance 1000Ω will be preferred over voltmeter with resistance 4000Ω.
Reason R : Voltmeter with higher resistance will draw smaller current than voltmeter with lower resistance.
In the light of the above statements, choose the most appropriate answer from the options given below.
[1-Feb-2023 Shift 2]

Options:

A. A is not correct but R is correct

B. Both A and R are correct and R is the correct explanation of A

C. Both A and R are correct but R is not the correct explanation of A

D. A is correct but R is not correct

Answer: A

Solution:

Solution:
Error of voltmeter decreases with increase in its resistance.

Question46

Equivalent resistance between the adjacent corners of a regular n-sided polygon of uniform wire of resistance R would be:
[1-Feb-2023 Shift 2]

Options:

A. $\frac{(n-1)R}{n^2}$

B. $\frac{(n-1)R}{(2n-1)}$

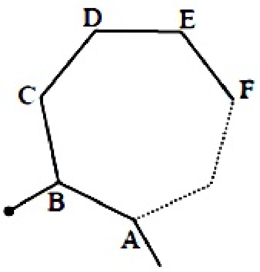
C. $\frac{n^2R}{n-1}$

D. $\frac{(n-1)R}{n}$

Answer: A

Solution:

Solution:



Suppose resistance of each arm is r, then $r = R/n$

$$R_{eq(AB)} = \frac{R_1R_2}{R_1 + R_2}$$

$$\frac{r(n-1)r}{r+(n-1)r}$$

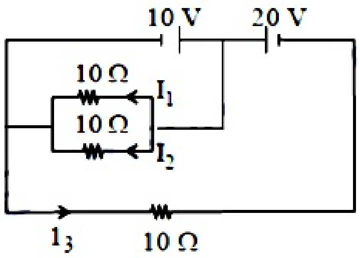
$$= \frac{r(n-1)r}{nr}$$

$$= \frac{n-1}{n}r$$

$$= \frac{(n-1)R}{n^2}$$

Question47

In the given circuit the value of $\left|\frac{I_1 + I_3}{I_2}\right|$ is:

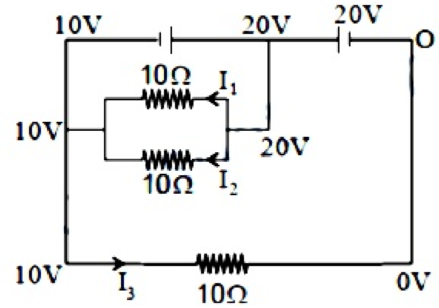


[1-Feb-2023 Shift 2]

Answer: 2

Solution:

Solution:



$;I_1 = I_2 = \frac{20-10}{10} = 1A$

$I_3 = 1A$

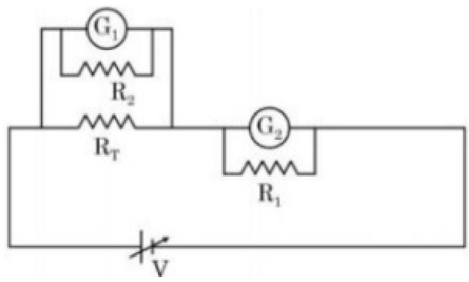
$\left|\frac{I_1 + I_3}{I_2}\right| = 2$

Question48

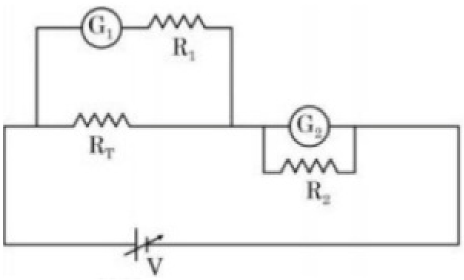
A student is provided with a variable voltage source V, a test resistor $R_T = 10\Omega$, two identical galvanometers G_1 and G_2 and two additional resistors, $R_1 = 10M\Omega$ and $R_2 = 0.001\Omega$. For conducting an experiment to verify ohm's law, the most suitable circuit is :
[6-Apr-2023 shift 2]

Options:

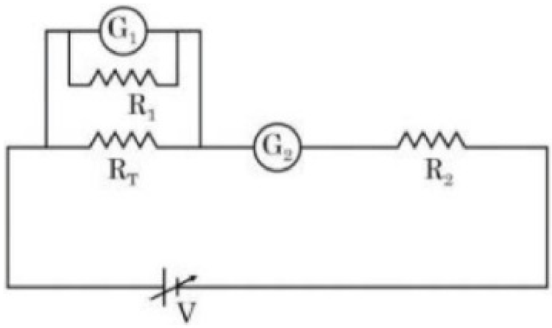
A.



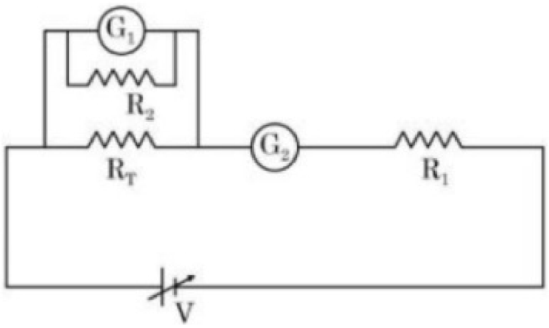
B.



C.



D.



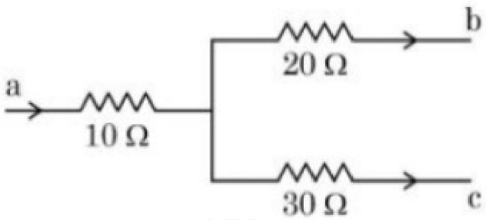
Answer: B

Solution:

Solution:
This question is based on the conceptual clarity that we should connect ammeter in series and voltmeter in parallel to measure current and potential difference, respectively
Also, when we use a galvanometer to create an ammeter, shunt resistance should be very small and should be in parallel.
When we create a voltemeter shunt should be large and in series with galvanometer.
All these criteria are satisfied in option (2)

Question49

Figure shows a part of an electric circuit. The potentials at points a, b and c are 30V, 12V and 2V respectively. The current through the 20Ω resistor will be



[6-Apr-2023 shift 2]

Options:

A. 1.0A

B. 0.2A

C. 0.4A

D. 0.6A

Answer: C

Solution:

Solution:

Let potential of the junction be x volts using junction law $i_i + i_2 + i_3 = 0$ or $\frac{x-30}{10} + \frac{x-12}{20} + \frac{x-2}{30} = 0$

or $\frac{1}{60}[6x - 180 + 3x - 36 + 2x - 4] = 0$

or $\frac{1}{60}[11x - 220] = 0$

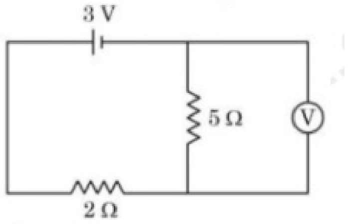
or $x = \frac{220}{11} = 20V$

current through 20Ω is $= \frac{x-12}{20}$

$i_2 = \frac{20-12}{20} = 0.4A$

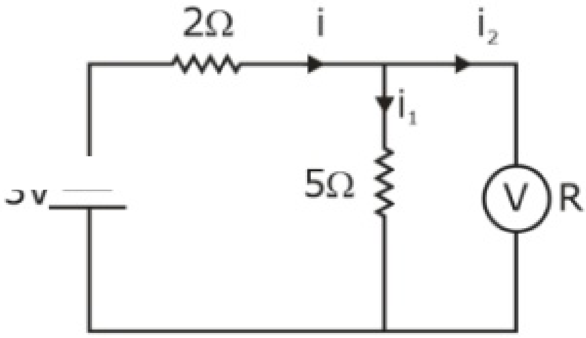
Question50

As shown in the figure, the voltmeter reads 2V across 5Ω resistor. The resistance of the voltmeter is _______ Ω.



[6-Apr-2023 shift 2]

Solution:



Method-I:

$R_{eq} = 2 + \frac{5R}{5+R} = \frac{10+7R}{5+R}$

$i = \frac{3}{R_{eq}} = \frac{3(5+R)}{10+7R}$

$i_1 = \frac{2}{5}, i_2 = \frac{2}{R}$

$i = i_1 + i^2$

$\frac{3(5+R)}{10+7R} = \frac{2}{5} + \frac{2}{R} = \frac{2(5+R)}{5R}$

$15R(5+R) = 2(5+R)(10+7R)$

$$75R + 15R^2 = 2(50 + 35R + 10R + 2R^2)$$
$$15R^2 + 75R = 14R^2 + 90R + 100$$
$$R^2 - 15R - 100 = 0$$
$$R = \frac{15\sqrt{225 \times 1 \times 100}}{2}$$
$$= \frac{15 \pm \sqrt{625}}{2} = \frac{15 \pm 25}{2}$$
$$R = 20\Omega$$

Method-II:
Given potential across 5Ω and voltmeter is 2V. To find resistance R of voltmeter.
Let current in 5Ω be i_1, and in Ri_2.

$$i_1 = \frac{2}{5} \text{ and } i_2 = \frac{2}{R}$$

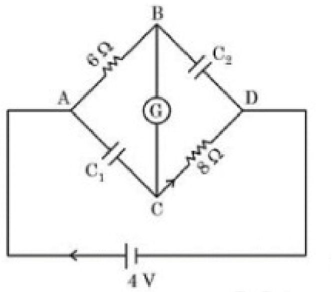
V across 2Ω will be 1 volt and $i = \frac{1}{2}A$.

Using junction law: $i = i_1 + i_2$

$$\frac{1}{2} = \frac{2}{5} + \frac{2}{R}$$
$$\frac{2}{R} = \frac{1}{2} - \frac{2}{5} = \frac{1}{10}$$
$$R = 20\Omega$$

Question51

In this figure the resistance of the coil of galvanometer G is 2Ω. The emf of the cell is 4V. The ratio of potential difference across C_1 and C_2 is:



[8-Apr-2023 shift 1]

Options:

A. $\frac{5}{4}$

B. 1

C. $\frac{4}{5}$

D. $\frac{3}{4}$

Answer: C

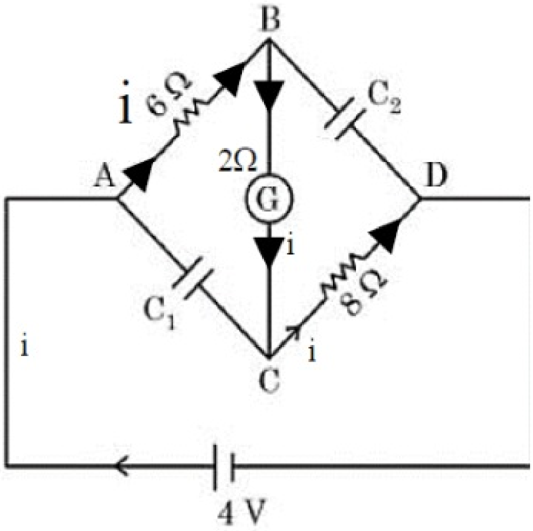
Solution:

Solution:
At steady state current will not be in the capacitor branch.

$$i = \frac{4}{6 + 2 + 8}$$
$$i = \frac{1}{4}A$$
$$\Delta V_{C_1} = i(6 + 2)$$

$\Delta V_{C_2} = i(2 + 8)$

$\frac{\Delta V_{C_1}}{\Delta V_{C_2}} = \frac{4}{5}$



Question52

A current of 2A through a wire of cross-sectional area $25.0 mm^2$. The number of free electrons in a cubic meter are 2.0×10^{28}. The drift velocity of the electrons is ______ $\times 10^{-6} ms^{-1}$ (given, charge on electron $= 1.6 \times 10^{-19} C$).
[8-Apr-2023 shift 1]

Answer: 25

Solution:

Solution:

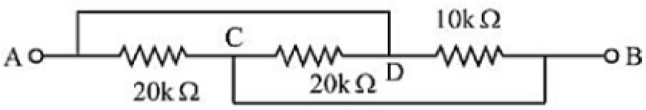
$I = neAV_d$

$V_d = \frac{I}{neA} \Rightarrow V_d = \frac{2}{2 \times 10^{28} \times 1.6 \times 10^{-19} \times 25 \times 10^{-6}}$

$V_d = 25 m / s$

Question53

The equivalent resistance between A and B as shown in figure is:



[8-Apr-2023 shift 2]

Options:

A. 20kΩ

B. 30kΩ

C. 5kΩ

D. 10kΩ

Answer: C

Solution:

Solution:
Potential different across all resistor is same
So they are in parallel

$$\frac{1}{R}=\frac{1}{20}++\frac{1}{20}+\frac{1}{10}$$

$R_{eq}=5k\Omega$

Question54

The number density of free electrons in copper is nearly $8\times10^{28}m^{-3}$. A copper wire has its area of cross section $=2\times10^{-6}m^{2}$ and is carrying a current of 3.2A. The drift speed of the electrons is _______ $\times10^{-6}ms^{-1}$ [8-Apr-2023 shift 2]

Answer: 125

Solution:

Solution:

$I=\ neAvd$

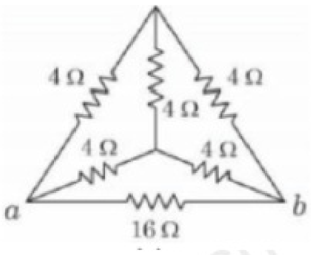
$\Rightarrow 3.2=8\times10^{28}\times1.6\times10^{-19}\times2\times10^{-6}(v_{d})$

$\Rightarrow v_{d}=\dfrac{1}{8\times10^{-6}\times10^{9}}$

$\Rightarrow v_{d}=125\times10^{-6}m/\ s$

Question55

The equivalent resistance of the circuit shown below between points a and b is :



[10-Apr-2023 shift 1]

Options:

A. 20Ω

B. 16Ω

C. 24Ω

D. 3.2Ω

Answer: D

Solution:

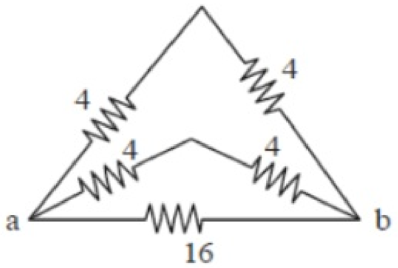
Solution:

$\frac{1}{R_{ab}} = \frac{1}{16} + \frac{1}{8} + \frac{1}{8}$

$= \frac{1}{R_{ab}} = \frac{1+2+2}{16} = \frac{5}{16}$

$R_{ab} = \frac{16}{5} = 3.2$

Balanced WSB



Question56

10 resistors each of resistance 10Ω can be connected in such as to get maximum and minimum equivalent resistance. The ratio of maximum and minimum equivalent resistance will be _______.
[10-Apr-2023 shift 1]

0

Solution:

Solution:

$R_{max} \Rightarrow$ in series $\Rightarrow 10R = 10 \times 10 = 100\Omega$

$R_{max} \Rightarrow$ in parallel $= \frac{R}{10} = \frac{10}{10} = 1\Omega$

$\frac{R_{max}}{R_{min}} = \frac{100}{1} = 100$ Ans.

$R_{min} \Rightarrow \frac{100}{1} = 100$ Ans.

Question57

In a metallic conductor, under the effect of applied electric field, the free electrons of the conductor
[10-Apr-2023 shift 2]

Options:

A. Move with the uniform velocity throughout from lower potential to higher potential

B. Move in the curved paths from lower potential to higher potential

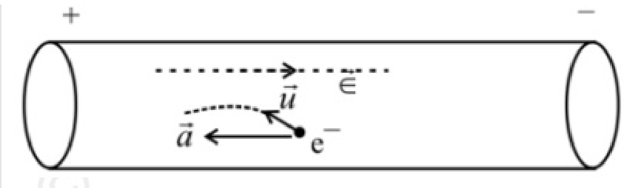
C. Move in the straight line paths in the same direction

D. Drift from higher potential to lower potential.

Answer: B

Solution:

Solution:
Electrons moves in curved path because there velocity $\vec{u}$ may make any angle θ with acceleration $\vec{a}$ between time interval of two successive collisions.



Also electron moves from lower potential to higher potential.

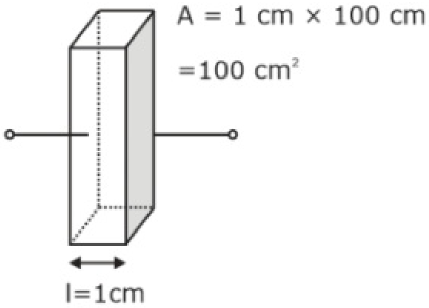
Question58

A rectangular parallelepiped is measured as 1 cm × 1 cm × 100 cm. If its specific resistance is $3 \times 10^{-7}\Omega m$, then the resistance between its tow opposite rectangular faces will be ________ $\times 10^{-7}\Omega$
[10-Apr-2023 shift 2]

Answer: 3

Solution:

Solution:
$\rho = 3 \times 10^{-7}\Omega - cm$
$R = \rho \cdot \frac{1}{A}$
$= \frac{3 \times 10^{-7} \times (10^{-2}m)}{(100 \times 10^{-4}m^2)} = 3 \times 10^{-7}$



Question59

Two identical heater filaments are connected first in parallel and then in series. At the same applied voltage, the ratio of heat produced in same time for parallel to series will be :
[11-Apr-2023 shift 1]

Options:

A. 1 : 2

B. 4 : 1

C. 1 : 4

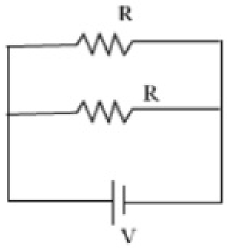
D. 2 : 1

Answer: B

Solution:

Solution:

$H_1 = \frac{V^2}{(R/2)}t = \frac{2V^2}{R} \dots (1)$



$H_2 = \frac{V^2}{2R}t$

$\frac{H_1}{H_2} = \left(\frac{2V^2t}{R}\right) \times \frac{2R}{V^2t} = \frac{4}{1}$

Question60

The current sensitivity of moving coil galvanometer is increased by 25%.This increase is achieved only by changing in the number of turns of coils and area of cross section of the wire while keeping the resistance of galvanometer coil constant. The percentage change in the

voltage sensitivity will be :
[11-Apr-2023 shift 1]

Options:

A. $+25\%$

B. -25%

C. -50%

D. Zero

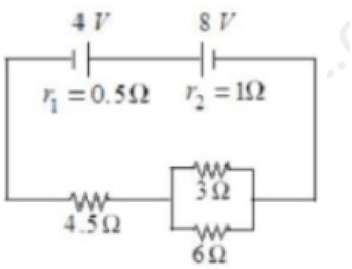
Answer: A

Solution:

Solution:
$\tau = \mathrm{mB}$ A = area of coil
$K\theta = \mathrm{IANB}$ B = magnetic field
$\frac{\theta}{I} = \frac{ANB}{K}$ Currect senstivity
$1.25\left(\frac{\theta}{I}\right)_2 = \left(\frac{\theta}{I}\right)_1 \ldots\ldots\ldots (1)$
$1.25\left[\frac{AN_2B}{K}\right] = \left[\frac{AN_1B}{K}\right]$
$1.25 = \frac{N_1}{N_2} = \frac{5}{4} \ldots\ldots (2)$
$\Rightarrow R = \frac{\delta\ell}{a} =$ const.
$\Rightarrow \ell = a$
Voltage sensitivity $= \frac{\theta}{V} = \frac{\theta}{\mathbb{R}} = \frac{\text{Current sensitivity}}{R}$
R = constant
Voltage sensitivity ∝ current sensitivity

Question61

In the circuit diagram shown in figure given below, the current flowing through resistance 3Ω is $\frac{x}{3}$A. The value of x is ________



[11-Apr-2023 shift 1]

Answer: 1

Solution:

$\text{Req.} = 0.5 + 1 + 4.5 + \left(\frac{3.6}{9}\right)$

$\text{Req.} = 6 + 2 = 8\Omega$

$I = \frac{8-4}{8} = \frac{1}{2}A = 0.5A$

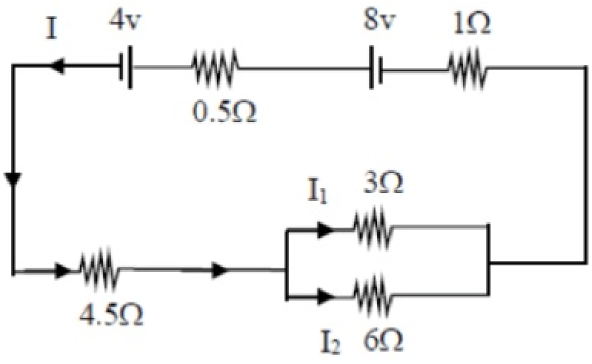
$I_1 : I_2 = \frac{1}{3} : \frac{1}{6}$

$I_1 : I_2 = 2 : 1$

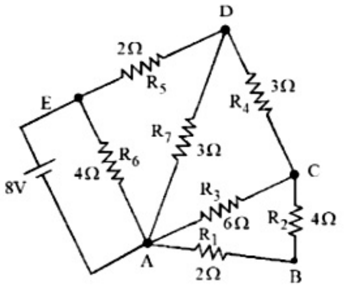
and $I_1 + I_2 = 0.5A$

$I_1 = \frac{2}{3} \times 0.5 = \frac{1}{3}A$

So $\frac{1}{3} = \frac{x}{3} \Rightarrow x = 1$



Question62



The current flowing through R_2 is:
[11-Apr-2023 shift 2]

Options:

A. $\frac{1}{3}A$

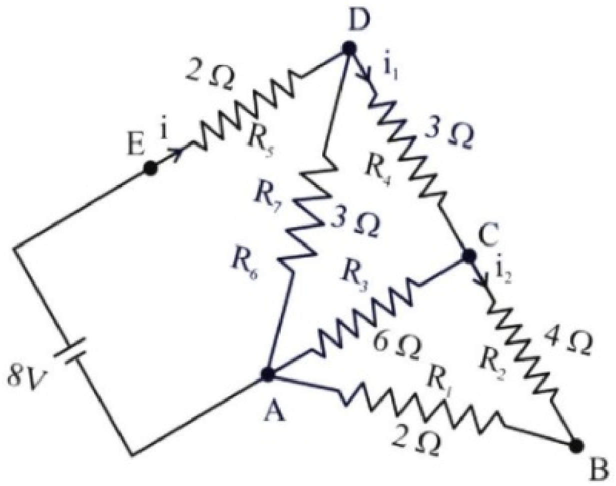
B. $\frac{1}{4}A$

C. $\frac{2}{3}A$

D. $\frac{1}{2}A$

Answer: A

Solution:



$R_{eq} = 4\Omega$

$i = \frac{8}{4} = 2A$

$i_1 = \frac{2 \times 3}{3+6} = \frac{2}{3}A$

$i_2 = \frac{2/3}{2} = \frac{1}{3}A$

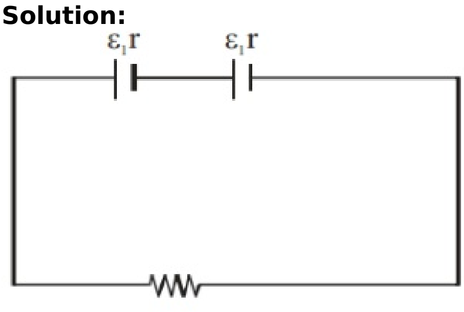
Question63

Two identical cells each of emf 1.5V are connected in series across a 10Ω resistance. An ideal voltmeter connected across 10Ω resistance reads 1.5V. The internal resistance of each cell is ________ Ω.
[11-Apr-2023 shift 2]

Answer: 5

Solution:

Solution:



$I = \frac{2\varepsilon}{10+2r} = \frac{1.5}{10}$

$20\varepsilon = 15 + 3r$

$\Rightarrow 20 \times 1.5 = 15 + 3r$

$\Rightarrow 30 = 15 + 3r$

$r = 5\Omega$

Question64

A wire of resistance 160Ω is melted and drawn in a wire of one-fourth of its length. The new resistance of the wire will be
[12-Apr-2023 shift 1]

Options:

A. 640Ω

B. 40Ω

C. 10Ω

D. 16Ω

Answer: C

Solution:

Solution:
Voulme remain same

$$A\ell = A'\ell'$$

$$A' = \frac{A\ell}{\ell'} = \frac{A\ell}{\ell / 4}$$

$$A' = 4A$$

$$L' = \frac{L}{4}$$

$$\frac{R'}{R} = \frac{\rho \frac{L'}{A'}}{\frac{L}{A}}$$

$$R' = R\left[\frac{L'}{A'} \times \frac{A}{L}\right]$$

$$R' = 160\left[\frac{L}{4L} \times \frac{A}{4A}\right]$$

$$R' = 10\Omega$$

Question65

The current flowing through a conductor connected across a source is 2A and 1.2A at 0°C and 100°C respectively. The current flowing through the conductor at 50°C will be ______ $\times 10^2$ mA
[12-Apr-2023 shift 1]

$$i_0 R_0 = i_{100} R_{100} \quad \text{(For same source)}$$

$$\Rightarrow 2R_0 = 1.2R(1 + 100\alpha)$$

$$\Rightarrow 1 + 100\alpha = \frac{5}{3} \Rightarrow 100\alpha = \frac{2}{3}$$

$\Rightarrow 50\alpha = \frac{1}{3}$

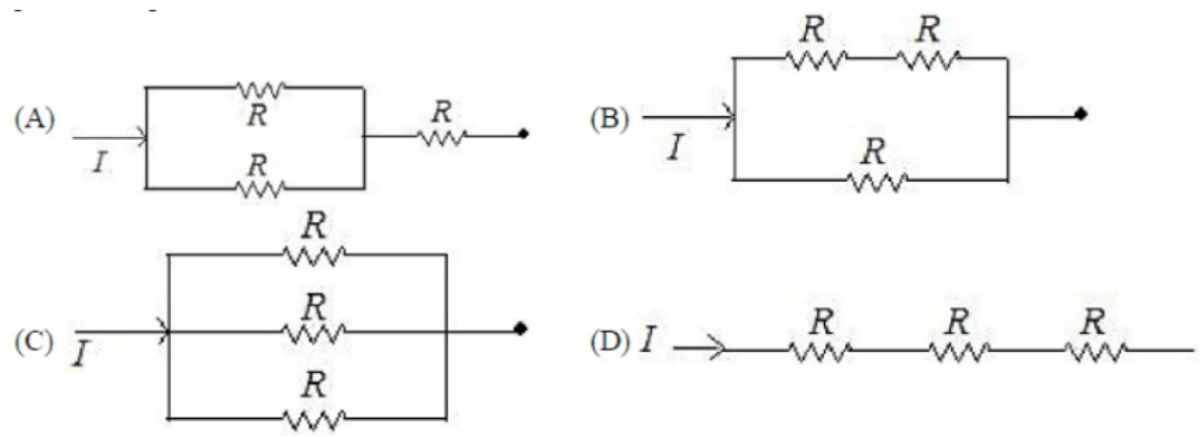
$\therefore i_{50}R_{50} = i_0R_0$

$\Rightarrow i_{50} = \frac{i_0R_0}{R_{50}} = \frac{2 \times R_0}{R_0(1 + 50\alpha)} = \frac{2}{1 + \frac{1}{3}} = 1.5A$

$= 15 \times 10^2 \text{ mA}$

Question66

Different combination of 3 resistors of equal resistance R are shown in the figures. The increasing order for power dissipation is:



[13-Apr-2023 shift 1]

Options:

A. $P_C < P_B < P_A < P_D$

B. $P_C < P_D < P_A < P_B$

C. $P_B < P_C < P_D < P_A$

D. $P_A < P_B < P_C < P_D$

Answer: A

Solution:

Power dissipation, $P = I^2R$

(A) $R_{eq} = \frac{R}{2} + R = \frac{3R}{2}$

(B) $R_{eq} = \frac{(2R)(R)}{2R + R} = \frac{2R}{3}$

(C) $R_{eq} = \frac{R}{3}$

(D)

$R_{eq} = 3R$

$R_D > R_A > R_B > R_C$

Since, $P \propto R_{eq}$

$P_D > P_A > P_B > P_C$

Question67

A potential V_0 is applied across a uniform wire of resistance R. The power dissipation is P_1. The wire is then cut into two equal halves and a potential of V_0 is applied across the length of each half. The total power dissipation across two wires is P_2. The ratio $P_2 : P_1$ is $\sqrt{x} : 1$. The value of x is ________
[13-Apr-2023 shift 1]

Answer: 16

Solution:

Solution:

$$P_1 = \frac{V_0^2}{R}$$

$$P_2 = \frac{V_0^{\ 2}}{\left(\frac{R}{2}\right)} + \frac{V_0^{\ 2}}{\left(\frac{R}{2}\right)}$$

$$P_2 = 4P_1$$

$$\frac{P_2}{P_1} = \frac{4}{1} = \frac{\sqrt{x}}{1}$$

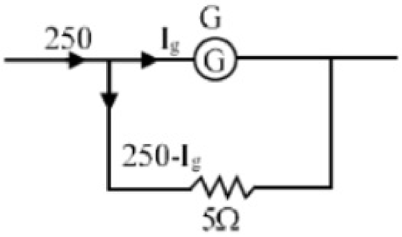
$$x = 16$$

Question68

When a resistance of 5Ω is shunted with a moving coil galvanometer, it shows a full scale deflection for a current of 250 mA, however when 1050Ω resistance is connected with it in series, it gives full scale deflection for 25 volt. The resistance of galvanometer is ________ Ω.
[13-Apr-2023 shift 1]

Answer: 50

Solution:



$I_g(G) = (250 - I_g)5$

$I_g = \frac{1250}{5 + G}$ mA

For voltmeter,

$V = I_g R$

$25 = I_g(G + 1050)$

From equation (1),

$25 = \frac{1250 \times 10^{-3}}{G + 5}(G + 1050)$

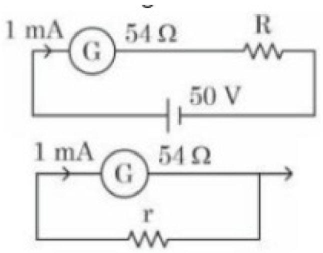
$20(G + 5) = G + 1050$

$19G = 1050 - 100$

$G = \frac{950}{19} = 50\Omega$

Question69

For designing a voltmeter of range 50V and an ammeter of range 10 mA using a galvanometer which has a coil of resistance 54Ω showing a full scale deflection for 1 mA as in figure.



(A) for voltmeter R ≈ 50kΩ
(B) for ammeter r ≈ 0.2Ω
(C) for ammeter r ≈ 6Ω
(D) for voltmeter R ≈ 5kΩ
(E) for voltmeter R ≈ 500Ω
Choose the correct answer from the options given below :
[15-Apr-2023 shift 1]

Options:

A. (C) and (D)

B. (A) and (B)

C. (C) and (E)

D. (A) and (C)

Answer: D

Solution:

$I = \frac{50}{R + 54} = 0.001A$
$R = 50k\Omega$
For Ammeter,
$I_r = 10 - 1 = 9\,mA$
$V_G = V_r$
$1\,mA \times 54 = 9\,mA \times r$
$r = 6\Omega$

Question70

Given below are two statements :
Statement I: The equivalent resistance of resistors in a series combination is smaller than least resistance used in the combination.
Statement II: The resistivity of the material is independent of temperature.
In the light of the above statements, choose the correct answer from the options given below :
[15-Apr-2023 shift 1]

Options:

A. Both Statement I and Statement II are true

B. Both Statement I and Statement II are false

C. Statement I is false but Statement II is true

D. Statement I is true but Statement II is false

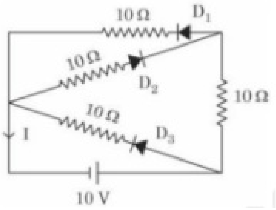
Answer: B

Solution:

Solution:
In series,
$R_{eq} = R_1 + R_2 + R_3 + \ldots.$
$R_{eq} > R_{Greatest}$
Hence, statement-I is false.
Resistivity of conductor increases with temperature.
Hence, statement-II is also false

Question71

In the given circuit, the current (I) through the battery will be



[15-Apr-2023 shift 1]

Options:

A. 1A

B. 1.5A

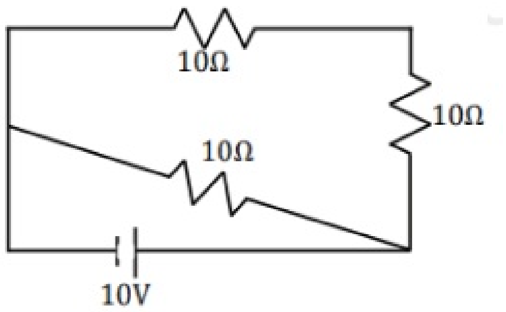
C. 2A

D. 2.5A

Answer: B

Solution:

In given figure,
orward Biased
$D_2 \rightarrow$ Reversed Biased

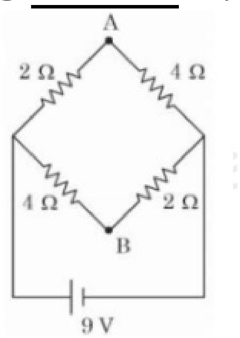


$$R_{eq} = \frac{(20)(10)}{30} = \frac{20}{3}\Omega$$

$$I = \frac{V}{R} = \frac{10}{\left(\frac{20}{3}\right)} = 1.5A$$

Question72

A network of four resistances is connected to 9V battery, as shown in figure. The magnitude of voltage difference between the points A and B is ________ V.

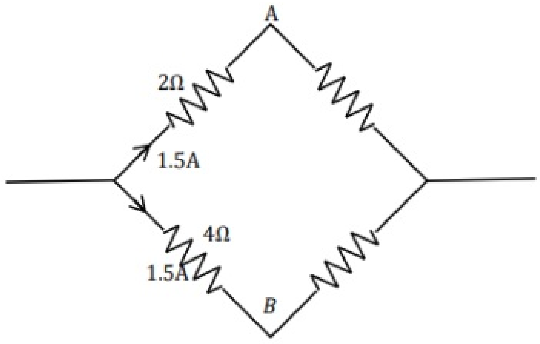


[15-Apr-2023 shift 1]

Solution:

$$R_{eq} = \frac{6}{2} = 3\Omega$$

$I = \frac{V}{R} = \frac{9}{3} = 3A$



$V_A + (1.5)(2) - (1.5)4 = V_B$
$V_A - V_B = 3V$

Question73

The current density in a cylindrical wire of radius 4 mm is $4 \times 10^6 Am^{-2}$. The current through the outer portion of the wire between radial distances $\frac{R}{2}$ and R is____ πA
[27-Jun-2022-Shift-1]

Answer: 48

Solution:

Solution:

$i = A \times j$

$= \pi \left(R^2 - \frac{R^2}{4} \right) j$

$= \frac{3\pi R^2}{4} \times j$

$= \frac{3\pi \times (4 \times 10^{-3})^2}{4} \times 4 \times 10^6$

$= 48\pi$

Question74

The current density in a cylindrical wire of radius r = 4.0 mm is $1.0 \times 10^6 A / m^2$. The current through the outer portion of the wire between radial distances $\frac{r}{2}$ and r is xπA; where x is____
[27-Jun-2022-Shift-2]

Answer: 12

Solution:

Solution:

$i = A \times j$

$= \pi\left(R^2 - \frac{R^2}{4}\right)j$

$= \frac{3\pi R^2}{4} \times j$

$= \frac{3\pi \times (4 \times 10^{-3})^2}{4} \times 1.0 \times 10^6$

$= 12\pi$

Question75

In the given circuit 'a' is an arbitrary constant. The value of m for which the equivalent circuit resistance is minimum, will be $\sqrt{\frac{x}{2}}$. The value of x is _____
[27-Jun-2022-Shift-2]

Answer: 3

Solution:

Solution:

$R_{net} = \frac{ma}{3} + \frac{a}{2m}$

$= a\left[\frac{m}{3} + \frac{1}{2m} - \frac{2}{\sqrt{6}} + \frac{2}{\sqrt{6}}\right]$

$= a\left[\left(\sqrt{\frac{m}{3}} - \frac{1}{\sqrt{2m}}\right)^2 + \sqrt{\frac{2}{3}}\right]$

This will be minimum when

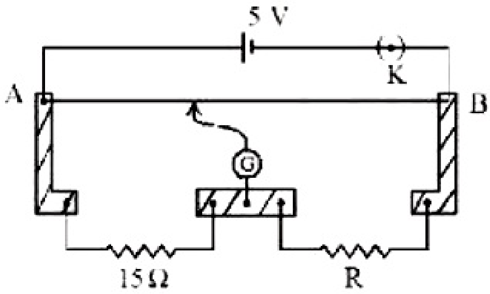
$\sqrt{\frac{m}{3}} = \frac{1}{\sqrt{2m}}$

or $m = \sqrt{\frac{3}{2}}$

so $x = 3$

Question76

A meter bridge setup is shown in the figure. It is used to determine an unknown resistance R using a given resistor of 15Ω. The galvanometer (G) shows null deflection when tapping key is at 43 cm mark from end A. If the end correction for end A is 2 cm, then the determined value of R will be _____Ω.



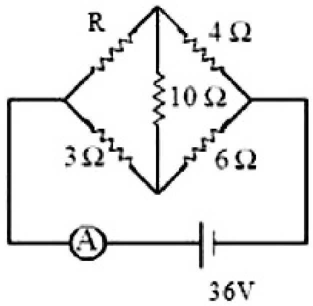
[28-Jun-2022-Shift-1]

Solution:

Solution:
Using the conditions of a balanced wheat stone bridge and adding the end correction.
$\frac{15}{(43+2)} = \frac{R}{(102-45)} \Rightarrow R = \frac{57}{45} \times 15$
$R = 19\Omega$

Question77

Current measured by the ammeter (A) in the reported circuit when no current flows through 10Ω resistance, will be_____A.



[28-Jun-2022-Shift-1]

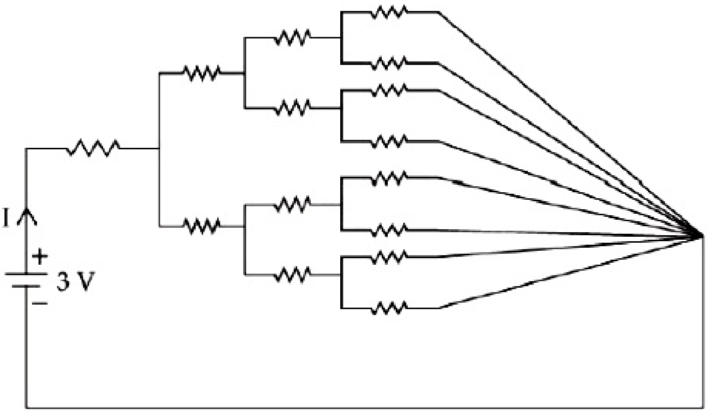
Answer: 10

...ion of a balanced wheat stone bridge,
$\Rightarrow \frac{R}{3} = \frac{4}{6} \Rightarrow R = 2\Omega$
So the effective resistance of the circuit is
$R_{eq} = \frac{6 \times 9}{6+9} = \frac{18}{5}\Omega$

R_{eq} 10A

Question78

All resistances in figure are 1Ω each. The value of current 'I' is $\frac{a}{5}$A. The value of a is______



[28-Jun-2022-Shift-2]

Solution:

Let the current is i
Using Kirchhoff's law

$iR + \frac{i}{2}R + \frac{i}{4}R + \frac{i}{8}R = 3$

$i = \frac{3 \times 8}{15} = \frac{8}{5}A$

So a = 8

Question79

Two coils require 20 minutes and 60 minutes respectively to produce same amount of heat energy when connected separately to the same source. If they are connected in parallel arrangement to the same source; the time required to produce same amount of heat by the combination of coils, will be _____min.
[29-Jun-2022-Shift-1]

Answer: 15

Solution:

$H = \frac{V^2}{R} \cdot \Delta t$

$\Rightarrow H = \frac{V^2}{R_1} \cdot 20 = \frac{V^2}{R_2} \cdot 60.....(i)$

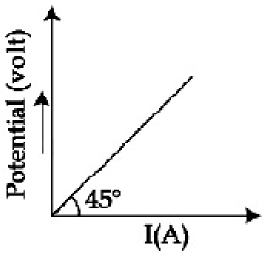
Also, $H = \frac{V^2}{\left[\frac{R_1 R_2}{R_1 + R_2}\right]} \cdot \Delta t$

$= \frac{4}{3} \cdot \frac{V^2}{R_1} \cdot \Delta t [\because R_2 = 3R_1]$

$\Rightarrow \Delta t = 15$

Question80

The variation of applied potential and current flowing through a given wire is shown in figure. The length of wire is 31.4 cm. The diameter of wire is measured as 2.4 cm. The resistivity of the given wire is measured as $x \times 10^{-3} \Omega$ cm. The value of x is____ [Take $\pi = 3.14$]



[29-Jun-2022-Shift-1]

4

Solution:

Solution:

Resistance $= \tan 45^\circ = 1\Omega$

$\Rightarrow 1 = \frac{pI}{A}$

$\Rightarrow p = \frac{\pi(1.2\,cm)^2}{31.4\,cm} = 1.44 \times 10^{-1} \Omega\,cm$

$\Rightarrow x = 144$

Question81

For the network shown below, the value of $V_B - V_A$ is ______V.
[29-Jun-2022-Shift-1]

Answer: 10

Solution:

Solution:

$V_B - V_A = i \times 2$

$= \frac{15}{1+2} \times 2$

$\Rightarrow V_B - V_A = 10$ volts

Question82

The combination of two identical cells, whether connected in series or parallel combination provides the same current through an external resistance of 2Ω. The value of internal resistance of each cell is [29-Jun-2022-Shift-2]

Options:

A. 2Ω

B. 4Ω

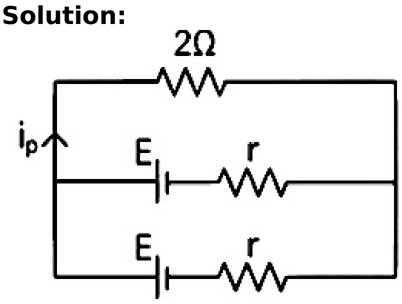
C. 6Ω

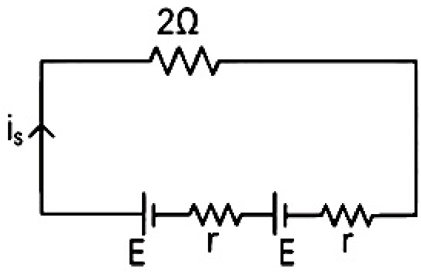
D. 8Ω

Answer: A

Solution:

Solution:





From diagram

$i_p = \frac{E}{2 + \frac{r}{2}}$ and $i_s = \frac{2E}{2 + 2r}$

given $i_p = i_s$

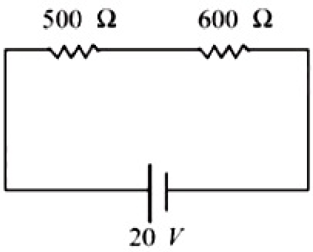
$$\frac{1}{2+\frac{r}{2}} = \frac{1}{1+r}$$

$$1 + r = 2 + \frac{r}{2}$$

$r = 2\Omega$

Question83

Two resistors are connected in series across a battery as shown in figure. If a voltmeter of resistance 2000Ω is used to measure the potential difference across 500Ω resistor, the reading of the voltmeter will be _____V.



[29-Jun-2022-Shift-2]

Answer: 8

Solution:

Solution:

New $R_{eff} = \frac{2000 \times 500}{2500} + 600\Omega = 1000\Omega$

$\Rightarrow$ Reading of voltmeter $= \frac{400}{1000} \times 20 = 8$ volts

---

Question84

Two identical cells each of emf 1.5V are connected in parallel across a parallel combination of two resistors each of resistance 20Ω. A voltmeter connected in the circuit measures 1.2V. The internal resistance of each cell is :
[24-Jun-2022-Shift-1]

Options:

A. 2.5Ω

B. 4Ω

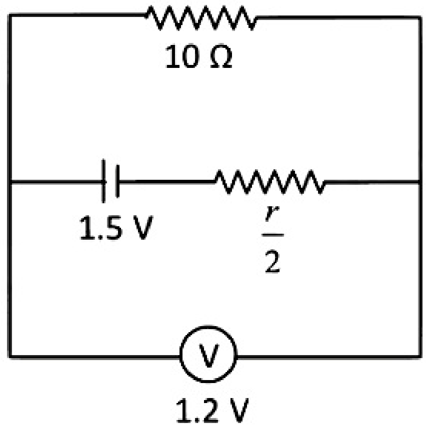
C. 5Ω

D. 10Ω

Answer: C

Solution:

Solution:



$$\frac{1.5 \times 10}{10 + \frac{r}{2}} = 1.2$$

$\Rightarrow r = 5\Omega$

Question85

In a potentiometer arrangement, a cell gives a balancing point at 75 cm length of wire. This cell is now replaced by another cell of unknown emf. If the ratio of the emf's of two cells respectively is 3 : 2, the difference in the balancing length of the potentiometer wire in above two cases will be ___cm.
[24-Jun-2022-Shift-1]

Answer: 25

Solution:

Solution:
At balancing point, we know that emf is proportional to the balancing length. i.e.,
emf ∝ balancing length
Now, let the emf's be 3ε and 2ε.
$\Rightarrow 3\varepsilon = k(75)\ldots..(1)$
and $2\varepsilon = k(I)\ldots...(2)$
$\Rightarrow I = 50\,\text{cm}$
⇒ Difference is $(75 - 50)\,\text{cm} = 25\,\text{cm}$.

Question86

What will be the most suitable combination of three resistors $A = 2\Omega$, $B = 4\Omega$, $C = 6\Omega$ so that $\left(\frac{22}{3}\right)\Omega$ is equivalent resistance of

combination?
[24-Jun-2022-Shift-2]

Options:

A. Parallel combination of A and C connected in series with B.

B. Parallel combination of A and B connected in series with C.

C. Series combination of A and C connected in parallel with B.

D. Series combination of B and C connected in parallel with A.

Answer: B

Solution:

Solution:
$R_{eq} = \frac{2 \times 4}{2+6} + 6 = \frac{22}{3}$
⇒A and B are in parallel and C is in series.

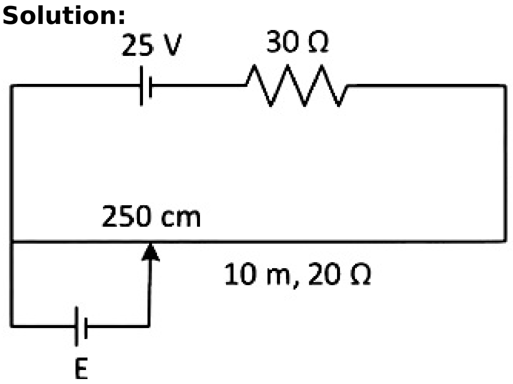
Question87

A potentiometer wire of length 10m and resistance 20Ω is connected in series with a 25V battery and an external resistance 30Ω. A cell of emf E in secondary circuit is balanced by 250 cm long potentiometer wire. The value of E (in volt) is $\frac{x}{10}$. The value of x is____
[24-Jun-2022-Shift-2]

Answer: 25

Solution:

Solution:



$\therefore E = I \times \left(\frac{20}{4}\right) = \frac{25}{(30+20)} \times \left(\frac{20}{4}\right)$

$= \frac{1}{2} \times 5 = 2.5$ volts $= \frac{25}{10}$ volts

Question88

A teacher in his physics laboratory allotted an experiment to determine the resistance (G) of a galvanometer. Students took the observations for $\frac{1}{3}$ deflection in the galvanometer. Which of the below is true for measuring value of G ?
[25-Jun-2022-Shift-1]

Options:

A. $\frac{1}{3}$ deflection method cannot be used for determining the resistance of the galvanometer.

B. $\frac{1}{3}$ deflection method can be used and in this case the G equals to twice the value of shunt resistances.

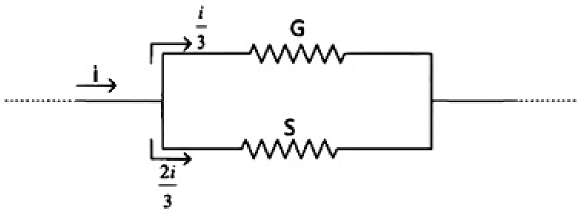
C. $\frac{1}{3}$ deflection method can be used and in this case, the G equals to three times the value of shunt resistances.

D. $\frac{1}{3}$ deflection method can be used and in this case the G value equals to the shunt resistances.

Answer: B

Solution:

Solution:
The circuit for the given situation is:



Since G and S are in parallel,
$\Rightarrow \frac{i}{3} \times G = \frac{2i}{3} \times S$
$\Rightarrow G = 2S$
$\Rightarrow$G equals twice the value of shunt resistance.

Question89

A resistor develops 300J of thermal energy in 15s, when a current of 2A is passed through it. If the current increases to 3A, the energy developed in 10s is_____J.
[25-Jun-2022-Shift-1]

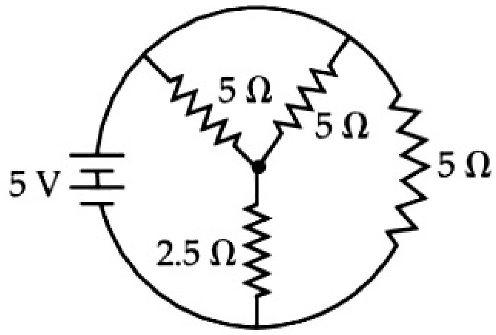
Answer: 450

Solution:

$300 = I^2R \times 15$
$\Rightarrow R = 5\Omega$
Now $I_2^2Rt_2$
$= 9 \times 5 \times 10$
$= 450J$

Question90

The total current supplied to the circuit as shown in figure by the 5V battery is ______A.

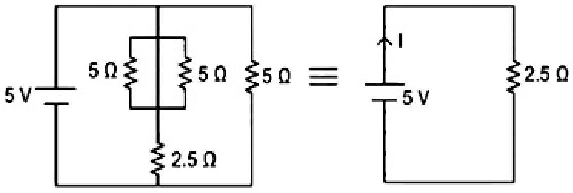


[25-Jun-2022-Shift-1]

Answer: 2

Solution:

Solution:



$\Rightarrow I = \frac{5}{2.5} = 2A$

Question91

Two cells of same emf but different internal resistances r_1 and r_2 are connected in series with a resistance R. The value of resistance R, for which the potential difference across second cell is zero, is : [25-Jun-2022-Shift-2]

Options:

A. $r_2 - r_1$

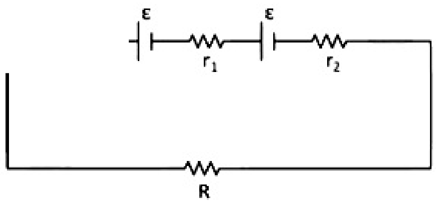
B. $r_1 - r_2$

C. r_1

D. r_2

Answer: A

Solution:



$I = \frac{2\varepsilon}{R + r_1 + r_2}$

As per the question,

$\frac{2\varepsilon}{R + r_1 + r_2} \times r_2 - \varepsilon = 0$

$\Rightarrow R = r_2 - r_1$

Question92

If n represents the actual number of deflections in a converted galvanometer of resistance G and shunt resistance S. Then the total current I when its figure of merit is K will be:
[25-Jun-2022-Shift-2]

Options:

A. $\frac{KS}{(S+G)}$

B. $\frac{(G+S)}{nKS}$

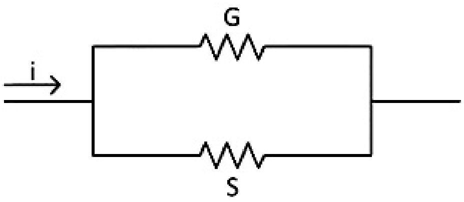
C. $\frac{nKS}{(G+S)}$

D. $\frac{nK(G+S)}{S}$

Answer: D

Solution:

Solution:



$\Rightarrow \frac{S}{S+G} i = nK$

$\Rightarrow i = \frac{nK(S+G)}{S}$

Question93

The length of a given cylindrical wire is increased to double of its original length. The percentage increase in the resistance of the wire will be _____%.
[25-Jun-2022-Shift-2]

Answer: 300

Solution:

Solution:
Volume is constant so on length doubled
Area is halved so $R = \rho \frac{l}{A}$ and $R' = \rho \frac{2l}{\frac{A}{2}} = 4\rho \frac{l}{A} = 4R$
So percentage increase will be
$R\% = \frac{4R - R}{R} \times 100 = 300\%$

Question94

An aluminium wire is stretched to make its length, 0.4% larger. The percentage change in resistance is :
[26-Jun-2022-Shift-1]

Options:

A. 0.4%

B. 0.2%

C. 0.8%

D. 0.6%

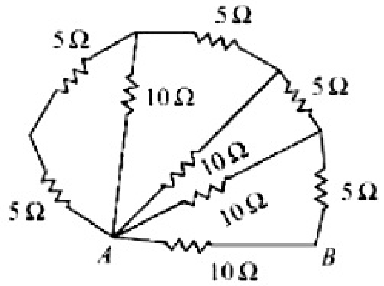
Answer: C

Solution:

Solution:
$R = \frac{\rho l}{A}$
Also volume will remain constant
i.e., $Al =$ constant $\Rightarrow A \propto \frac{1}{l}$
$\therefore R \propto l^2$
$\frac{\Delta R}{R} = 2\frac{\Delta l}{l} = 0.8$

Question95

The equivalent resistance between points A and B in the given network is :



[26-Jun-2022-Shift-2]

Options:

A. 65Ω

B. 20Ω

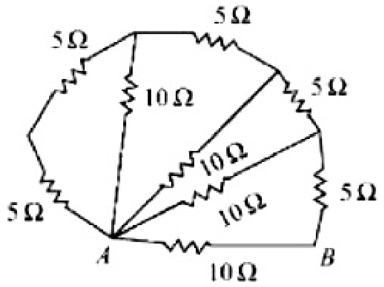
C. 5Ω

D. 2Ω

Answer: C

Solution:

Solution:
Initially 5Ω and 5Ω are in series and then in parallel with 10Ω this pattern continues thus



$R_{net} = 5\Omega$

Question96

A 72Ω galvanometer is shunted by a resistance of 8Ω. The percentage of the total current which passes through the galvanometer is : [27-Jun-2022-Shift-1]

Options:

A. 0.1%

B. 10%

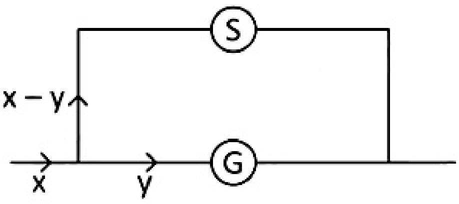
C. 25%

D. 0.25%

Answer: B

Solution:

Solution:



From the given setup

$y \times R_G = (x - y)(R_S)$

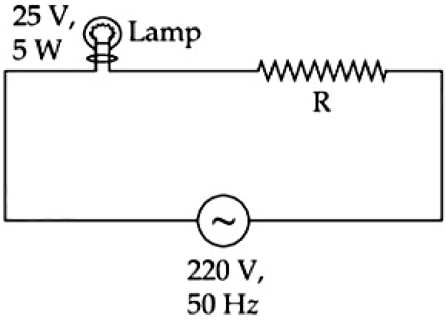
$\Rightarrow y \times 72 = (x - y) \times 8$

$\Rightarrow 9y = x - y$

$\Rightarrow y = \frac{x}{10}$ or 10% of x

Question97

A 220V, 50 Hz AC source is connected to a 25V, 5W lamp and an additional resistance R in series (as shown in figure) to run the lamp at its peak brightness, then the value of R (in ohm) will be__



[27-Jun-2022-Shift-1]

Answer: 975

Solution:

Solution:

$R_b = \frac{(25)^2}{5} = 125\Omega$

$I_{rms} = \sqrt{\frac{5}{125}} = \frac{1}{5}A$

$\Rightarrow \frac{220}{R + 125} = \frac{1}{5}$

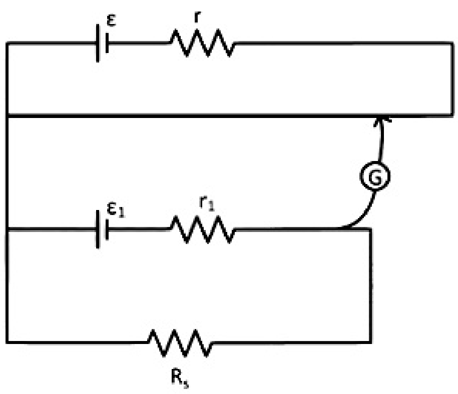
$\Rightarrow R = 1100 - 125$

$= 975\Omega$

Question98

A cell, shunted by a 8Ω resistance, is balanced across a potentiometer wire of length 3m. The balancing length is 2m when the cell is shunted by 4Ω resistance. The value of internal resistance of the cell will be____ Ω.
[27-Jun-2022-Shift-1]

Solution:



$$\frac{\varepsilon_1 8}{r_1 + 8} = 3c$$
$$\frac{\varepsilon_1 4}{r_1 + 4} = 2c$$
$$\Rightarrow \frac{2(r_1 + 4)}{r_1 + 8} = \frac{3}{2}$$
$$\Rightarrow r_1 = 8\Omega$$

Question99

Which of the following physical quantities have the same dimensions?
[25-Jul-2022-Shift-1]

Options:

A. Electric displacement $(\vec{D})$ and surface charge density

B. Displacement current and electric field

C. Current density and surface charge density

D. Electric potential and energy

Answer: A

Solution:

Electric displacement $(\vec{D}) = \varepsilon_0 \vec{E}$

$\Rightarrow [\bar{D}] = [\varepsilon_0][\bar{E}]$

$= M^{-1}L^{-3}T^{4}A^{2}][M^{1}L^{1}A^{-1}T^{-3}$

$[\bar{D}] = [L^{-2}T^{1}A^{1}]$

[Surface charge density] $= \frac{[Q]}{[A]}$

$[\sigma] = [AT\,L^{-2}]$

$\Rightarrow \vec{D}$ and $[\sigma]$ have same dimensions

Question100

In the given figure, the value of V_0 will be V.

[25-Jul-2022-Shift-1]

Solution:

Solution:

Using Kirchhoff's junction rule.

$$\frac{2 - V_0}{1} + \frac{4 - V_0}{1} + \frac{6 - V_0}{1} = 0$$

$12 - 3V_0 = 0$

$V_0 = 4V$

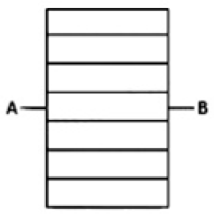
Question101

Eight copper wire of length l and diameter d are joined in parallel to form a single composite conductor of resistance R. If a single copper wire of length $2l$ have the same resistance (R) then its diameter will be d.

[25-Jul-2022-Shift-1]

Answer: 4

Solution:



RAB = R

$R = \frac{1}{8}$ (Resistance of one wire) $= \frac{1}{8}\rho \frac{l}{\pi \frac{d^2}{4}} = \frac{\rho l}{2\pi d^2}$

Resistance of copper wire of length 2l and diameter x = R

$$\rho \frac{2l}{\pi \frac{x^2}{4}} = R$$

$$\frac{8\rho l}{\pi x^2} = \frac{\rho l}{2\pi d^2}$$

$$16d^2 = x^2$$

$$x = 4d$$

Question102

In AM modulation, a signal is modulated on a carrier wave such that maximum and minimum amplitudes are found to be 6V and 2V respectively. The modulation index is:
[25-Jul-2022-Shift-2]

Options:

A. 100%

B. 80%

C. 60%

D. 50%

Answer: D

Solution:

Solution:

$A_{max} = 6V$

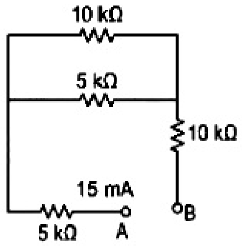
$A_{min} = 2V$

$$\mu = \frac{A_{max} - A_{min}}{A_{max} + A_{min}} = \frac{6-2}{6+2} = 0.5$$

$\mu = 50\%$

Question103

A current of 15mA flows in the circuit as shown in figure. The value of potential difference between the points A and B will be:



[25-Jul-2022-Shift-2]

Options:

A. 50V

B. 75V

C. 150V

D. 275V

Answer: D

Solution:

Solution:

Effective $R = \left[5 + \frac{5 \times 10}{5 + 10} + 10\right] k\Omega$

$= \frac{275}{15} k\Omega$

$\Rightarrow \Delta V_{AB} = 15mA \times \frac{275}{15} k\Omega$

$= 275V$

Question104

In a potentiometer arrangement, a cell of emf 1.20V gives a balance point at 36cm length of wire. This cell is now replaced by another cell of emf 1.80V. The difference in balancing length of potentiometer wire in above conditions will be ____ cm.
[25-Jul-2022-Shift-2]

Answer: 18

Solution:

$E \propto I$

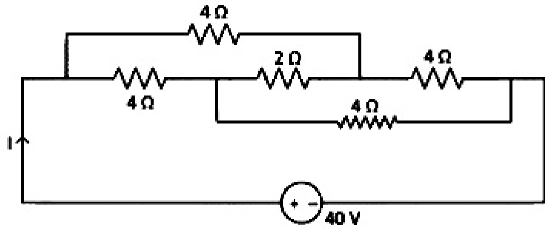
$\frac{1.2}{1.8} = \frac{36}{I'}$

$I' = \frac{3}{2} \times 36 = 54cm$

$\Delta I = I' - I = 54 - 36 = 18cm$

Question105

The current I in the given circuit will be :



[26-Jul-2022-Shift-1]

Options:

A. 10A

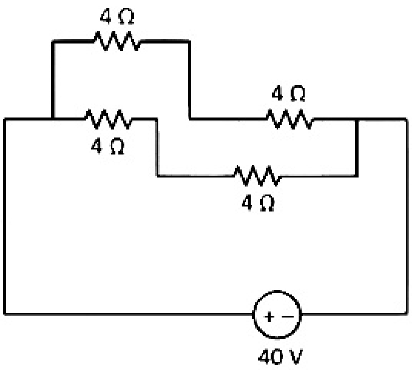
B. 20A

C. 4A

D. 40A

Answer: A

Solution:



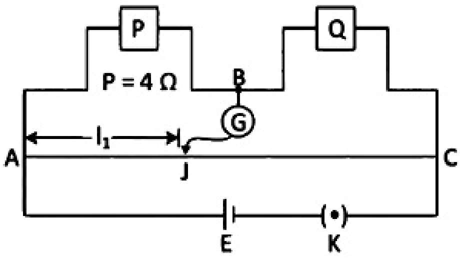
The grouping of resistance is a wheatstone bridge

So, $R_{net} = 4\Omega$

So, $i = \frac{V}{R_{net}} = 10A$

Question106

Resistances are connected in a meter bridge circuit as shown in the figure. The balancing length l_1 is 40 cm. Now an unknown resistance x is connected in series with P and new balancing length is found to be 80 cm measured from the same end. Then the value of x will be ________ Ω.



[26-Jul-2022-Shift-1]

Solution:

Solution:

$\frac{P}{40} = \frac{Q}{60} \ldots\ldots (1)$

$\frac{P+x}{80} = \frac{Q}{20} \ldots (2)$

$\frac{P}{P+x} \times \frac{80}{40} = \frac{20}{60}$

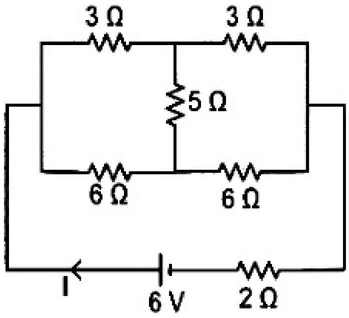
$\frac{4}{4+x} \times 2 = \frac{1}{3}$

$24 = 4 + x$

$x = 20$

Question107

A battery of 6V is connected to the circuit as shown below. The current I drawn from the battery is:



[26-Jul-2022-Shift-2]

Options:

A. 1A

B. 2A

C. $\frac{6}{11}$A

D. $\frac{4}{3}$A

Answer: A

Solution:

Solution:
Balanced wheat stone bridge in circuit so there is no current in 5Ω resistor so it can be removed from the circuit.

$R_{eq} = \frac{6 \times 12}{6 + 12} + 2$

$= \frac{6 \times 12}{18} + 2$

$R_{eq} = 6\Omega$

$I = \frac{V}{R_{eq}} = \frac{6}{6} = 1 \text{ Amp.}$

Question108

A potentiometer wire of length 300 cm is connected in series with a resistance 780Ω and a standard cell of emf 4V. A constant current flows through potentiometer wire. The length of the null point for cell of emf 20 mV is found to be 60 cm. The resistance of the potentiometer wire is ________ Ω
[26-Jul-2022-Shift-2]

Answer: 20

Solution:

Solution:
Let resistance of potentiometers wire is R $i = \frac{4}{R + 780}$

Potential difference across AB

$= \frac{4R}{R + 780}$

Potential difference across AC

$= \frac{4R \times 60}{(R + 780) \times 300} = \frac{4R}{5(R + 780)}$

This should be equal to 20 mV

$\frac{4R}{5(R + 780)} = 20 \times 10^{-3} = 2 \times 10^{-2}$

$4R = 10^{-1}(R + 780)$

$4R = \frac{R}{10} + 78$

$4R - \frac{R}{10} = 78$

$\frac{39R}{10} = 78$

$R = 20\Omega$

Question109

Two sources of equal emfs are connected in series. This combination is connected to an external resistance R. The internal resistances of the two sources are r_1 and $r_2 (r_1 > r_2)$. If the potential difference across the

source of internal resistance r_1 is zero, then the value of R will be : [27-Jul-2022-Shift-1]

Options:

A. $r_1 - r_2$

B. $\frac{r_1 r_2}{r_1 + r_2}$

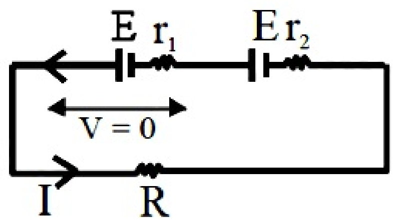
C. $\frac{r_1 + r_2}{2}$

D. $r_2 - r_1$

Answer: A

Solution:

Solution:



$I = \frac{2E}{r_1 + r_2 + R}$

$IR = E - Ir_2$

$I(R + r_2) = E$

$I = \frac{E}{R + r_2}$

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

$2R + 2r_2 = r_1 + r_2 + R$

$R = r_1 - r_2$

Question110

A direct current of 4A and an alternating current of peak value 4A flow through resistance of 3Ω and 2Ω respectively. The ratio of heat produced in the two resistances in same interval of time will be : [27-Jul-2022-Shift-1]

Options:

A. 3 : 2

B. 3 : 1

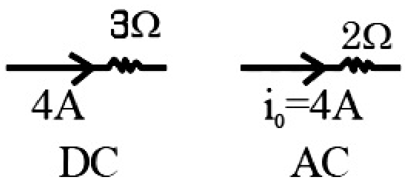
C. 3 : 4

D. 4 : 3

Answer: B

Solution:

Solution:



$H_1 = i^2R_1t \; H_2 = i_{rms}{}^2R_2t \left\{ i_{rms} = \frac{i_0}{\sqrt{2}} \right\}$

$H_1 = 16(3)t \;\; H_2 = \frac{i_0{}^2}{2}R_2t$

$H_2 = 16t$

$H_1 : H_2 = 3 : 1$

Question111

A 1m long copper wire carries a current of 1A. If the cross section of the wire is $2.0 mm^2$ and the resistivity of copper is $1.7 \times 10^{-8} \Omega m$, the force experienced by moving electron in the wire is ______ $\times 10^{-23}$N.
(charge on electron $= 1.6 \times 10^{-19}$C)
[27-Jul-2022-Shift-1]

Solution:

$l = 1m$

$i = 1A$

$\text{Area} = 2 \times 10^{-6}$

$\rho = 1.7 \times 10^{-8}$

$$R = \frac{\rho l}{A} = \frac{1.7 \times 10^{-8} \times 1}{2 \times 10^{-5}} = \frac{1.7}{2} \times 10^{-2}$$

$$v = \frac{1.7}{2} \times 10^{-2}$$

$$F = 1.6 \times 10^{-19} \times \frac{1.7}{2} \times 10^{-2}$$

$= 1.36 \times 10^{-21}$

$= 136 \times 10^{-23}$

Question112

(A) The drift velocity of electrons decreases with the increase in the temperature of conductor.
(B) The drift velocity is inversely proportional to the area of cross-section of given conductor.
(C) The drift velocity does not depend on the applied potential

difference to the conductor.
(D) The drift velocity of electron is inversely proportional to the length of the conductor.
(E) The drift velocity increases with the increase in the temperature of conductor.
Choose the correct answer from the options given below :
[27-Jul-2022-Shift-2]

Options:

A. (A) and (B) only

B. (A) and (D) only

C. (B) and (E) only

D. (B) and (C) only

Answer: B

Solution:

Solution:

Drift velocity $= \left(\frac{e\tau}{m}\right)E$

$v_d = \left(\frac{e\tau}{m}\right)\left(\frac{\Delta V}{\ell}\right)$

$\Delta V =$ Potential difference applied across the wire

As temperature increases, relaxation time decreases, hence V_d decreases.

As per formula, $V_d \propto \frac{1}{\ell}$

$v_d = \frac{I}{neA}$, as it is not mentioned that current is at steady state neither it is mentioned that n is constant for given conductor. So it can't be said that v_d is inversely proportional to A.

$I = neAv_d = \frac{V}{R} = \frac{V}{\rho\ell}A$

$v_d = \frac{V}{\rho\ell\ ne}\ \left(E = \frac{V}{\ell}\right)$

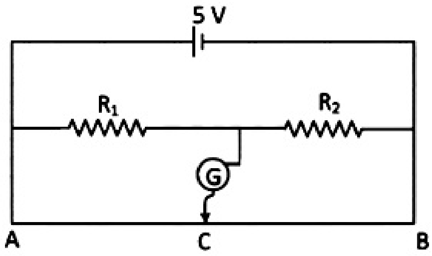
$v_d = \frac{eE\tau}{m}$

τ decrease with temperature increase.

First and fourth statements are correct.

Question113

In the given figure of meter bridge experiment, the balancing length AC corresponding to null deflection of the galvanometer is 40 cm. The balancing length, if the radius of the wire AB is doubled, will be ________ cm.



[27-Jul-2022-Shift-2]

Answer: 40

Solution:

Solution:

Even if the radius of wire is doubled, the balancing point would not change as $\frac{x}{l - x} = \frac{R_1}{R_2}$, which is not including a term of area.

Question114

A wire of resistance R_1 is drawn out so that its length is increased by twice of its original length. The ratio of new resistance to original resistance is:
[28-Jul-2022-Shift-1]

Options:

A. 9 : 1

B. 1 : 9

C. 4 : 1

D. 3 : 1

Answer: A

Solution:

Solution:

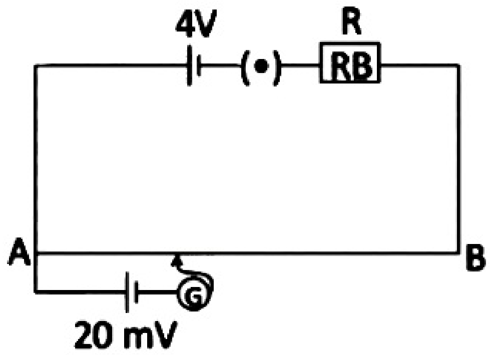
$R_1 = \rho \frac{L_1}{A_1}$

$R_2 = \rho \left(\frac{3L_1}{A_1 / 3} \right) = 9\rho \frac{L_1}{A_1}$

$\therefore \frac{R_2}{R_1} = 9$

Question115

As shown in the figure, a potentiometer wire of resistance 20Ω and length 300 cm is connected with resistance box (R.B.) and a standard cell of emf 4 V. For a resistance ' R ' of resistance box introduced into the circuit, the null point for a cell of 20 mV is found to be 60 cm. The value of ' R ' ______ is Ω.



[28-Jul-2022-Shift-1]

Solution:

Solution:

$E = \frac{AC}{AB}(V_A - V_B)$

$\therefore 20 \times 10^{-3} = \frac{60}{300} \times \frac{4 \times 20}{R + 20}$

$\therefore R = 780$

Question116

Given below are two statements :
Statement I : A uniform wire of resistance 80Ω is cut into four equal parts. These parts are now connected in parallel. The equivalent resistance of the combination will be 5Ω.
Statement II: Two resistances 2R and 3R are connected in parallel in a electric circuit. The value of thermal energy developed in 3R and 2R will be in the ratio 3 : 2.
In the light of the above statements, choose the most appropriate answer from the option given below
[28-Jul-2022-Shift-2]

Options:

A. Both statement I and statement II are correct

B. Both statement I and statement II are incorrect

C. Statement I is correct but statement II is incorrect

D. Statement I is incorrect but statement II is correct

Answer: C

Solution:

Statement I: $R_{1\ part} = \frac{80}{4} = 20\Omega$

$\Rightarrow R_{eff} = \frac{20}{4} = 5\Omega$

Statement II : Ratio $= \frac{\frac{(\Delta V)^2}{3R}}{\frac{\Delta\Delta V)^2}{2R}}$

$= \frac{2}{3}$

Question117

An electrical bulb rated 220V, 100W, is connected in series with another bulb rated 220V, 60W. If the voltage across combination is 220V, the power consumed by the 100W bulb will be about ______ W.
[28-Jul-2022-Shift-2]

Answer: 14

Solution:

Solution:

$R_1 = \frac{V^2}{P} = \frac{220^2}{100} = 484$

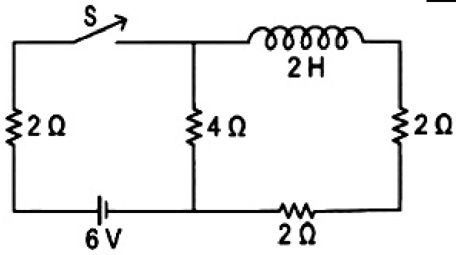
$R_2 = \frac{V^2}{P} = \frac{220^2}{60} = 484\left(\frac{10}{6}\right)$

$I = \frac{220}{484 + 484 \times \frac{10}{6}}$

$P_1 = I^2 R_1 = 14.06W$

Question118

For the given circuit the current through battery of 6V just after closing the switch 'S' will be _______ A.



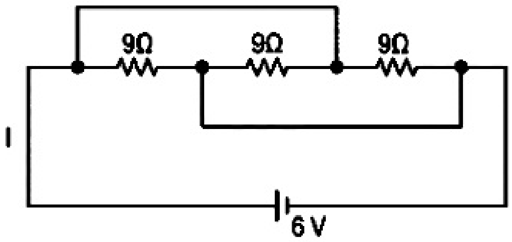
[28-Jul-2022-Shift-2]

Solution:

Just after closing the switch S, inductor behaves like an open circuit.
$$I = \frac{6}{2+4} = 1A$$

Question119

The current I flowing through the given circuit will be _______ A.



[29-Jul-2022-Shift-1]

Answer: 2

Solution:

Solution:
All 9Ω resistances are in parallel
$R_{eq} = 3\Omega$
$I = \frac{6}{3}A = 2A$

Question120

Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A: Alloys such as constantan and manganin are used in making standard resistance coils.
Reason R: Constantan and manganin have very small value of temperature coefficient of resistance.
In the light of the above statements, choose the correct answer from the options given below.
[29-Jul-2022-Shift-2]

Options:

A. Both A and R are true and R is the correct explanation of A.

B. Both A and R are true but R is NOT the correct explanation of A.

C. A is true but R is false.

D. A is false but R is true.

Answer: A

Solution:

Solution:
Since they have low temperature coefficient of resistance, their resistance remains almost constant.

Question121

A1m long wire is broken into two unequal parts X and Y. The X part of the wire is streched into another wire W. Length of W is twice the length of X and the resistance of W is twice that of Y. Find the ratio of length of X and Y.
[29-Jul-2022-Shift-2]

Options:

A. 1 : 4

B. 1 : 2

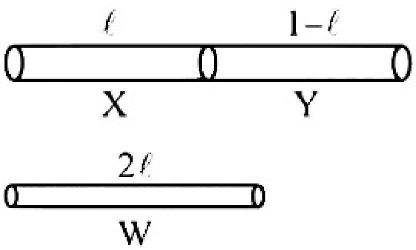
C. 4 : 1

D. 2 : 1

Answer: B

Solution:

Solution:



$\frac{R_X}{R_Y} = \frac{\ell_X}{\ell_Y}$

When wire is stretched to double of its length, then resistance becomes 4 times

$R_W = 4R_X = 2R_Y$

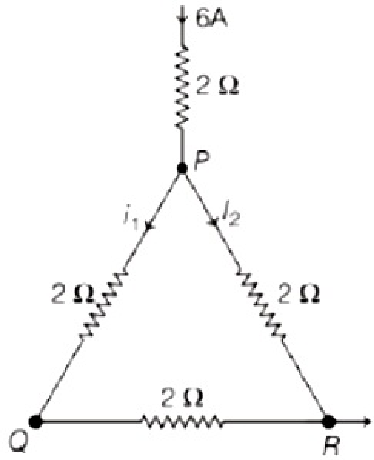
$\frac{R_X}{R_Y} = \frac{1}{2}$

So. $\frac{\ell_x}{\ell_y} = \frac{1}{2}$

Question122

A current of 6A enters one corner P of an equilateral triangle PQR having three wires of resistance 2Ω each and leaves by the corner R.

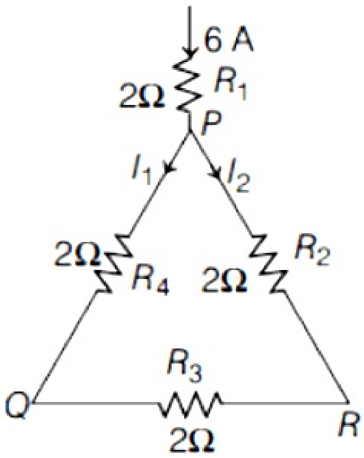
The currents i, in ampere is ....



[25 Feb 2021 Shift 2]

Solution:

Solution:
Let resistances be R_1, R_2, R_3 and R_4 and I_1 current is passing through R_4 as shown in figure
$\therefore I_2 = (6 - I_1)$ is passing through R_2
As, same current is flowing through R_4 and R_3.
$\therefore R_4$ and R_3 are in series.



and series equivalent resistance,
$R_{eq} = R_4 + R_3$
$\therefore\ R_{eq} = 2 + 2 = 4\Omega$
Voltage through R_{eq} and R_2 will be same.
$\Rightarrow\ I_1R_{eq} = I_2R_2 \Rightarrow I_14 = (6 - I_1)2$
$\Rightarrow\ 2I_1 = 6 - I_1 \Rightarrow I_1 = 2A$

Question123

A cylindrical wire of radius 0.5mm and conductivity $5 \times 10^7 S / m$ is subjected to an electric field of 10mV / m. The expected value of current in the wire will be $x^3 \pi mA$. The value of x is ....
[24 Feb 2021 Shift 2]

Answer: 5

Solution:

Given, radius of cylindrical wire, $r = 0.5mm = 0.5 \times 10^{-3}m$
, $\sigma = 5 \times 10^{7} S / m$
Electric field, $E = 10mV / m = 10 \times 10^{-3} V / m$
We know that current density,
$\therefore J = \sigma E$
$= 5 \times 10^{7} \times 10 \times 10^{-3} = 5 \times 10^{5} A / m^{2}$
Also, $J = I / A \Rightarrow I = J A$
$\Rightarrow I = 5 \times 10^{5} \times \pi \times (0.5 \times 10^{-3})^{2}$
$= 5 \times 10^{5} \times \pi \times 25 \times 10^{-8} = 125\pi \times 10^{-3}$
$\Rightarrow x^{3}\pi mA = 125\pi mA \Rightarrow x^{3} = 5^{3}$
$\Rightarrow x = 5$

Question124

In an electrical circuit, a battery is connected to pass 20C of charge through it in a certain given time. The potential difference between two plates of the battery is maintained at 15V . The work done by the battery is .... J.
[26 Feb 2021 Shift 1]

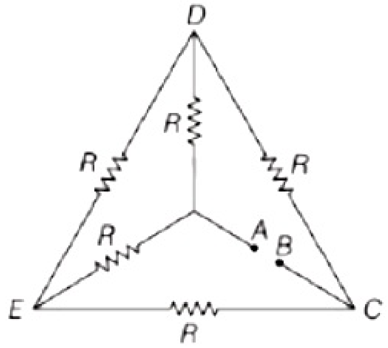
Answer: 300

Solution:

Solution:
Given, charge passing through circuit, $q = 20C$
Potential difference between two plates,
$V = 15V$
Let W be the amount of work done by battery.
$\therefore W = qV = 20 \times 15 = 300J$

Question125

Five equal resistances are connected in a network as shown in figure. The net resistance between the points A and B is



[26 Feb 2021 Shift 1]

Options:

A. 2R

B. R / 2

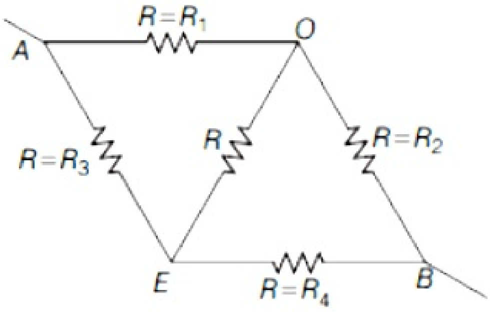
C. $\frac{3R}{2}$

D. R

Answer: D

Solution:

Solution:
Given all resistances have same resistance R.
Now, we can redraw the circuit as below



Let resistances be R_1, R_2, R_3 and R_4.

$\because \frac{R_1}{R_3} = \frac{R_2}{R_4}$

So, circuit will behave as a Wheatstone bridge and no current will flow through midthle resistor.

$\therefore R_{eq} = \frac{(R_1 + R_2)(R_3 + R_4)}{(R_1 + R_2) + (R_3 + R_4)}$

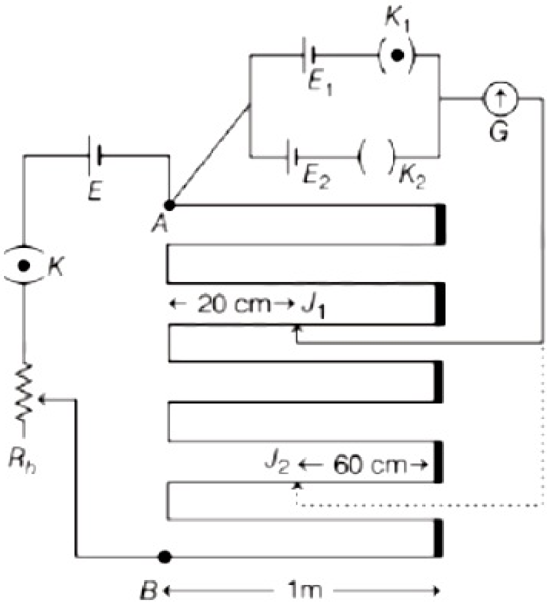
$= \frac{(R + R)(R + R)}{(R + R) + (R + R)}$

$= R$

Question126

In the given circuit of potentiometer, the potential difference E across AB (10 m length) is larger than E_1 and E_2 as well. For key K_1 (closed), the jockey is adjusted to touch the wire at point J_1, so that there is no deflection in the galvanometer. Now, the first battery (E_1) is replaced by second battery (E_2) for working by making K_1 open and K_2 closed. The

galvanometer gives then null deflection at J_2. The value of $\frac{E_1}{E_2}$ is $\frac{a}{b}$, where a = ...



[25 Feb 2021 Shift 1]

Answer: 1

Solution:

Solution:
Given, length of AB = 10m = 1000cm
Length of one arm = $\frac{1000}{10} = 100\text{cm}$
For no deflection,
In first case, $l_1 = 3 \times 100 + 80 = 380\text{cm}$
In 2 nd case, $I_2 = 7 \times 100 + 60 = 760\text{cm}$
As we know that in balanced potentiometer,
$\Rightarrow \frac{a}{b} = \frac{380}{760} = \frac{1}{2}$
$\therefore a = 1$

Question127

A current through a wire depends on time as $i = \alpha_0 t + \beta t^2$ where $\alpha_0 = 20\text{A/s}$ and $\beta = 8\text{As}^{-2}$. Find the charge crossed through a section of the wire in 15s.
[24feb2021shift1]

Options:

A. 2250C

B. 11250C

C. 2100C

D. 260C

Answer: B

Solution:

Given, $i = \alpha_0 t + \beta t^2$

20 and $\beta = 8$

We get $i = 20t + 8t^2$

Current, $i = \frac{dq}{dt}$

$\Rightarrow \int dq = \int i\,dt$

$\Rightarrow q = \int_0^{15} (20t + 8t^2)dt$

$\Rightarrow q = \left(\frac{20t^2}{2} + \frac{8t^3}{3} \right)_0^{15}$

$\Rightarrow q = 20 \times \left(\frac{15^2 - 0^2}{2} \right) + \frac{8}{3}(15^3 - 0^3)$

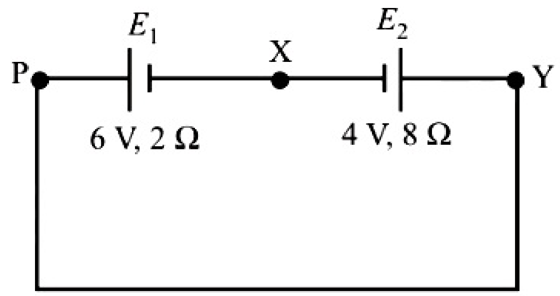
$\Rightarrow q = 10 \times (15)^2 + \frac{8(15)^3}{3}$

$\Rightarrow q = 2250 + 9000$

$\Rightarrow q = 11250C$

Question128

A cell E_1 of emf $6V$ and internal resistance 2Ω is connected with another cell E_2 of emf $4V$ and internal resistance 8Ω (as shown in the figure). The potential difference across points X and Y is :



[24feb2021shift1]

Options:

A. 10.0V

B. 3.6V

C. 5.6V

D. 2.0V

Answer: C

Solution:

$I = \frac{6-4}{10} = \frac{1}{5}A$

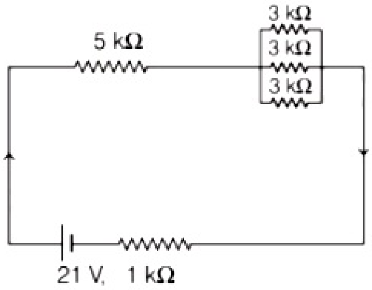
$V_x + 4 + 8 \times \frac{1}{5} - V_y = 0$

$V_x - V_y = -5.6$

$\Rightarrow |V_x - V_y| = 5.6V$

Question129

In the figure given, the electric current flowing through the 5kΩ resistor is xmA.



The value of x to the nearest Integer is ...3...
[16 Mar 2021 Shift 1]

Answer: 3

Solution:

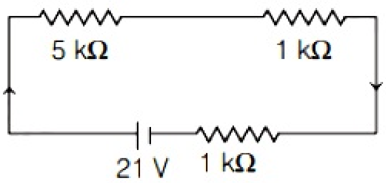
Solution:
According to the figure given in question, all 3Ω resistances are in parallel combination. So, their equivalent resistance is

$\frac{1}{R_{parallel}} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3}$

$\frac{1}{R_{parallel}} = \frac{3}{3}$

$\Rightarrow R_{parallel} = 1k\Omega$

Equivalent circuit



5 mathrm k Omega and 1 mathrm k Omega resistance are in series to the equivalent of all 3 Omega resistances.

$\therefore R_{net} = 5 + 1 + R_{parallel}$ ...(i)

$\Rightarrow R_{net} = (5 + 1 + 1)k\Omega = 7k\Omega = 7 \times 10^3\Omega$

∴ The value of electric current flowing through 5kΩ resistor will be

$I = \frac{V}{R_{net}} = \frac{21}{7 \times 10^3} = 3 \times 10^{-3}A$

$= 3mA$

Comparing with the given value in the question i.e., xmA, the value of x = 3.

Question130

Two wires of same length and thickness having specific resistances

$6\Omega - cm$ and $3\Omega - cm$ respectively are connected in parallel. The effective resistivity is $\rho\Omega - cm$. The value of ρ to the nearest integer, is [18 Mar 2021 Shift 2]

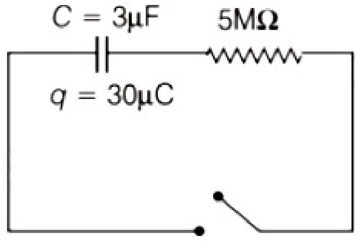
Answer: 4

Solution:

Solution:
Given, specific resistance for wire 1 ,
$\rho_1 = 6\Omega - cm$
Specific resistance for wire 2,
$\rho_2 = 3\Omega - cm$
Resistance,
$R = \frac{\rho l}{A}$
For parallel connections,
$R_{net} = \frac{R_1 R_2}{R_1 + R_2}$
$\Rightarrow \frac{\rho I}{2A} = \frac{\frac{\rho_1 I}{A} \times \frac{\rho_2 I}{A}}{\frac{\rho_1 I}{A} + \frac{\rho_2 I}{A}}$
$\Rightarrow \frac{\rho}{2} = \frac{\rho_1 \rho_2}{\rho_1 + \rho_2}$
$\Rightarrow \frac{\rho}{2} = \frac{6 \times 3}{6 + 3}$
$\rho = 4\Omega - cm$
Hence, the value of ρ to the nearest integer is 4 .

Question131

The circuit shown in the figure consists of a charged capacitor of capacity $3\mu F$ and a charge of $30\mu C$. At time $t = 0$, when the key is closed, the value of current flowing through the $5M\,\Omega$ resistor is $x\mu A$. The value of x to the nearest integer is



[18 Mar 2021 Shift 1]

Solution:

According to given circuit diagram,
At $t = 0$, the key is in closed position.
Current through the resistor will be maximum.
Using Ohm's law,

$$I_{max} = \frac{V}{R} \Rightarrow I_{max} = \left(\frac{Q}{C}\right) \times \frac{1}{R}$$

$$\Rightarrow I_{max} = \left(\frac{30 \times 10^{-6}}{3 \times 10^{-6}}\right) \times \frac{1}{5 \times 10^{6}}$$

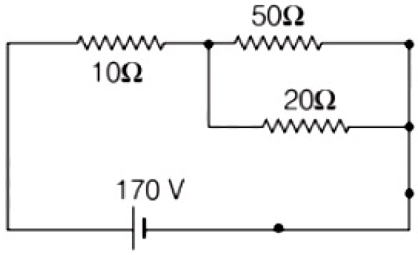
$$I_{max} = 2 \times 10^{-6} A$$

$$I_{max} = 2 \mu A$$

The value of the current flowing through the 5Ω resistor is $2\mu A$.
Hence, the value of the x to the nearest integer is 2 .

Question132

The voltage across the 10Ω resistor in the given circuit is x volt.

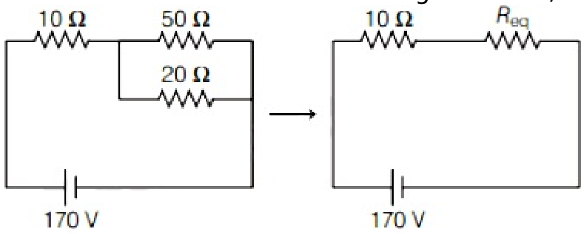


The value of x to the nearest integer is [18 Mar 2021 Shift 1]

Answer: 70

Solution:

Solution:
Electrical circuit is shown in the diagram. Now, let's draw the equivalent circuit.



Equivalent resistance of the circuit,

$$R_{eq} = \frac{50 \times 20}{50 + 20}$$

$$R_{eq} = \frac{100}{7}\Omega$$

According to voltage division rule,
voltage across the 10Ω resistance of the circuit,

$$V_{10\Omega} = 170 \times \left(\frac{10}{10 + \frac{100}{7}}\right)$$

$$V_{10\Omega} = 70V$$

The value of the x to the nearest integer is 70 .

Question133

A current of 10A exists in a wire of cross sectional area of $5mm^2$ with a drift velocity of $2 \times 10^{-3}ms^{-1}$. The number of free electrons in each cubic metre of the wire is
[17 Mar 2021 Shift 1]

Options:

A. 2×10^6

B. 625×10^{25}

C. 2×10^{25}

D. 1×10^{23}

Answer: B

Solution:

Solution:
Given, current, $I = 10A$
Cross-sectional area, $A = 5mm^2 = 5 \times 10^{-6}m^2$
Drift velocity, $v_d = 2 \times 10^{-3}ms^{-1}$
The value of current flowing through a conductor can be given by
$I = neAv_d$ ....(i)
where, $n =$ number of free electrons
and $e =$ charge on an electron
Putting all the given values in Eq. (i) we get
$10 = n \times 1.6 \times 10^{-19} \times 5 \times 10^{-6} \times 2 \times 10^{-3}$
$\Rightarrow n = \dfrac{10}{1.6 \times 10^{-19} \times 5 \times 10^{-6} \times 2 \times 10^{-3}}$
$= 0.625 \times 10^{28} = 625 \times 10^{25}$

Question134

The equivalent resistance of series combination of two resistors is s. When they are connected in parallel, the equivalent resistance is p. If s = np, then the minimum value for n is ....
(Round off to the nearest integer)
[17 Mar 2021 Shift 1]

Let two resistors have resistances R_1 and R_2, respectively.
As per question, equivalent resistance of series combination is s
$\Rightarrow s = R_1 + R_2$.....(i)

and equivalent resistance of parallel combination is p

$\Rightarrow \ p = \frac{R_1 R_2}{R_1 + R_2}$....(ii)

According to the question, s = np....(iii)

From Eqs. (i),(ii) and (iii), we get

$R_1 + R_2 = n\frac{R_1 R_2}{(R_1 + R_2)} \Rightarrow n(R_1 R_2) = (R_1 + R_2)^2$

$\Rightarrow n = \frac{(R_1 + R_2)^2}{R_1 R_2}$

For n to be minimum, $R_1 = R_2 = R$

$\Rightarrow \ n = \frac{(R + R)^2}{R \cdot R} = \frac{(2R)^2}{R^2} = \frac{4R^2}{R^2} \Rightarrow n = 4$

Question135

A conducting wire of length l, area of cross-section A and electric resistivity ρ is connected between the terminals of a battery. A potential difference V is developed between its ends, causing an electric current. If the length of the wire of the same material is doubled and the area of cross-section is halved, the resultant current would be
[16 Mar 2021 Shift 1]

Options:

A. $\frac{1}{4}\frac{VA}{\rho l}$

B. $\frac{3}{4}\frac{VA}{\rho l}$

C. $\frac{1}{4}\frac{\rho l}{VA}$

D. $4\frac{VA}{\rho l}$

Answer: A

Solution:

Solution:

Initially, the resistance of wire is $R_1 = \rho L/A$

In second case,

Length, $I' = 2I$

Area, $A' = \frac{A}{2}$

$\therefore \ R_2 = \frac{\rho l'}{A'} = \frac{\rho(2l)}{(A/2)} = \frac{4\rho l}{A}$

According to Ohm's law, $I = \frac{V}{R_2}$

$\Rightarrow \ l = \frac{V}{4\rho l/A} = \frac{1}{4}\frac{VA}{\rho l}$

This is the required value of resultant current.

Question136

The energy dissipated by a resistor is 10mJ in 1s when an electric current of 2mA flows through it. The resistance is .... Ω. (Round off to the nearest integer)
[16 Mar 2021 Shift 2]

Solution:

Solution:
Since, $\lambda v = c =$ constant
where, $\lambda =$ wavelength of light
and $v =$ frequency of light.
Red light and blue light have different wavelengths and different frequencies but same speed.
$\Rightarrow R = \frac{H}{I^2 T}$ .....(i)
Substituting the given values in Eq. (i), we get
$R = \frac{10 \times 10^{-3}}{(2 \times 10^{-3})^2 \times 1}$
$\Rightarrow R = \frac{10^{-2}}{4 \times 10^{-6}} \Rightarrow R = 0.25 \times 10^4$
$\Rightarrow R = 2500\Omega$

Question137

A resistor develops 500J of thermal energy in 20s, when a current of 1.5A is passed through it. If the current is increased from 1.5A to 3A, what will be the energy developed in 20 s?
[16 Mar 2021 Shift 2]

Options:

A. 1500rfloor

B. 1000J

C. 500J

D. 2000J

Answer: D

Solution:

Solution:
Given,
Heat energy, $H_1 = 500J$
Initial current, $I_1 = 1.5A$, final current, $I_2 = 3A$
and time, $t = 20s$
According to Joule's law of heating,
$H = I^2 Rt$
$\Rightarrow H_1 = I_1^2 Rt$.....(i)
and $H_2 = I_2^2 Rt$....(ii)

[Resistance and time being the same in both cases]
Dividing Eq. (i) by Eq. (ii), we get

$\Rightarrow \frac{H_1}{H_2} = \frac{I_1^2 Rt}{I_2^2 Rt} \Rightarrow \frac{H_1}{H_2} = \left(\frac{I_1}{I_2}\right)^2$

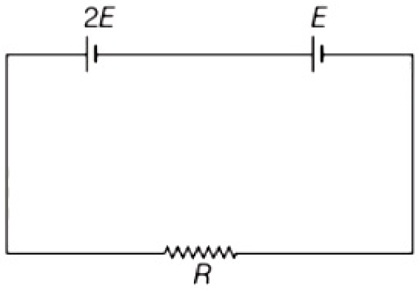
$\Rightarrow \frac{H_1}{H_2} = \left(\frac{1.5}{3}\right)^2 = \left(\frac{15}{30}\right)^2 \Rightarrow \frac{H_1}{H_2} = \left(\frac{1}{2}\right)^2$

$\Rightarrow \frac{H_1}{H_2} = \frac{1}{4} \Rightarrow \frac{500}{H_2} = \frac{1}{4} \Rightarrow H_2 = 500 \times 4$

$\Rightarrow H_2 = 2000J$

Question138

Two cells of emf 2E and E with internal resistance r_1 and r_2 respectively are connected in series to an external resistor R (see figure). The value of R, at which the potential difference across the terminals of the first cell becomes zero is



[17 Mar 2021 Shift 2]

Options:

A. $r_1 + r_2$

B. $\frac{r_1}{2} - r_2$

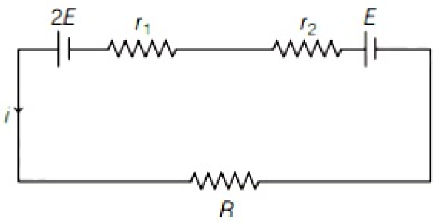
C. $\frac{r_1}{2} + r_2$

D. $r_1 - r_2$

Answer: B

Solution:

Solution:
The given circuit can be drawn as



Since in series combination, the current through each resistance remains same. So, equivalent resistance of the circuit is given as
$R_{equivalent} = R + r_1 + r_2$
and equivalent emf, $E_{equivalent} = 2E + E = 3E$

From Ohm's law, $I = \frac{E_{equivalent}}{R_{equivalent}} \Rightarrow I = \frac{3E}{R + r_1 + r_2}$

When potential difference is zero across the first cell, then potential positive terminal is equal to the potential at negative terminal.

$V_P = V_N$

$2E = I r_1$

Substituting the values in the above equation, we get

$2E = \frac{3E}{R + r_1 + r_2} r_1$

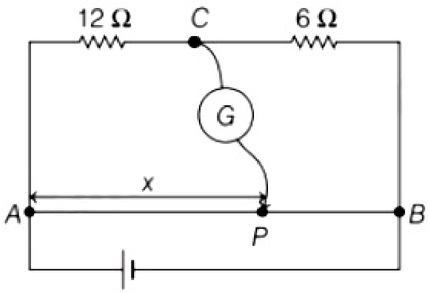
$2R + 2r_1 + 2r_2 = 3r_1 \Rightarrow R = \frac{r_1 - 2r_2}{2}$

$\Rightarrow R = \frac{r_1}{2} - r_2$

Question139

Consider a 72cm long wire AB as shown in the figure. The galvanometer jockey is placed at P on AB at a distance xcm from A. The galvanometer shows zero deflection.

The value of x, to the nearest integer, is__________.



[18 Mar 2021 Shift 2]

Answer: 48

Solution:

Solution:

At the balanced condition of the

Wheatstone bridge, $\frac{R}{S} = \frac{L_1}{L - L_1}$

$\Rightarrow \frac{12}{6} = \frac{x}{72 - x}$

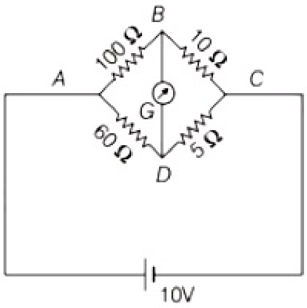
$\Rightarrow x = 48cm$

∴ The galvanometer jockey is placed at P on AB at a distance of 48 cm from the A.

So, the value of the x to the nearest integer is 48 .

Question140

The four arms of a Wheatstone bridge have resistances as shown in the figure. A galvanometer of 15Ω resistance is connected across BD. Calculate the current through the galvanometer when a potential difference of 10V is maintained across AC.



[17 Mar 2021 Shift 2]

Options:

A. 2.44μA

B. 2.44mA

C. 4.87mA

D. 4.87μA

Answer: C

Solution:

Solution:
As, A is directly connected to the positive terminal of the battery, $V_A = 10V$ and $V_C = 0$
By nodal analysis at B,
$$\frac{V_B - 10}{100} + \frac{V_B - V_D}{15} + \frac{V_B - 0}{10} = 0$$
$53V_B - 20V_D = 30$...(i)
By nodal analysis at D,
$$\frac{V_D - 10}{60} + \frac{V_D - V_B}{15} + \frac{V_D - 0}{5} = 0$$
$-4V_B + 17V_D = 10$....(ii)
Solving Eqs. (i) and (ii) by substitution method, we get
$V_D = 0.792V \Rightarrow V_B = 0.865V$
The current through the galvanometer,
$$I = \frac{V_B - V_D}{R}$$
Substituting the values in the above equation, we get
$$I = \frac{0.865 - 0.792}{15} \Rightarrow I = 4.87mA$$

Question141

In the experiment of Ohm's law, a potential difference of 5.0V is applied across the end of a conductor of length 10.0cm and diameter of 5.00mm. The measured current in the conductor is 2.00A. The maximum permissible percentage error in the resistivity of the conductor is
[18 Mar 2021 Shift 1]

Options:

A. 3.9

B. 8.4

C. 7.5

D. 3.0

Answer: A

Solution:

Solution:
Given, the potential difference applied across the ends of the conductor, $V = 5V$
The length of the conductor, $L = 10cm$
The measured value of the current in the conductor, $I = 2A$
The diameter of the conductor, $d = 5mm$
As we know that, $R = \frac{\rho l}{A}$
Using Ohm's law,
$V = IR \Rightarrow R = \frac{V}{I}$
$\frac{\rho l}{A} = \frac{V}{I} \Rightarrow \rho = \frac{V}{Il}\left(\frac{\pi d^2}{4}\right)$
In error form,
$\frac{\Delta\rho}{\rho} = \frac{\Delta V}{V} + \frac{\Delta I}{I} + \frac{\Delta l}{l} + 2\frac{\Delta d}{d}$
$\Rightarrow \frac{\Delta\rho}{\rho} = \frac{0.1}{5} + \frac{0.01}{2} + \frac{0.1}{10} + 2\frac{(0.01)}{(5)} \Rightarrow \frac{\Delta\rho}{\rho} = 0.039$
$\frac{\Delta\rho}{\rho} \times 100 = 3.9\%$
The maximum permissible percentage error in the resistivity of the conductor is 3.9%.

Question142

The resistance of a conductor at 15°C is 16Ω and at 100°C is 20Ω. What will be the temperature coefficient of resistance of the conductor? [27 Jul 2021 Shift 2]

Options:

A. $0.010°C^{-1}$

B. $0.033°C^{-1}$

C. $0.003°C^{-1}$

D. $0.042°C^{-1}$

Answer: C

Solution:

Solution:
$16 = R_0[1 + \alpha(15 - T_o)]$
$20 = R_0[1 + \alpha(100 - T_o)]$
Assuming $T_o = 0°C$, as a general convention.
$\Rightarrow \frac{16}{20} = \frac{1 + \alpha \times 15}{1 + \alpha \times 100}$
$\Rightarrow \alpha = 0.003°C^{-1}$

Question143

In Bohr's atomic model, the electron is assumed to revolve in a circular orbit of radius 0.5Å. If the speed of electron is 2.2×16^6m / s, then the current associated with the electron will be ______ $\times 10^{-2}$mA . [Take π as $\frac{22}{7}$]

[27 Jul 2021 Shift 1]

Solution:

Solution:

$I = \frac{e}{T} = \frac{e\omega}{2\pi} = \frac{eV}{2\pi r}$

$I = \frac{1.6 \times 10^{-19} \times 2.2 \times 10^{6} \times 7}{2 \times 22 \times 0.5 \times 10^{-10}}$

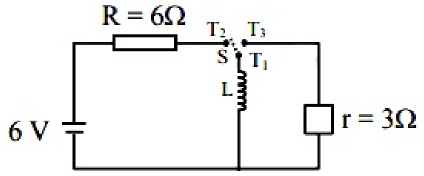
$= 1.12\text{mA}$

$112 \times 10^{-2}\text{mA}$

Question144

Consider an electrical circuit containing a two way switch ' S′. Initially S is open and then T_1 is connected to T_2. As the current in R = 6Ω attains a maximum value of steady state level, T_1 is disconnected from T_2 and immediately connected to T_3. Potential drop across r = 3Ω resistor immediately after T_1 is connected to T_3 is ____V.

(Round off to the Nearest Integer)



[27 Jul 2021 Shift 1]

Answer: 3

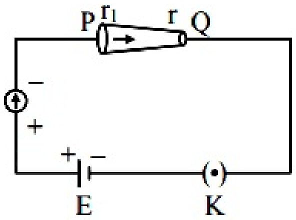
When T_1 and T_2 are connected, then the steady state current in the inductor $I = \frac{6}{6} = 1A$

When T_1 and T_3 are connected then current through inductor remains same. So potential difference across 3Ω

$V = Ir = 1 \times 3 = 3\text{volt}$

Question145

In the given figure, a battery of emf E is connected across a conductor PQ of length 'l' and different area of cross-sections having radii r_1 and $r_2 (r_2 < r_1)$. Choose the correct option as one moves from P to Q :



[27 Jul 2021 Shift 1]

Options:

A. Drift velocity of electron increases.

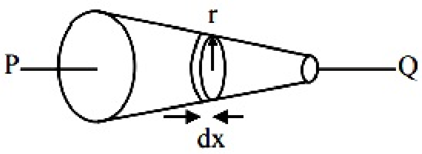
B. Electric field decreases.

C. Electron current decreases.

D. All of these

Answer: A

Solution:



Current is constant in conductor $i =$ constant

Resistance of element $dR = \frac{\rho dx}{\pi r^2}$

$dV = i dR = \frac{i \rho dx}{\pi r^2}$

$E = \frac{dV}{dx} = \frac{i\rho}{\pi r^2}$

& $V_d = \frac{eE\tau}{m}$

$\therefore V_d \propto E$

$\rightarrow E \propto \frac{1}{r^2}$

if r decreases, E will increase $\therefore V_d$ will increase

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Question146

For the circuit shown, the value of current at time t = 3.2 s will be _____ A.

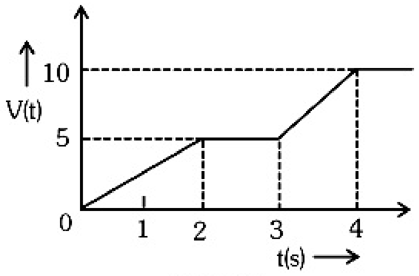


Figure 1

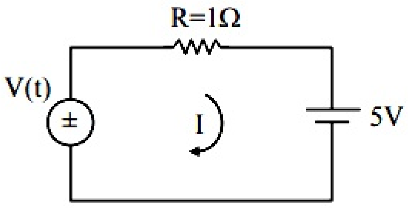


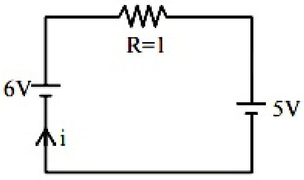
Figure-2

[Voltage distribution V(t) is shown by Fig. (1) and the circuit is shown in Fig. (2)]
[27 Jul 2021 Shift 2]

Answer: 1

Solution:

Solution:
From graph voltage at t = 3.2 sec is 6 volt.



$i = \frac{6-5}{1}$
$i = 1A$

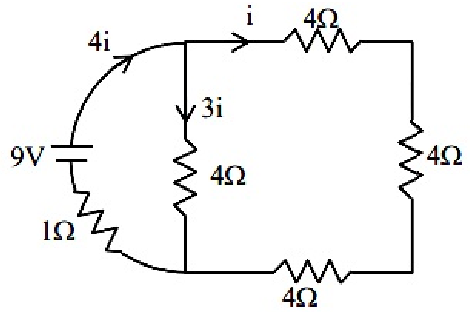
Question147

A 16Ω wire is bend to form a square loop. A 9V supply having internal resistance of 1Ω is connected across one of its sides. The potential drop across the diagonals of the square loop is ________ $\times 10^{-1}$V
[25 Jul 2021 Shift 2]

Answer: 45

Solution:

here assume current as



By KVL in outer loop

$9 - 12i - 4i = 0$

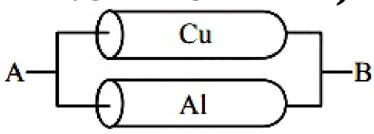
$16i = 9$

$8i = \frac{9}{2} = 4.5$

$= 45 \times 10^{-1}$

Question148

A Copper (Cu) rod of length 25cm and cross sectional area $3mm^2$ is joined with a similar Aluminum (Al) rod as shown in figure. Find the resistance of the combination between the ends A and B.
(Take Resistivity of Copper $= 1.7 \times 10^{-8}\Omega m$ Resistivity of Aluminium $= 2.6 \times 10^{-8}\Omega m$)



[22 Jul 2021 Shift 2]

Options:

A. 2.170 mΩ

B. 1.420 mΩ

C. 0.0858 mΩ

D. 0.858 mΩ

Answer: D

Solution:

Solution:

$R = \frac{R_1R_2}{R_1 + R_2} = \frac{l}{A} \cdot \frac{\rho_1\rho_2}{\rho_1 + \rho_2}$

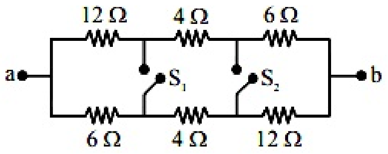
$R = \frac{25 \times 10^{-2}}{3 \times 10^{-6}} \times \frac{1.7 \times 2.6 \times 10^{-16}}{4.3 \times 10^{-8}}$

$R = 0.858m\Omega$

Question149

In the given figure switches S_1 and S_2 are in open condition. The

resistance across ab when the switches S_1 and S_2 are closed is______ Ω.

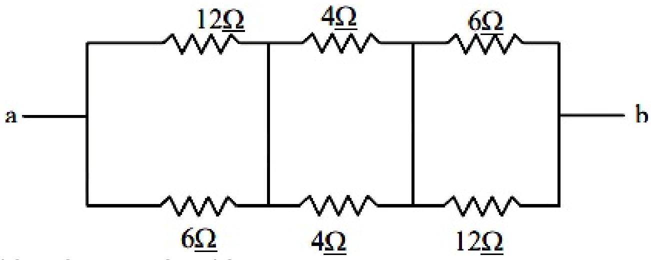


[20 Jul 2021 Shift 2]

Answer: 10

Solution:

Solution:
when switch S_1 and S_2 are closed



$\frac{12 \times 6}{12 + 6} + 2 + \frac{6 \times 12}{6 + 12}$

$\frac{72}{18} + 2 + \frac{72}{18} = 4 + 2 + 4 = 10\Omega$

Question150

A current of 5A is passing through a non-linear magnesium wire of cross-section $0.04m^2$. At every point the direction of current density is at an angle of 60° with the unit vector of area of cross-section. The magnitude of electric field at every point of the conductor is : (Resistivity of magnesium $\rho = 44 \times 10^{-8}\Omega m$)
[20 Jul 2021 Shift 1]

Options:

A. $11 \times 10^{-2} V / m$

B. $11 \times 10^{-7} V / m$

C. $11 \times 10^{-5} V / m$

D. $11 \times 10^{-3} V / m$

Answer: C

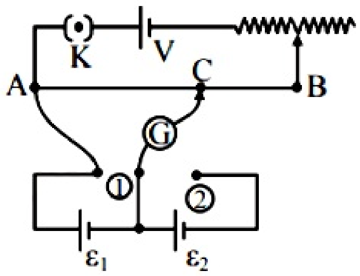
Solution:

$I = \vec{J} . \vec{A} = J A \cos(\theta)$

$5 = J\left(\frac{4}{100}\right) \times \cos(60)$
$J = 5 \times 50 = 250A / m^2$
Now, $\vec{E} = \rho . \vec{J}$
$= 44 \times 10^{-8} \times 250 = 11 \times 10^{-5} V / m$

Question151

In the given potentiometer circuit arrangement, the balancing length AC is measured to be 250cm. When the galvanometer connection is shifted from point (1) to point (2) in the given diagram, the balancing length becomes 400cm. The ratio of the emf of two cells, $\frac{\varepsilon_1}{\varepsilon_2}$ is :



[25 Jul 2021 Shift 2]

Options:

A. $\frac{5}{3}$

B. $\frac{8}{5}$

C. $\frac{4}{3}$

D. $\frac{3}{2}$

Answer: A

Solution:

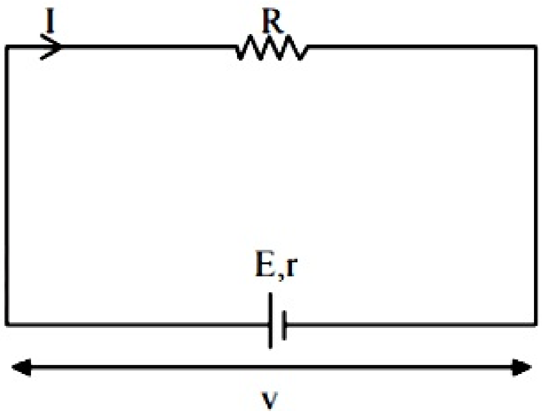
Solution:
$E_1 = kl_1$ ....(i)
$E_1 + E_2 = kl_2$ ....(ii)
$\frac{E_1}{E_1 + E_2} = \frac{l_1}{l_2} = \frac{250}{400} = \frac{5}{8}$
$8E_1 = 5E_1 + 5E_2$
$3E_1 = 5E_2$
$\frac{E_1}{E_2} = \frac{5}{3}$

Question152

In an electric circuit, a call of certain emf provides a potential difference of 1.25V across a load resistance of 5Ω. However, it provides

a potential difference of 1V across a load resistance of 2Ω.The emf of the cell is given by $\frac{x}{10}$V . Then the value of x is ________.
[22 Jul 2021 Shift 2]

Solution:



Terminal voltage $v = iR = \frac{ER}{R+r}$

$1^{st} \rightarrow 1.25 = \frac{E(5)}{5+r}$ ....(i)

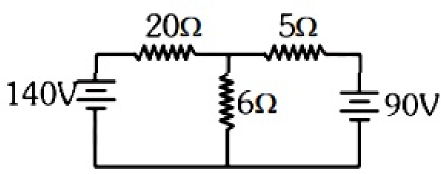
$2^{nd} \rightarrow 1 = \frac{E(2)}{2+r}$...... (ii)

By (i) and (ii)

$r = 1\Omega,\ E = \frac{3}{2}V = \frac{15}{10}\text{volt}$

$\Rightarrow x = 15$

Question153



The value of current in the 6Ω resistance is :
[20 Jul 2021 Shift 1]

Options:

A. 4A

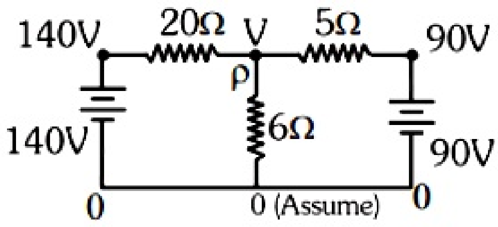
B. 8A

C. 10A

D. 6A

Answer: C

Solution:



Applying KCL at point P,

$\frac{V-0}{6}+\frac{V-90}{5}+\frac{V-140}{20}=0$

$\Rightarrow 10V+12V-1080+3V-420=0$

$\Rightarrow V=60$

$\therefore$ current in $6\Omega = V - 06 = 10A$

Hence option 3.

Question154

A square shaped wire with resistance of each side 3Ω is bent to form a complete circle. The resistance between two diametrically opposite points of the circle in unit of Ω will be
[31 Aug 2021 Shift 1]

Let the sides of square be a.

$\therefore$ Total length or perìmeter of square $=4a$

If the radius of shape of circle be r, then

$\therefore 2\pi r=4a$

$\Rightarrow r=\frac{4a}{2\pi}$

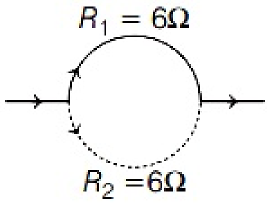
π

Since, resistance of each side of square = 3 Ω

$\therefore$ Total resistance of square $=4\times 3=12\Omega$

i.e. resistance of length $2\pi r=12\Omega$

$\Rightarrow$ Resistance of $\pi r=6\Omega$

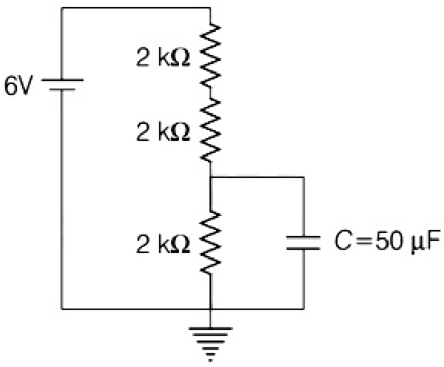


Now, equivalent resistance of circle diametrically opposite

$(R_{eq})=\frac{R_1R_2}{R_1+R_2}=\frac{6\times 6}{6+6}=3\Omega$

Question155

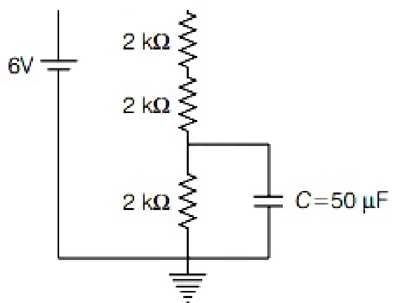
A capacitor of 50μF is connected in a circuit as shown in figure. The charge on the upper plate of the capacitor is........... μC.



[31 Aug 2021 Shift 1]

Solution:

According to given circuit diagram,
Capacitance $= 50\mu F = 50 \times 10^{-6} F$
Supply voltage, V = 6 V



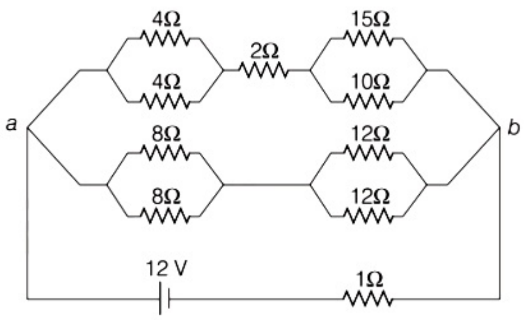
In steady state, capacitor will act as open circuit,
∴ Equivalent resistance $R_{eq} = (2 + 2 + 2) k\Omega = 6 k\Omega$

Circuit current, $I = \frac{V}{R_{eq}} = \frac{6}{6 \times 1000} = 10^{-3} A$

∴ Voltage across $2k\Omega = 1 \times 2 = 10^{-3} \times 2 \times 10^{3} = 2V$
Now, charge on capacitor, $q = CV = 50 \times 10^{-6} \times 2$
$= 100 \times 10^{-6} C$
$= 100 \mu C$

Question156

The voltage drop across 15Ω resistance in the given figure will be .... V.

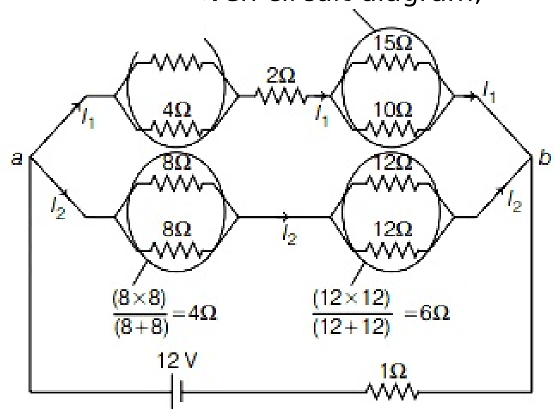


[31 Aug 2021 Shift 1]

Answer: 6

Solution:

According to given circuit diagram,



As we know that, parallel equivalent resistance,

$\frac{1}{R_{eq}} = 1R_1 + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$

and series equivalent resistance,

$R_{eq} = R_1 + R_2 + R_3 + \ldots$

Let the net resistance across a and b be R’

$\therefore \frac{1}{R'} = \frac{1}{2+2+6} + \frac{1}{4+6}$

$a = \frac{1}{10} + \frac{1}{10} = \frac{2}{10}$

R' = 5 Ω

Hence, total resistance, $R = R' + 1 = 5 + 1 = 6\Omega$

According to current division rule, current in upper branch,

$I_1 = I \cdot \frac{4+6}{(2+2+6)+(4+6)}$

$= 1 \cdot \frac{10}{20} = \frac{1}{2} = \frac{1}{2} \cdot \frac{V}{R} = \frac{1}{2} \times \frac{12}{6} = 1A$

Again, according to current division rule, current in 15Ω resistor

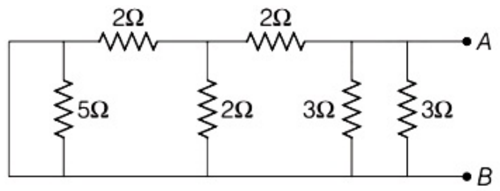
$I_{15} = I_1 \cdot \frac{10}{10+15} = 1 \times \frac{2}{5} = 0.4A$

∴ Voltage drop across15Ω resistor,

$V_{15} = I_{15} \times 15 = 0.4 \times 15 = 6V$

Question157

The equivalent resistance of the given circuit between the terminals A and B is



[31 Aug 2021 Shift 2]

Options:

A. 0

B. 3Ω

C. $\frac{9}{2}\Omega$

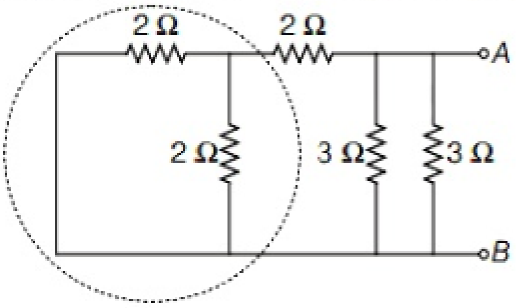
D. 1Ω

Answer: D

Solution:

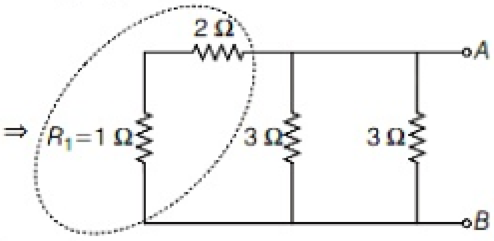
In the given circuit, 5 Ω resistance is shorted. So, it can be discarded.

Now, we get a resolved circuit as shown below



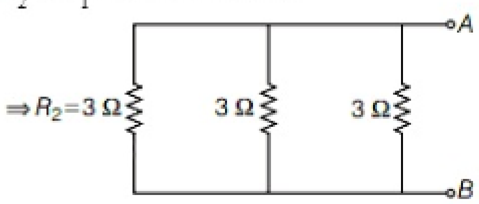
In parallel,

$$R_1 = \frac{2 \times 2}{2+2} = 1\Omega$$



In series,

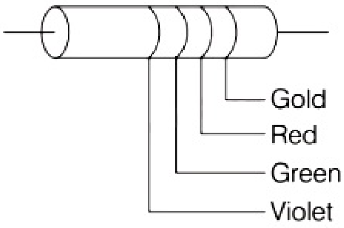
$$R_2 = R_1 + 2 = 1 + 2 = 3\Omega$$



Here, all the three resistances(3Ω) are parallel

Question158

The colour coding on a carbon resistor is shown in the given figure. The resistance value of the given resistor is



[27 Aug 2021 Shift 2]

Options:

A. $(5700 \pm 285)\Omega$

B. $(7500 \pm 750)\Omega$

C. $(5700 \pm 375)\Omega$

D. $(7500 \pm 375)\Omega$

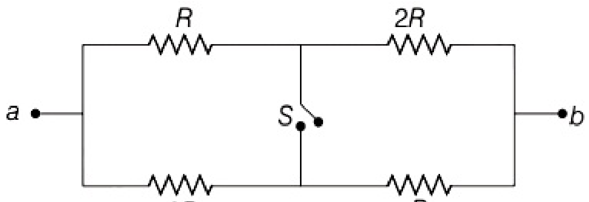
Answer: D

Solution:

Solution:

Question159

The ratio of the equivalent resistance of the network (shown in figure) between the points a and b when switch is open and switch is closed is x : 8. The value of x is



Answer: 9

Solution:

According to given circuit diagram When switch is open, then combination R_1 and R_2 will be in series and also combination R_3 and R_4 will be in series and these branches will be in parallel.

∴ Equivalent resistance

$$(R_{eq}) = \frac{3R \cdot 3R}{3R + 3R} = \frac{9R^2}{6R} = \frac{3}{2}R$$

When switch is closed, then combination R_1 and R_3 will be in parallel and also, combination R_2 and R_4 will be in parallel. After that, both will be in series.

∴ Equivalent resistance,

$$(R'_{eq}) = \frac{R \cdot 2R}{R + 2R} + \frac{R \cdot 2R}{R + 2R} = \frac{2R^2}{3R} + \frac{2R^2}{3R}$$

$$= \frac{2R}{3} + \frac{2R}{3} = \frac{4R}{3}$$

Now, dividing Eq. (i) by Eq. (ii), we get

$$c\ \frac{R_{eq}}{R_{eq}'} = \frac{3\frac{R}{2}}{4\frac{R}{3}} = \frac{9}{8}$$

$x = 9$

Question160

First, a set of n equal resistors of 10Ω each are connected in series to a battery of emf 20V and internal resistance 10Ω. A current / is observed to flow. Then, the n resistors are connected in parallel to the same battery. It is observed that the current is increased 20 times, then the value of n is ....
[27 Aug 2021 Shift 1]

Answer: 20

Solution:

Given, value of each resistance, R = 10 Ω
Emf of battery, e = 20V
Internal resistance of battery, r = 10 Ω
Current in parallel connection is 20 times current in series combination, $i_p = 20i_s$.
Net resistance in parallel combination will be given as

$$R_p = r + \left[\frac{1}{\frac{1}{R} + \frac{1}{R} + \frac{1}{R} \ldots. + n}\right]$$

$$= r + \frac{R}{n}$$

$R_p = 10 + \frac{10}{n}$ ($\because$ r = 10 Ω and R = 10 Ω)...(i)
In series combination,
The net resistance of circuit will be equivalent to sum of all resistances as all are connected in series.
$R_s = [R + R + \ldots.. + n] + r = nR + r$
$R_s = 10n + 10$ ($\because$ r = 10 Ω and R = 10 Ω)...(ii)
By Ohm’s law, current flowing in circuit is given as
$i = \frac{V}{R}$
As, $i_p = 20i_s$
$\frac{V_p}{R_p} = 20\frac{V_s}{R_s}$
$\Rightarrow \frac{20}{10 + \frac{10}{n}} = \frac{20 \times 20}{10n + 10}$ $[\because V_p = V_s = e = 20V]$
$\Rightarrow \frac{20n}{10n + 10} = \frac{400}{10n + 10}$
⇒ 20n = 400
n = 20
Thus, the value of number of resistances n is 20.

Question161

If you are provided a set of resistances 2Ω, 4Ω, 6Ω and 8Ω. Connect these resistances, so as to obtain an equivalent resistance of $\frac{46}{3}$Ω. [26 Aug 2021 Shift 2]

Options:

A. 4Ω and 6Ω are in parallel with 2Ω and 8Ω in series.

B. 6Ω and 8Ω are in parallel with 2Ω and 4Ω in series.

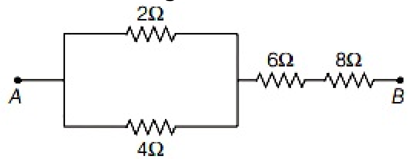
C. 2Ω and 6Ω are in parallel with 4Ω and 8Ω in series.

D. 2Ω and 4Ω are in parallel with 6Ω and 8Ω in series.

Answer: D

Solution:

Solution:
The given value of resistances are 2Ω, 4Ω, 6Ω and 8Ω.
The required value of combination is $\frac{46}{3}$Ω.
In order to achieve the above mentioned values of resistance from given resistances, we will connect 2Ω and 4Ω resistance in parallel, then join 6 Ω and 8 Ω resistance in series with the combination.
The circuit diagram for connection is shown below.



$\therefore R_{eq} = (2 \mid 4) + 6 + 8 = \frac{2 \times 4}{2 + 4} + 14 = \frac{46}{3}\Omega$
Thus, resistance of 2Ω and 4Ω are in parallel with 6Ω and 8Ω in series combination.

Question162

What equal length of an iron wire and a copper-nickel alloy wire, each of 2 mm diameter connected parallel to give an equivalent resistance of 3Ω?
(Given, resistivities of iron and copper-nickel alloy wire are 12μΩ cm and 51μΩ cm respectively)
[26 Aug 2021 Shift 1]

Options:

A. 82m

B. 97m

C. 110m

D. 90m

Answer: B

Solution:

Solution:
Let the resistance of iron wire be R_1 and that of copper nickel alloy wire be R_2
$r_1 = r_2 = 1\,mm = 10^{-3}m$
$\rho_1 = 12\mu\Omega\,cm$
$= 12 \times 10^{-6}\Omega\,cm$
$= 12 \times 10^{-8}\Omega m$
$\rho_2 = 51\mu\Omega\,cm$
$= 51 \times 10^{-6}\Omega\,cm$
$= 51 \times 10^{-8}\Omega m$
For parallel combination,
$$R_{eq} = \frac{R_1R_2}{R_1 + R_2}$$
$$3 = \frac{\frac{\rho_1 l}{\pi r_1^2}\frac{\rho_2 l}{\pi r_2^2}}{\frac{\rho_1 l}{\pi r_1^2} + \frac{\rho_2}{\pi r_2^2}}$$
$$\Rightarrow 3 = \frac{\frac{(12 \times 10^{-8})l}{\pi \times 10^{-6}} \times \frac{51 \times 10^{-8}l}{\pi \times 10^{-6}}}{\frac{12 \times 10^{-8}l}{\pi \times 10^{-6}} + \frac{51 \times 10^{-8}l}{\pi \times 10^{-6}}}$$
On solving, l = 97 m

Question163

A resistor dissipates 192 J of energy in 1 s when a current of 4A is passed through it. Now, when the current is doubled, the amount of thermal energy dissipated in 5 s is .... J.
[31 Aug 2021 Shift 2]

Solution:

Given that, initial current, $I_1 = 4A$
Final current, $I_2 = 2I_1 = 8A$
Initial heat dissipated, $H_1 = 192J$
Initial time, $t_1 = 1s$
Final time, $t_2 = 5s$
Let final heat dissipated = H_2
By Joule's law of heating,
$H \propto I^2 RT$
Since resistance remains same at initial and final condition,
$\therefore \frac{H_2}{H_1} = \frac{I_2^2 Rt_2}{I_1^2 Rt_1} = \frac{I_2^2 t_2}{I_1^2 t_1}$
Substituting the given values, we get
$\frac{H_2}{192} = \left(\frac{8}{4}\right)^2 \times \frac{5}{1}$
$\Rightarrow H_2 = 3840$ J

Question164

An electric bulb of 500W at 100V is used in a circuit having a 200V supply. Calculate the resistance R to be connected in series with the bulb, so that the power delivered by the bulb is 500W.
[26 Aug 2021 Shift 2]

Options:

A. 20Ω

B. 30Ω

C. 5Ω

D. 10Ω

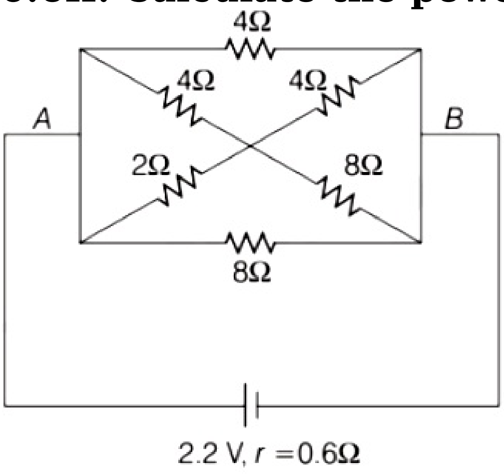
Answer: A

Solution:

Solution:
Given, power rating of bulb, $P_B = 500W$
Voltage across bulb, $V_B = 100V$
Supply voltage, $V_S = 200V$
If a resistance R is attached in series with the bulb, then the voltage across resistance will be 100 V.
Now, current flowing in circuit when bulb delivers power of 500 W is given as
$P_B = V_B I$
$\Rightarrow 500 = 100 \times I$
$\Rightarrow I = 5A$
Same amount of current will flow from the resistance as it is connected in series.
Using Ohm's law,
V = IR
⇒ 100 = 5 × R
⇒ R = 20Ω
Thus, the resistance connected in series is 20Ω.

Question165

In the given figure, the emf of the cell is 2.2V and if internal resistance is 0.6Ω. Calculate the power dissipated in the whole circuit



[26 Aug 2021 Shift 1]

Options:

A. 1.32W

B. 0.65W

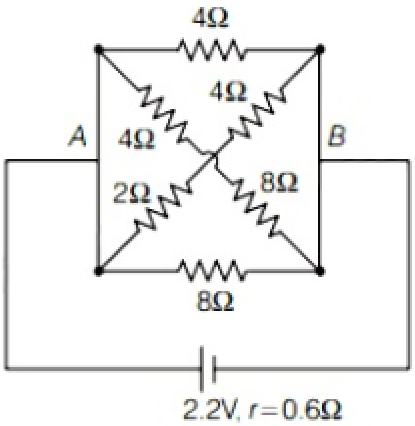
C. 2.2W

D. 4.4W

Answer: C

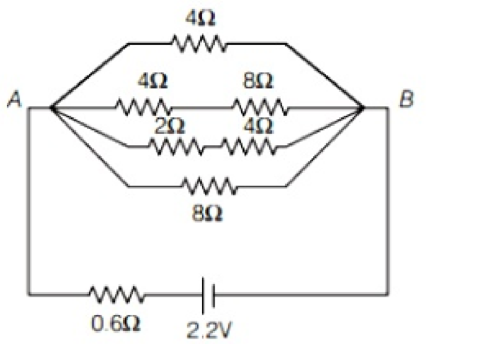
Solution:

Solution:
The given circuit diagram can be drawn as

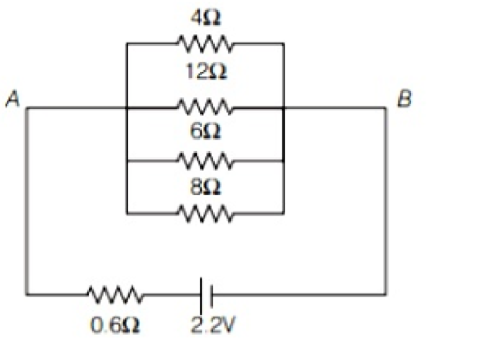


Redrawing the above circuit diagram as

Redrawing the above circuit diagram as



⇓



Equivalent resistance of the circuit between point A and B is given as

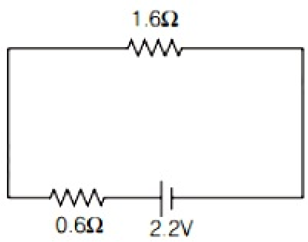
$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$$

$$= \frac{1}{4} + \frac{1}{12} + \frac{1}{6} + \frac{1}{8}$$

$$= \frac{6+2+4+3}{24}$$

$$= \frac{15}{24}$$

$$= \frac{24}{15}\Omega = 1.6\Omega$$



$R_{total} = 1.6 + 0.6 = 2.2\Omega$

$$P = \frac{V^2}{R_{total}} = \frac{2.2 \times 2.2}{2.2}$$

$= 2.2$ W

Question166

Five identical cells each of internal resistance 1Ω and emf 5V are connected in series and in parallel with an external resistance R. For what value of R, current in series and parallel combination will

remain the same ?
[27 Aug 2021 Shift 1]

Options:

A. 1Ω

B. 25Ω

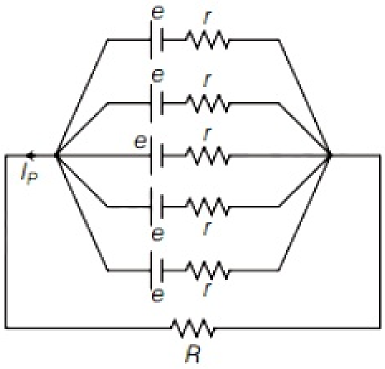
C. 5Ω

D. 10Ω

Answer: A

Solution:

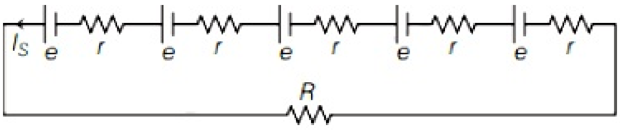
Given, number of cells, $n = 5$
istance of each cell, $r = 1\Omega$
Emf of each cell, $e = 5$ V
When all cells are connected in parallel as shown below.



Potential will remain same as, $V_P = 5V$
Net resistance in parallel combination will be given as

$$R_p = R + \left[\frac{1}{\frac{1}{r} + \frac{1}{r} + \frac{1}{r} + \frac{1}{r} + \frac{1}{r}}\right] = R + \frac{r}{5}$$

$R_p = R + \frac{1}{5}$ ($\because$ r = 1 Ω) ...(i)
When all cells are connected in series as shown below



The net potential will increase as cells are connected in series,
$V_S = 5 + 5 + 5 + 5 + 5 = 25V$
The net resistance of circuit will be equivalent of sum of all resistances as all are connected in series.
$R_s = r + r + r + r + r + R = 5r + R$
$R_s = 5 + R$ ($\because$ r = 1Ω) ...(ii)
By Ohm's law, current flowing in circuit is given as
$I = \frac{V}{R}$
As current in both series and parallel combination is same,
$\frac{V_p}{R_p} = \frac{V_s}{R_s}$
$\Rightarrow \frac{5}{R + \frac{1}{5}} = \frac{25}{5 + R}$ [From Eqs. (i) and (ii)]
$\Rightarrow 25 + 5R = 25R + 5$
$\Rightarrow$ R = 1 Ω

Question167

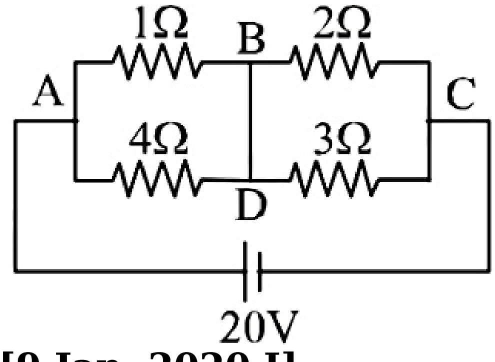
A uniform heating wire of resistance 36Ω is connected across a potential difference of 240V. The wire is then cut into half and potential difference of 240V is applied across each half separately. The ratio of power dissipation in first case to the total power dissipation in the second case would be 1 : x , where x is ....
[1 Sep 2021 Shift 2]

Solution:

For **case I,**
The potential difference of the uniform wire, V =240 V
The resistance of the uniform wire, $R_1 = 36\ \Omega$
The power dissipation in the first case,
$$P_1 = \frac{V^2}{R_1} = \frac{(240)^2}{36}$$
For **case II,**
The resistance of each half, $R_2 = \frac{R_1}{2} = \frac{36}{2} = 18\Omega$
$$P_2 = \frac{V^2}{R_2} + \frac{V^2}{R_2} = \frac{(240)^2}{18} + \frac{(240)^2}{18} = \frac{(240)^2}{9}$$
Thus, the ratio of the total power dissipation in the first case to thesecond case
$$\frac{P_1}{P_2} = \frac{(240)^2 / 36}{(240)^2 / 9}$$
$$\Rightarrow \frac{P_1}{P_2} = \frac{1}{4}$$
Comparing with, $\frac{P_1}{P_2} = \frac{1}{x}$
The value of the x = 4.

Question168

In the given circuit diagram, a wire is joining points B and D. Th current in this wire is:



[9 Jan. 2020 I]

A. 0.4A

B. 2A

C. 4A

D. zero

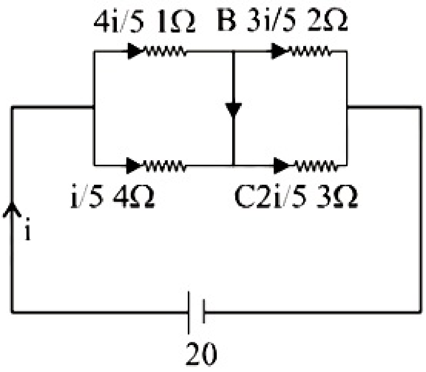
Answer: B

Solution:

Solution:
From circuit diagram,

$\frac{1}{R_1} = \frac{1}{1} + \frac{1}{4} \Rightarrow R_1 = \frac{4}{5}$

$\frac{1}{R_2} = \frac{1}{2} + \frac{1}{3} \Rightarrow R_2 = \frac{6}{5}$



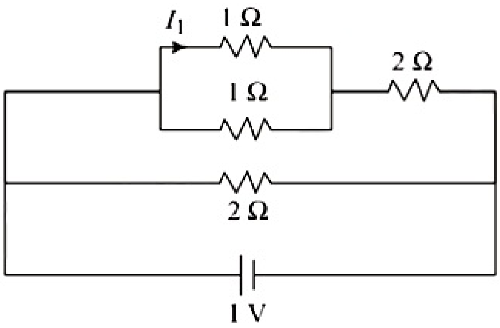
$R_{eff} = R_1 + R_2 = \frac{4}{5} + \frac{6}{5} = 2\Omega$

$i = \frac{v}{R_{eff}} = \frac{20}{2} = 10A$

$\therefore I_{BC} = \frac{4i}{5} - \frac{3i}{5} = \frac{i}{5} = 2A$

Question169

The current I_1 (in A) flowing through 1 Ω resistor in the following circuit is:



[7 Jan. 2020 I]

Options:

A. 0.4

B. 0.5

C. 0.2

D. 0.25

Answer: C

Solution:

Solution:

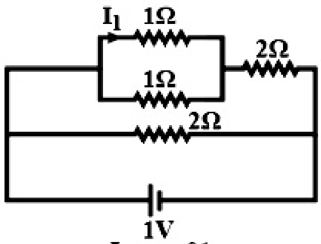


Image 01

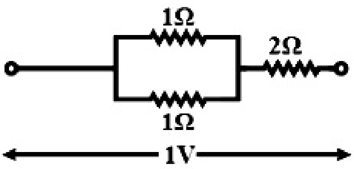


Image 02

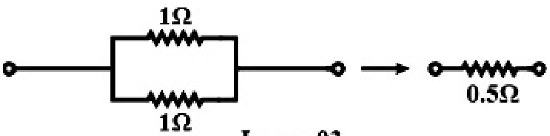


Image 03

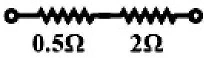


Image 04

Refer image .1
Potential difference across the top most branch is 1V
Refer image. 2
Equivalent resistance of the top most branch is given by the combinations of the 1Ω and the 2Ω resistor. The parallel combination of 1Ω resistor give 0.5Ω
Refer image. 3
∴ The equivalent circuit would be
Refer image. 4

$R_{total} = 2 + 0.5$
$= 2.5\Omega$

$I_{total} = \frac{V}{R_{total}} = \frac{1}{2.5} = \frac{2}{5} = 0.4A$

Now, using current division,
Refer image. 5

$V = I_1R_1 = I_2R_2$

$T = I_1 + I_2$
$\therefore I_1R_1 = (I - I_1)R_2$
$I_1(R_1 + R_2) = IR_2$
$I_1 = \frac{IR_2}{R_1 + R_2} = \frac{0.4 \times 1}{1 + 1} = 0.2A$

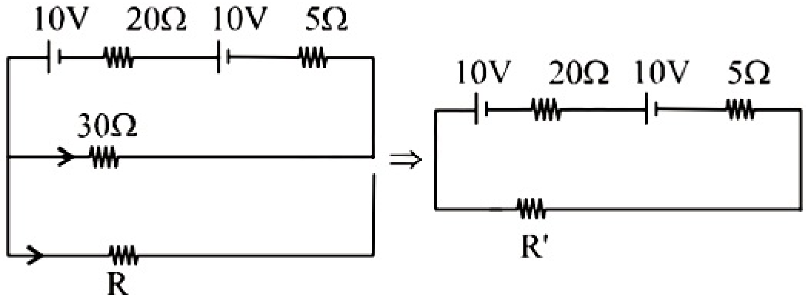
Question170

The series combination of two batteries, both of the same emf 10 V, but different internal resistance of 20 Ω and 5 Ω, is connected to the parallel combination of two resistors 30 Ω and R Ω. The voltage difference across the battery of internal resistance 20 W is zero, the value of R (in Ω) is ________.

[NA. 8 Jan. 2020 II]

Solution:

Solution:



The resistance of 30Ω is in parallel with R. Their effective resistance $\frac{1}{R'} = \frac{1}{30} + \frac{1}{R}$

$R' = \frac{30R}{30 + R}$ ....(i)

Also, $V = IR \Rightarrow 10 = \frac{20 \times 20}{R' + 25}$

$\Rightarrow R' + 25 = 40 \Rightarrow R' = 15$

$R' = 15 = \frac{30R}{30 + R}$ Using (i)

$\Rightarrow 30 + R = 2R$

$\Rightarrow R = 30\Omega$

Question171

In a building there are 15 bulbs of 45 W, 15 bulbs of 100 W, 15 small fans of 10 W and 2 heaters of 1 kW. The voltage of electric main is 220 V. The minimum fuse capacity (rated value) of the building will be:
[7 Jan. 2020 II]

Options:

A. 10 A

B. 25 A

C. 15 A

D. 20 A

Answer: D

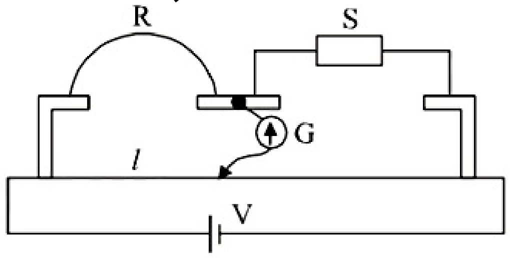
Solution:

Solution:
Net Power, P
$= 15 \times 45 + 15 \times 100 + 15 \times 10 + 2 \times 1000$
$= 15 \times 155 + 2000W$
Power, $P = VI \Rightarrow I = \frac{P}{V}$

$\therefore I_{main} = \frac{15 \times 155 + 2000}{220} = 19.66A \approx 20A$

Question172

In a meter bridge experiment S is a standard resistance. R is a resistance wire. It is found that balancing length is l = 25 cm. If R is replaced by a wire of half length and half diameter that of R of same material, then the balancing distance l' (in cm) will now be ____.



[NA. 9 Jan. 2020 II]

Solution:

For the given meter bridge

$\frac{R}{S} = \frac{l_1}{100 - l_1}$ Where, $l_1 =$ balancing length

S 75 $= \frac{1}{3}$ ....(i)

New resistance

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

$\Rightarrow R' = 2R$

$\frac{R'}{S} = \frac{l_2}{100 - l_2} \Rightarrow \frac{2R}{S} = \frac{l_2}{100 - l_2}$

$\Rightarrow 2 \times \frac{1}{3} = \frac{l_2}{100 - l_2}$ Using (i

$\Rightarrow l_2 = 40cm$

Question173

The length of a potentiometer wire is 1200 cm and it carries a current of 60 mA. For a cell of emf 5 V and internal resistance of 20Ω, the null point on it is found to be at 1000 cm. The resistance of whole wire is: [8 Jan. 2020 I]

Options:

A. 80 Ω

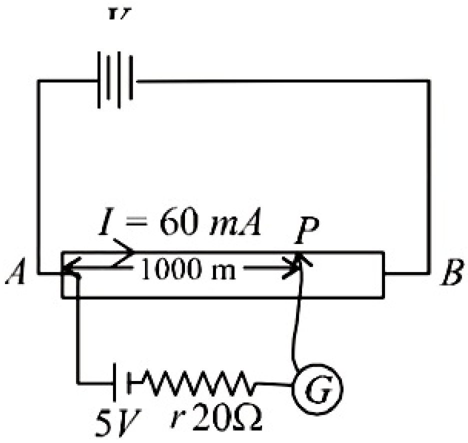
B. 120 Ω

C. 60 Ω

D. 100 Ω

Answer: D

Solution:



Let R be the resistance of the whole wire
Potential gradient for the potentiometer wire

$AB' = -\frac{dV}{dl} = \frac{I \times R}{l} = \left[\frac{60 \times R}{l_{AB}}\right] mv / m$

$V_{AP} = \left(\frac{dV}{dl_{AB}}\right) l_{AP} = \frac{60 \times R}{1200} \times 1000mV$

$\Rightarrow V_{AP} = 50RmV$

Also, $V_{AP} = 5V$ (for balance point at P)

$\therefore R = \frac{V_{AP}}{50 \times 10^{-3}} = \frac{5}{50 \times 10^{-3}} = 100\Omega$

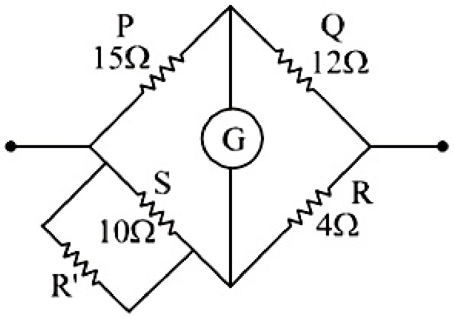
Question174

Four resistances of 15 Ω, 12 Ω, 4 Ω and 10 Ω respectively in cyclic order to form Wheatstone's network. The resistance that is to be connected in parallel with the resistance of 10 Ω to balance the network is _____ Ω. [NA. 8 Jan. 2020 I]

Answer: 10

Solution:

Solution:



As per Wheatstone bridge balance condition $\frac{P}{Q} = \frac{S}{R}$

Let resistance R ' is connected in parallel with resistance S of 10Ω

$\therefore \frac{15}{12} = \frac{\frac{10R'}{10+R'}}{4} \Rightarrow 5 = \frac{10R'}{10+R'}$

$\Rightarrow 50 + 5R' = 10R$

$\therefore R' = \frac{50}{5} = 10\Omega$

Question175

The balancing length for a cell is 560 cm in a potentiometer experiment. When an external resistance of 10 Ω is connected in parallel to the cell, the balancing length changes by 60 cm. If the internal resistance of the cell is $\frac{N}{10}$ Ω, where N is an integer then value of N is ______.

[NA. 7 Jan. 2020 II]

Answer: 12

Solution:

Solution:

We know that

$E \propto l$ where l is the balancing length

$\therefore E = k(560)$ .....(i)

When the balancing length changes by 60cm

$\frac{E}{r+10} 10 = k(500)$

Dividing (i) by (ii) we get

$\Rightarrow \frac{r+10}{10} = \frac{56}{50} \Rightarrow 50r + 500 = 560$

$\Rightarrow r = \frac{6}{5}\Omega = \frac{N}{10}\Omega \Rightarrow N = 12$

Question176

A circuit to verify Ohm's law uses ammeter and voltmeter in series or parallel connected correctly to the resistor. In the circuit :

[Sep. 06, 2020 (II)]

Options:

A. ammeter is always used in parallel and voltmeter is series

B. Both ammeter and voltmeter must be connected in parallel

C. ammeter is always connected in series and voltmeter in parallel

D. Both, ammeter and voltmeter must be connected inseries

Answer: C

Solution:

Solution:
Ammeter : In series connection, the same current flows through all the components. It aims at measuring the current flowing through the circuit and hence, it is connected in series.
Voltmeter : A voltmeter measures voltage change between two points in a circuit. So we have to place the voltmeter in parallel with the cicuit component.

Question177

Consider four conducting materials copper, tungsten, mercury and aluminium with resistivity ρ_C, ρ_T, ρ_M and ρ_A respectively. Then : [Sep. 02, 2020 (I)]

Options:

A. $\rho_C > \rho_A > \rho_T$

B. $\rho_M > \rho_A > \rho_C$

C. $\rho_A > \rho_T > \rho_C$

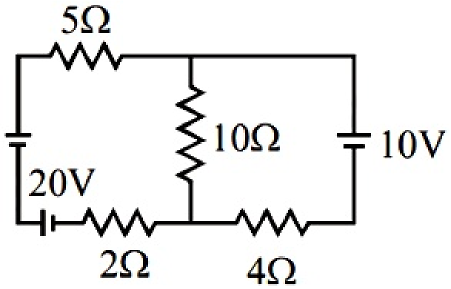
D. $\rho_A > \rho_M > \rho_C$

Answer: B

Solution:

Solution:
$\rho_M = 98 \times 10^{-8}$
$\rho_A = 2.65 \times 10^{-8}$
$\rho_C = 1.724 \times 10^{-8}$
$\rho_T = 5.65 \times 10^{-8}$
$\therefore \rho_M > \rho_T > \rho_A > \rho_C$

Question178



In the figure shown, the current in the 10 V battery is close to : [Sep. 06, 2020 (II)]

Options:

A. 0.71 A from positive to negative terminal

B. 0.42 A from positive to negative terminal

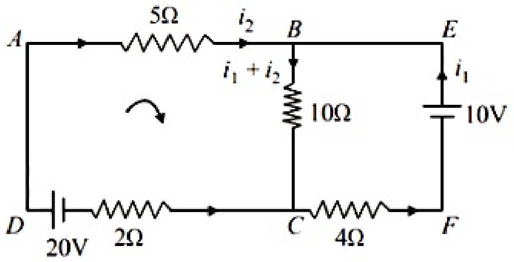
C. 0.21 A from positive to negative terminal

D. 0.36 A from negative to positive terminal

Answer: C

Solution:

Solution:



Using Kirchoff's loop law in loop ABCD

$-5i_2 - 10(i_1 + i_2) - 2i_2 + 20 = 0$

$\Rightarrow -10i_1 - 17i_2 + 20 = 0$ ......(i)

Using Kirchoff's loop law in loop BE F C

$\Rightarrow -10 + 4i_1 + 10(i_1 + i_2) = 0$

$\Rightarrow 14i_1 + 10i_2 + 10 = 0$ ....(ii)

Multiplying equation (i) by 10 , we have

$(10i_1 + 17i_2 = 20) \times 10$

$\Rightarrow 100i_1 - 170i_2 = 200$ .....(iii)

Multiplying equation (ii) by 17, we have

$(14i_1 + 10i_2 = 10) \times 17$

$\Rightarrow 238i_1 - 170i_2 = 170$ ......(iv)

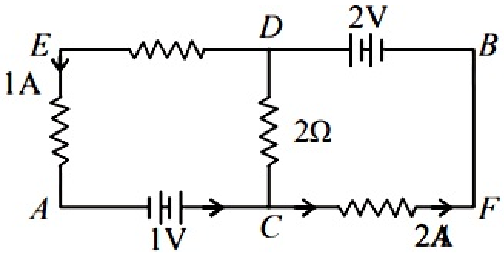
On solving equations (iii) and (iv), we get

$-138i_1 = 30 \Rightarrow i_1 = -\frac{30}{138} = -0.217$

i_1 is negative it means current flows from positive to negative terminal.

Question179

9. In the circuit, given in the figure currents in different branches and value of one resistor are shown. Then potential at point B with respect to the point A is :



[Sep. 05, 2020 (II)]

Options:

A. + 2 V

B. – 2 V

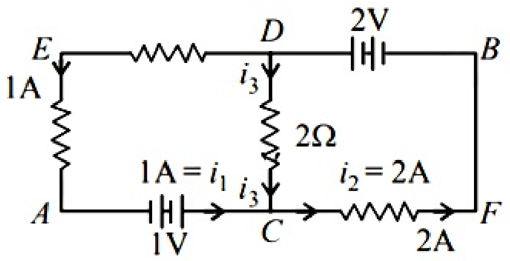
C. – 1 V

D. + 1 V

Answer: D

Solution:

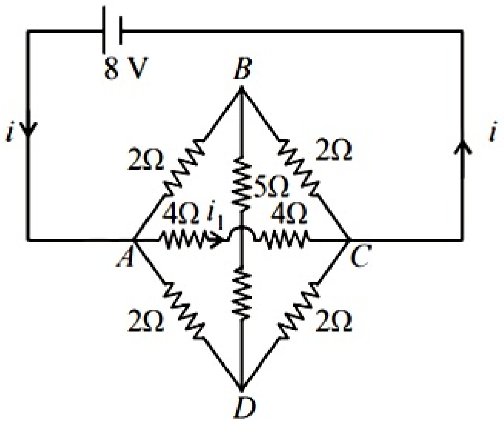
Solution:



Let us assume the potential at $A = V_A = 0$
Using Kirchoff's junction rule at C, we get
$i_1 + i_3 = i_2$
$1A + i_3 = 2A \Rightarrow i_3 = 2A$
Now using Kirchoff's loop law along ACDB
$V_A + 1 + i_3(2) - 2 = V_B$
$\Rightarrow V_A + 1 + i_3(1) - 2 = V_B$
$\Rightarrow V_B - V_A = 3 - 2 = 1$ volt

Question180

The value of current i_1 flowing from A to C in the circuit diagram is



[Sep. 04, 2020 (II)]

Options:

A. 2 A

B. 4 A

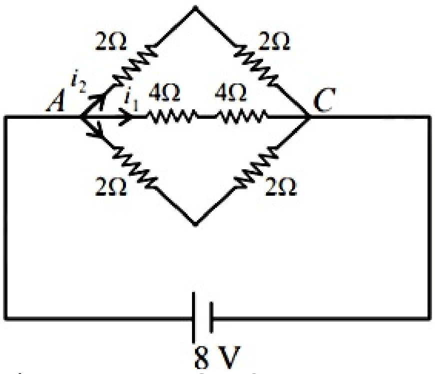
C. 1 A

D. 5 A

Answer: C

Solution:

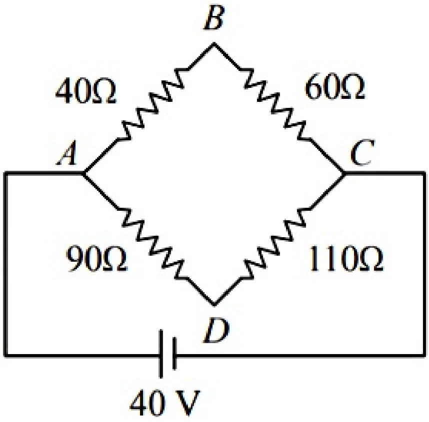
Solution:
The equivalent circuit can be drawn as



Voltage across AC = 8V
Resistance $R_{AC} = 4 + 4 = 8\Omega$

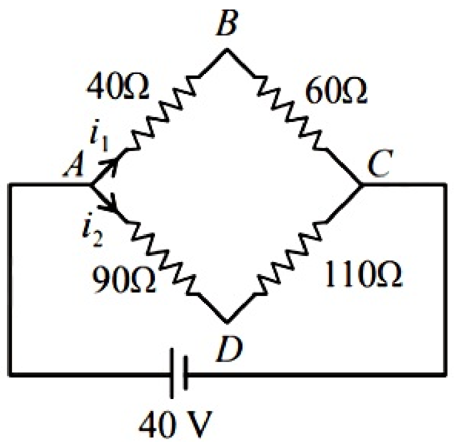
$$i_1 = \frac{V}{R_{AC}} = \frac{8}{4+4} = 1 \text{ Amp}$$

Question181



Four resistances 40 Ω, 60 Ω, 90 Ω and 110 Ω make the arms of a quadrilateral ABCD. Across AC is a battery of emf 40 V and internal resistance negligible. The potential difference across BD in V is ________.
[NA. Sep. 04, 2020 (II)]

Solution:



Current through AB, $i_1 = \frac{40}{40 + 60} = 0.4$

Current through AD, $i_2 = \frac{40}{90 + 110} = \frac{1}{5}$

Using KVL in BAD loop

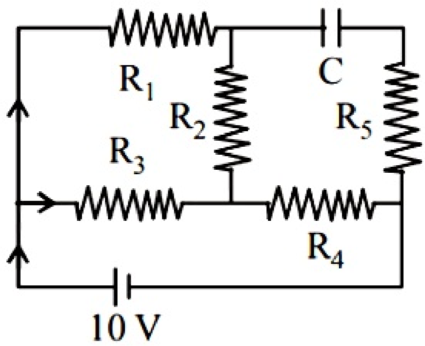
$V_B + i_1(40) - i_2(90) = V_D$

$\Rightarrow V_B - V_D = \frac{1}{5}(90) - \frac{4}{10}(40)$

$\Rightarrow V_B - V_D = 18 - 16 = 2V$

Question182

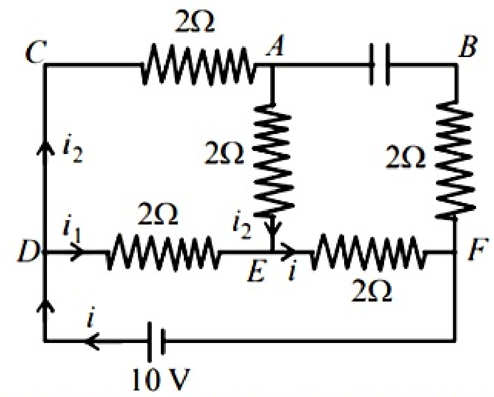
An ideal cell of emf 10 V is connected in circuit shown in figure. Each resistance is 2 Ω. The potential difference (in V) across the capacitor when it is fully charged is _________.



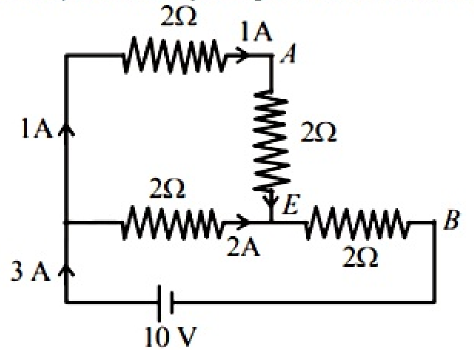
[Sep. 02, 2020 (II)]

Answer: 8

Solution:



As capacitor is fully charged no current will flow through it



We have the current distribution as shown in the figure.

Equivalent resistance, $R_{eq} = \left(\frac{4 \times 2}{4+2}\right) + 2$

Net current, $i = \frac{10}{\frac{4}{3}+2} = \frac{10 \times 3}{10} = 3\,\text{Amp}$

$i_1 = 2A$ and $i_2 = 1A$

$V_{AE\,B} = 1 \times 2 + 3 \times 2 = 8V$

Question183

An electrical power line, having a total resistance of 2 Ω,delivers 1 kΩ at 220 V. The efficiency of the transmission line is approximately : [Sep. 05, 2020 (I)]

Options:

A. 72%

B. 91%

C. 85%

D. 96%

Answer: D

Solution:

Solution:

Given : Power, $P = 1kW = 1000W$ $R = 2\Omega$, $V = 220V$

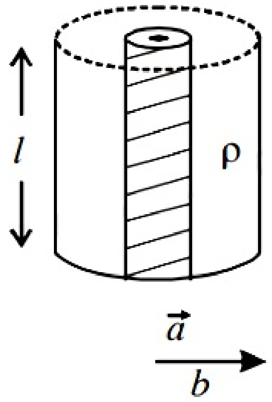
Current, $I = \frac{P}{V} = \frac{1000}{220}$

$P_{loss} = I^2R = \left(\frac{1000}{220}\right)^2 \times 2$

Efficiency $= \frac{1000}{1000 + P_{loss}} \times 100 = 96\%$

Question184

Model a torch battery of length l to be made up of a thin cylindrical bar of radius ‘a’ and a concentric thin cylindrical shell of radius ‘b’ filled in between with an electrolyte of resistivity ρ (see figure). If the battery is connected to a resistance of value R, the maximum Joule heating in R will take place for :



[Sep. 03, 2020 (I)]

Options:

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

B. $R = \frac{\rho}{2\pi l}\ln\left(\frac{b}{a}\right)$

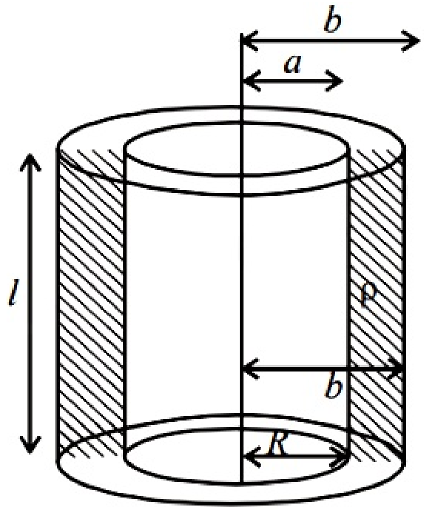
C. $R = \frac{\rho}{\pi l}\ln\left(\frac{b}{a}\right)$

D. $R = \frac{2\rho}{\pi l}\ln\left(\frac{b}{a}\right)$

Answer: B

Solution:

Solution:
Maximum power in external resistance is generated when it is equal to internal resistance of battery i.e., P_R maximum when $r = R$
The maximum Joule heating in R will take place for, the resistance of small element
$\Delta R = \frac{\rho d r}{2\pi r l} \Rightarrow R = \frac{\rho}{2\pi l}\int_a^b \frac{d r}{r}$



or, $R = \frac{\rho}{2\pi l} \ln \frac{b}{a}$

Question185

Two resistors 400Ω and 800Ω are connected in series across a 6 V battery. The potential difference measured by a voltmeter of 10 kΩ across 400Ω resistor is close to:
[Sep. 03, 2020 (II)]

Options:

A. 2 V

B. 1.8 V

C. 2.05 V

D. 1.95 V

Answer: D

Solution:

Solution:
The voltmeter of resistance 10kΩ is parallel to the resistance of 400Ω. So, their equivalent resistance is

$$\frac{1}{R'} = \frac{1}{10k\Omega} + \frac{1}{400\Omega} = \frac{1}{10000} + \frac{1}{400}$$

$$\Rightarrow \frac{1}{R'} = \frac{1+25}{10000} = \frac{26}{10000}$$

$$\Rightarrow R' = \frac{10000}{26}\Omega$$

Using Ohm's law, current in the circuit

$$I = \frac{\text{Voltage}}{\text{Net Resistance}} = \frac{6}{\frac{10000}{26} + 800}$$

Potential difference measured by voltmeter

$$V = IR' = \frac{6}{\frac{10000}{26} + 800} \times \frac{10000}{26}$$

$$\Rightarrow V = \frac{150}{77} = 1.95\,\text{volt}$$

Question186

**Which of the following will NOT be observed when a multimeter (operating in resistance measuring mode) probes connected across a component, are just reversed?
[Sep. 03, 2020 (II)]**

Options:

A. Multimeter shows an equal deflection in both cases i.e. before and after reversing the probes if the chosen component is resistor.

B. Multimeter shows NO deflection in both cases i.e. before and after reversing the probes if the chosen component is capacitor.

C. Multimeter shows a deflection, accompanied by a splash of light out of connected and NO deflection on reversing the probes if the chosen component is LED.

D. Multimeter shows NO deflection in both cases i.e. before and after reversing the probes if the chosen component is metal wire.

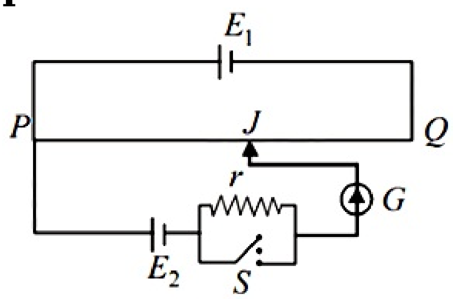
Answer: B

Solution:

Solution:
Multimeter shows deflection in both cases i.e. before and after reversing the probes if the chosen component is capacitor.

Question187

A potentiometer wire PQ of 1m length is connected to a standard cell E_1. Another cell E_2 of emf 1.02V is connected with a resistance 'r' and switch S (as shown in figure). With switch S open, the null position is obtained at a distance of 49cm from Q. The potential gradient in the potentiometer wire is :



[Sep. 02, 2020 (II)]

Options:

A. 0.02 V/cm

B. 0.01 V/cm

C. 0.03 V/cm

D. 0.04 V/cm

Answer: A

Solution:

Solution:

Potential gradient, $x = \frac{\text{Potential drop}}{\text{length}}$

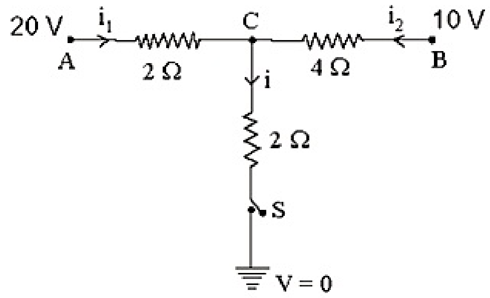
Here, Potential drop $= 1.02$

Balancing length from $P = 100 - 49$

$\therefore x = \frac{1.02}{100 - 49} = 0.02 \text{ volt / cm}$

Question188

When the switch S, in the circuit shown, is closed then the valued of current i will be:



[9 Jan. 2019 I]

Options:

A. 3A

B. 5A

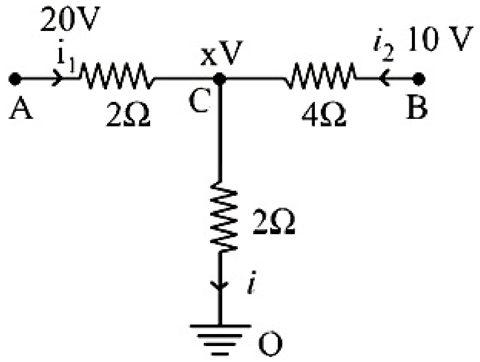
C. 4A

D. 2A

Answer: B

Solution:

Solution:



Let voltage at C = xV

From kirchhoff's current law,

$KCL : i_1 + i_2 = i$

$\frac{20 - x}{2} + \frac{10 - x}{4} = \frac{x - 0}{2} \Rightarrow x = 10$

$\therefore i = \frac{V}{R} = \frac{X}{R} = \frac{10}{2} = 5A$

Question189

Two electric bulbs, rated at (25W , 220V) and (100W , 220V) are connected in series across a 220V voltage source. If the 25W and 100W bulbs draw powers P_1 and P_2 respectively, then:
[12 Jan. 2019 I]

Options:

A. $P_1 = 16W$, $P_2 = 4W$

B. $P_1 = 16W$, $P_2 = 9W$

C. $P_1 = 9W$, $P_2 = 16W$

D. $P_1 = 4W$, $P_2 = 16W$

Answer: A

Solution:

Solution:
As $R = \frac{V^2}{P}$, so $R_1 = \frac{220^2}{25}$ and $R_2 = \frac{220^2}{100}$
Current flown $i = \frac{220}{R_1 + R_2}$

$$P_1 = i^2R_1 = \frac{220^2}{\left(\frac{220^2}{25} + \frac{220^2}{100}\right)} \times \frac{220^2}{25} = 16W$$

Similarly, $P_2 = i^2R_2 = 4W$

Question190

Two equal resistances when connected in series to a battery, consume electric power of 60 W. If these resistance are now connected in parallel combination to the same battery, the electric power consumed will be :
[11 Jan. 2019 I]

Options:

A. 60 W

B. 240 W

C. 120 W

D. 30 W

Answer: B

Solution:

Solution:
When two resistances are connected in series,
$R_{eq} = 2R$
Power consumed, $P = \varepsilon^2 R_{eq} = \frac{\varepsilon^2}{2R}$
In parallel condition, $R_{eq} = R / 2$
New power, $P' = \frac{\varepsilon^2}{(R/2)}$
or $P' = 4P = 240W$ ($\because P = 60W$)

Question191

A 2 W carbon resistor is color coded with green, black, red and brown respectively. The maximum current which can be passed through this resistor is:
[10 Jan. 2019 I]

Options:

A. 20 mA

B. 100 mA

C. 0.4 mA

D. 63 mA

Answer: A

Solution:

Solution:
Colour code for carbon resistor

Bl,	Br,	R,	O,	Y,	G,	Blue,	V	Gr,	W
0,	1,	2,	3,	4,	5,	6,	7,	8,	9

Resistance, $R = AB \times C \pm D$
$\therefore$ Resistance, $R = 50 \times 10^2 \Omega$
Now using formula, Power, $P = i^2 R$
$\therefore i = \sqrt{\frac{P}{R}} = \sqrt{\frac{2}{50 \times 10^2}} = 20 mA$

Question192

A current of 2 mA was passed through an unknown resistor which dissipated a power of 4.4 W. Dissipated power when an ideal power supply of 11 V is connected across it is:
[10 Jan. 2019 II]

Options:

A. 11×10^{-5}W

B. 11×10^{-3}W

C. 11×10^{-4}W

D. 11×10^{5}W

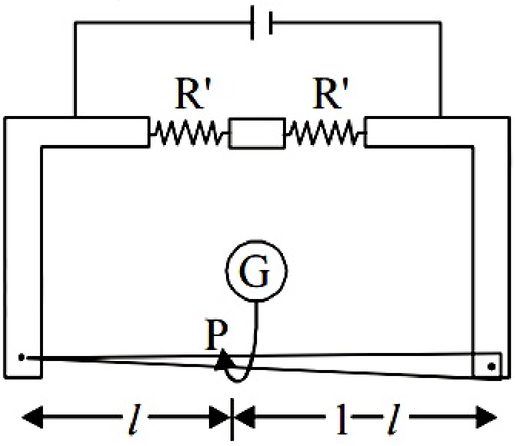
Answer: A

Solution:

Solution:
Power, $P = I^2R$
$4.4 = 4 \times 10^{-6} \times R$
$\Rightarrow R = 1.1 \times 10^{6}\Omega$
When supply of 11v is connected
Power, $P' = \frac{v^2}{R} = \frac{11^2}{1.1} \times \frac{11^2}{1.1} \times 10^{-6}$
$= 11 \times 10^{-5}$W

Question193

In a meter bridge, the wire of length 1m has a non-uniform cross-section such that, the variation $\frac{dR}{dl}$ of its resistance R with length l is $\frac{dR}{dl} \propto \frac{1}{\sqrt{l}}$. Two equal resistances are connected as shown in the figure. The galvanometer has zero deflection when the jockey is at point P. What is the length AP?



[12 Jan. 2019 I]

Options:

A. 0.2 m

B. 0.3 m

C. 0.25 m

D. 0.35 m

Answer: C

Solution:

We have given
$\frac{dR}{dl} \propto \frac{1}{\sqrt{l}} \Rightarrow \frac{dR}{dl} = k \times \frac{1}{\sqrt{l}}$ (where k is constant)
$dR = k\frac{dl}{\sqrt{l}}$
Let R_1 and R_2 be the resistance of AP and PB respectively. Using wheatstone bridge principle
$\therefore \frac{R'}{R'} = \frac{R_1}{R_2}$ or $R_1 = R_2$
Now, $\int dR = k\int \frac{dl}{\sqrt{l}}$
$\therefore R_1 = k\int_0^l l^{-1/2} dl = k.2.\sqrt{l}$
$R_2 = k\int_l^1 l^{-1/2} dl = k.(2 - 2\sqrt{l})$
Putting $R_1 = R_2$
$k2\sqrt{l} = k(2 - 2\sqrt{l})$
$\therefore 2\sqrt{l} = 1$
$\sqrt{l} = \frac{1}{2}$
i.e., $l = \frac{1}{4}m \Rightarrow 0.25m$

Question194

An ideal battery of 4 V and resistance R are connected in series in the primary circuit of a potentiometer of length 1 m and resistance 5Ω. The value of R, to give a potential difference of 5 mV across 10 cm of potentiometer wire is:
[12 Jan. 2019 I]

Options:

A. 490Ω

B. 480Ω

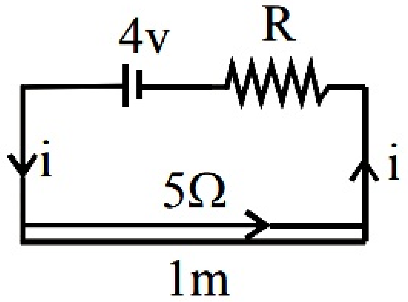
C. 395Ω

D. 495Ω

Answer: C

Solution:

Solution:



Current flowing through the circuit (I) is given by
$I = \left(\frac{4}{R+5}\right)A$
Resistance of length 10cm of wire

$= 5 \times \frac{10}{100} = 0.5\Omega$

According to question,

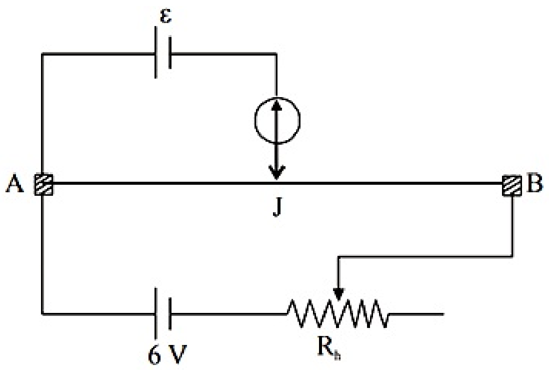
$5 \times 10^{-3} = \left(\frac{4}{R+5}\right) . (0.5)$

$\therefore \frac{4}{R+5} = 10^{-2}$ or $R + 5 = 400\Omega$

$\therefore R = 395\Omega$

Question195

The resistance of the meter bridge AB in given figure is 4Ω. With a cell of emf $\varepsilon = 0.5V$ and rheostat resistance $R_h = 2\Omega$ the null point is obtained at some point J. When the cell is replaced by another one of emf $\varepsilon = \varepsilon_2$ the same null point J is found for $R_h = 6\Omega$. The emf ε_2 is:



[11 Jan. 2019 I]

Options:

A. 0.4 V

B. 0.3 V

C. 0.6 V

D. 0.5 V

Answer: B

Solution:

Solution:

Given, Emf of cell, $\varepsilon = 0.5v$

Rheostat resistance, $R_h = 2\Omega$

Potential gradient is

$\frac{dv}{dL} = \left(\frac{6}{2+4}\right) \times \frac{4}{L}$

Let null point be at $l$cm when cell of emf $\varepsilon = 0.5v$ is used.

thus $\varepsilon_1 = 0.5V = \left(\frac{6}{2+4}\right) \times \frac{4}{L} \times l$ ....(i)

For resistance $R_h = 6\Omega$ new potential gradient is $\left(\frac{6}{4+6}\right) \times \frac{4}{L}$ and at null point

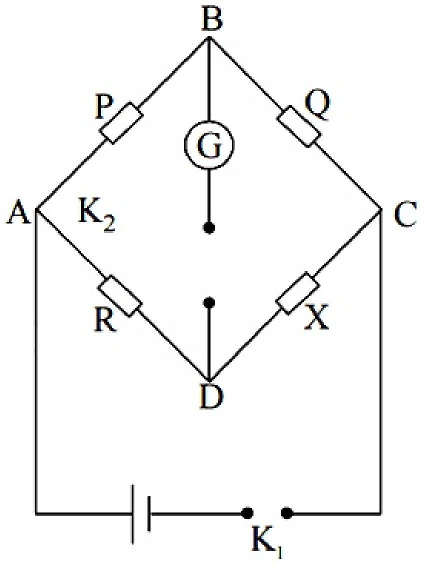
$\left(\frac{6}{4+6}\right)\left(\frac{4}{L}\right) \times l = \varepsilon_2$ ......(ii)

Dividing equation (i) by (ii) we get

$\frac{0.5}{\varepsilon_2} = \frac{10}{6}$ thus $\varepsilon_2 = 0.3v$

Question196

In a Wheatstone bridge (see fig.), Resistances P and Q are approximately equal. When R = 400 Ω, the bridge is balanced. On interchanging P and Q, the value of R, for balance, is 405Ω. The value of X is close to :



[11 Jan. 2019 I]

Options:

A. 401.5 ohm

B. 404.5 ohm

C. 403.5 ohm

D. 402.5 ohm

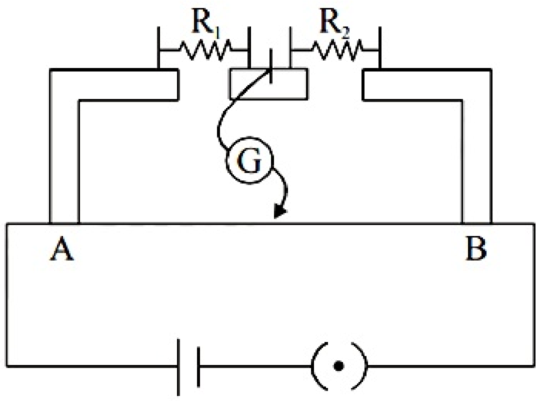
Answer: D

Solution:

Solution:

Question197

In the experimental set up of metre bridge shown in the figure, the null point is obtained data distance of 40 cm from A. If a 10 W resistor is connected in series with R_1 , the null point shifts by 10 cm. The resistance that should be connected in parallel with $(R_1 + 10)\Omega$ such that the null point shifts back to its initial position is :



[11 Jan. 2019 II]

Options:

A. 20 Ω

B. 40 Ω

C. 60 Ω

D. 30 Ω

Answer: C

Solution:

Solution:

Initially at null deflection $\frac{R_1}{R_2} = \frac{2}{3}$...(i)

Finally at null deflection, when null point is shifted

$\frac{R_1 + 10}{R_2} = 1 \Rightarrow R_1 + 10 = R_2$ ......(ii)

Solving equations (i) and (ii) we get

$\frac{2R_2}{3} + 10 = R_2$

$10 = \frac{R_2}{3} \Rightarrow R_2 = 30\Omega$

& $R_1 = 20\Omega$

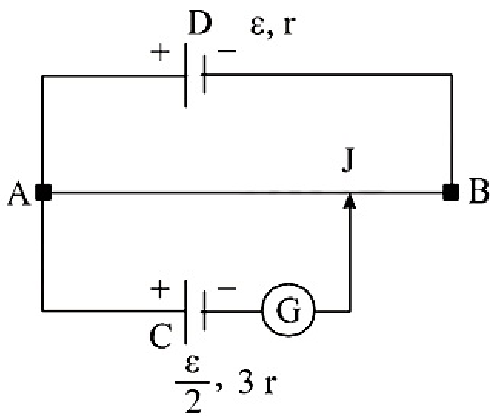
Now if required resistance is R then

$\frac{\frac{30 \times R}{30 + R}}{30} = \frac{2}{3}$

$R = 60\Omega$

Question198

A potentiometer wire AB having length L and resistance 12r is joined to a cell D of emf ε and internal resistance r. A cell C having emf ε / 2 and internal resistance 3r is connected. The length AJ at which the galvanometer as shown in fig. shows no deflection is:



[10 Jan. 2019 I]

Options:

A. $\frac{11}{12}L$

B. $\frac{11}{24}L$

C. $\frac{13}{24}L$

D. $\frac{5}{12}L$

Answer: C

Solution:

Solution:
Let x be the length AJ at which galvanometer shows null deflection current,

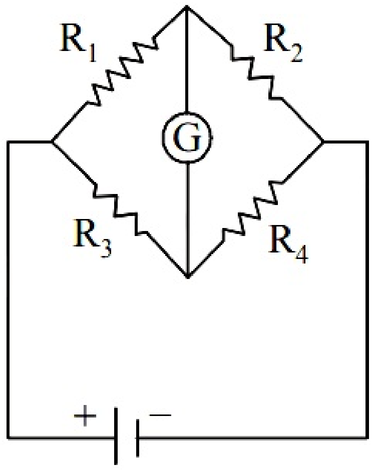
$i = \frac{\varepsilon}{12r + r} = \frac{3}{13r}$ or, $i\left(\frac{x}{L}12r\right) = \frac{\varepsilon}{2}$

$\Rightarrow \frac{\varepsilon}{13r}\left[\frac{x}{L}.12r\right] = \frac{\varepsilon}{2} \Rightarrow \frac{\varepsilon}{13r}\left[\frac{x}{L}.12r\right] = \frac{\varepsilon}{2}$

or, $x = \frac{13L}{24}$

Question199

The Wheatstone bridge shown in Fig. here, gets balanced when the carbon resistor used as R_1 has the colour code (Orange, Red, Brown). The resistors R_2 and R_4 are 80Ω and 40Ω, respectively. Assuming that the colour code for the carbon resistors gives their accurate values, the colour code for the carbon resistor, used as R_3, would be:



[10 Jan. 2019 II]

Options:

A. Brown, Blue, Brown

B. Brown, Blue, Black

C. Red, Green, Brown

D. Grey, Black, Brown

Answer: A

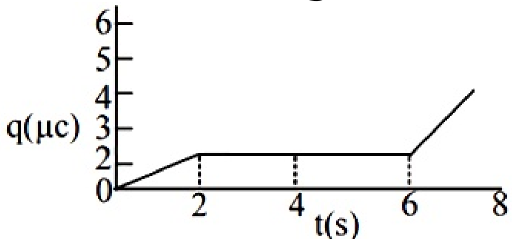
Solution:

Solution:
Given, colour code of resistance,
$R_1 =$ Orange, Red and Brown
$\therefore R_1 = 32 \times 10 = 320$
using balanced wheatstone bridge principle,
$\frac{R_1}{R_3} = \frac{R_2}{R_4} \Rightarrow \frac{320}{R_3} = \frac{80}{40}$
$\therefore R_3 = 160$ i.e. colour code for R_3 Brown, Blue and Brown

----

Question200

The charge on a capacitor plate in a circuit, as a function of time, is shown in the figure:



What is the value of current at t = 4 s ?
[12 Jan. 2019 II]

Options:

A. Zero

B. 3 μA

C. 2 μA

D. 1.5 μA

Answer: A

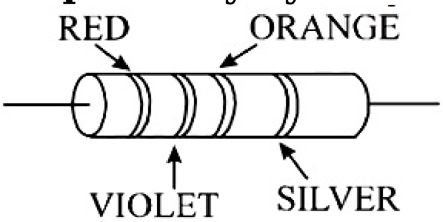
Solution:

Solution:

Clearly, from graph Current, $I = \frac{dq}{dt} = 0$ at $t = 4s$ [Since q is constant]

Question201

A resistance is shown in the figure. Its value and tolerance are given respectively by:



[9 Jan. 2019 I]

Options:

A. 270 Ω, 10%

B. 27 kΩ, 10%

C. 27 kΩ, 20%

D. 270 Ω, 5%

Answer: B

Solution:

Solution:
Color code :
Bl , Br, R, O, Y , G, B, V , Gr, W
0, 1, 2, 3, 4, 5, 6, 7, 8, 9
$R = AB \times C \pm D\%$ where D = tolerance
$D_{gold} = \pm 5\%$, $D_{silver} = \pm 10\%$; $D_{no\ colour} = \pm 20\%$
Red voilet orange silver
$R = 27 \times 10^3 \Omega \pm 10\% = 27 k\Omega \pm 10\%$

Question202

Drift speed of electrons, when 1.5A of current flows in a copper wire of cross section $5 mm^2$, is v. If the electron density in copper is $9 \times 10^{28} / m^3$ the value of v in mm / s close to (Take charge of electron to be $= 1.6 \times 10^{-19} C$)

[9 Jan. 2019 I]

Options:

A. 0.02

B. 3

C. 2

D. 0.2

Answer: A

Solution:

Using, $I = neAv_d$

∴ Drift speed $v_d = \frac{1}{neA}$

$$\frac{1.5}{9 \times 10^{28} \times 1.6 \times 10^{-19} \times 5 \times 10^{-6}} = 0.02 \text{mms}^{-1}$$

Question203

A copper wire is stretched to make it 0.5% longer. The percentage change in its electrical resistance if its volume remains unchanged is: [9 Jan. 2019 I]

Options:

A. 2.0%

B. 2.5%

C. 1.0%

D. 0.5%

Answer: C

Solution:

Solution:

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

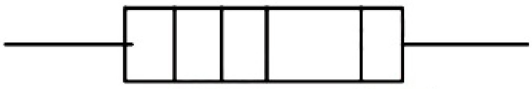
$R = \rho \frac{l}{A} \times \frac{l}{l} = \frac{\rho l^2}{V}$[>> Volume (V) = A> > .]

Since resistivity and volume remains constant therefore % change in resistance

$\frac{\Delta R}{R} = \frac{2\Delta l}{l} = 2 \times (0.5) = 1\%$

Question204

A carbon resistance has following colour code. What is the value of the resistance?



[9 Jan. 2019 II]

Options:

A. $530 k\Omega \pm 5\%$

B. $5.3 k\Omega \pm 5\%$

C. $6.4 kM\,\Omega \pm 5\%$

D. $64 kM\,\Omega \pm 10\%$

Answer: A

Solution:

Solution:
Colour code for carbon resistor

Bl,	Br,	R,	O,	Y,	G,	Blue,	V,	Gr,	W
0,	1,	2,	3,	4,	5,	6,	7,	8,	9

Resistance, $R = AB \times C \pm D$
Bands A and B are the first two significant figures of resistance
B and C indicates the decimal multiplier or the number of zeros that follow A and B
B and D is tolerance: Gol d $= \pm 5\%$
Silver $= \pm 10\%$ No colour $= \pm 20\%$
$R = 53 \times 10^4 \pm 5\% = 530 k\Omega \pm 5\%$

Question205

A uniform metallic wire has a resistance of 18 Ω and is bent into an equilateral triangle. Then, the resistance between any two vertices of the triangle is:
[10 Jan. 2019 I]

Options:

A. $4\ \Omega$

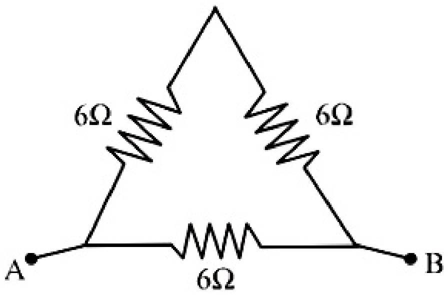
B. $8\ \Omega$

C. $12\ \Omega$

D. $2\ \Omega$

Answer: A

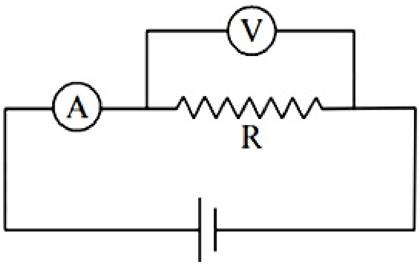
Solution:



Resistance, $R \propto l$ so resistance of each side of the equilateral triangle $= 6\Omega$
Resistance R_{eq} between any two vertices
$\frac{1}{R_{eq}} = \frac{1}{12} + \frac{1}{6} \Rightarrow R_{eq.} = 4\Omega$

Question206

The actual value of resistance R, shown in the figure is 30 Ω. This is measured in an experiment as shown using the standard formula $R = \frac{V}{I}$, where V and I are the reading of the voltmeter and ammeter, respectively. If the measured value of R is 5% less, then the internal resistance of the voltmeter is:



[10 Jan. 2019 II]

Options:

A. 600 Ω

B. 570 Ω

C. 35 Ω

D. 350 Ω

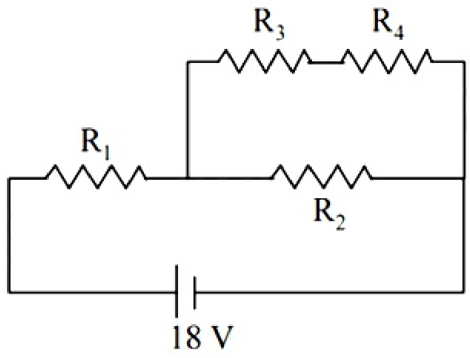
Answer: B

Solution:

Solution:
Using , $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$
$0.95R = \frac{RR\upsilon}{R + R\upsilon}$ (measured value 5% less then internal resistance of voltmeter)
or, $0.95 \times 30 = 0.05R\upsilon$
$\therefore R\upsilon = 19 \times 30 = 570\Omega$

Question207

In the given circuit the internal resistance of the 18V cell is negligible. If R_1 = 400Ω, R_3 = 100Ω and R_4 = 500Ω and the reading of an ideal voltmeter across R_4 is 5V then the value of R_2 will be:



[9 Jan. 2019 II]

Options:

A. 300 Ω

B. 450 Ω

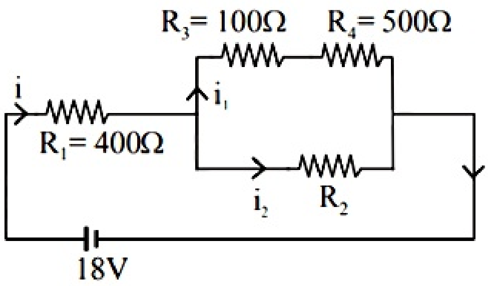
C. 550 Ω

D. 230 Ω

Answer: A

Solution:

Solution:



Across R_4 reading of voltmeter, $V_4 = 5V$

Current, $i_4 = \frac{V_4}{R_4} = 0.01A$

$V_3 = i_1R_3 = 1V$

$V_3 + V_4 = 6V = V_2$

$V_1 + V_3 + V_4 = 18V$

$\Rightarrow V_1 = 12V$

$i = \frac{V_1}{R_1} = 0.03A$

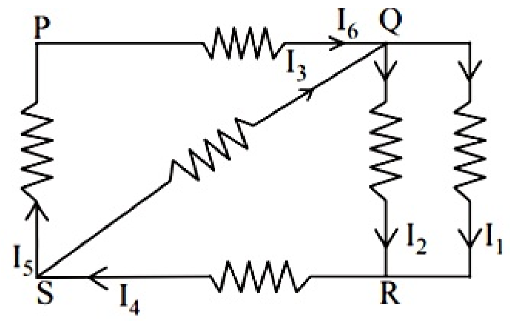
$i = i_1 + i_2 \Rightarrow i_2 = i - i, = 0.03 - 0.01A = 0.02A$

$\therefore R_2 = \frac{V_2}{i_2} = \frac{6}{0.02} = 300\Omega$

Question208

In the given circuit diagram, the currents, $I_1 = -0.3A$, $I_4 = 0.8$ A and $I_5 = 0.4A$, are flowing as shown. The currents I_2, I_3 and I_6, respectively,

are



[12 Jan. 2019 II]

Options:

A. 1.1 A, – 0.4 A, 0.4 A

B. 1.1 A, 0.4 A, 0.4 A

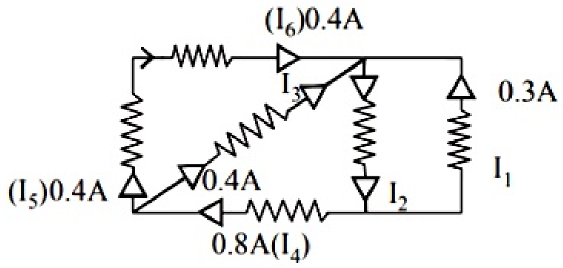
C. 0.4 A, 1.1 A, 0.4 A

D. –0.4 A, 0.4 A, 1.1 A

Answer: B

Solution:

Solution:



From KCL, $I_3 = 0.8 - 0.4 = 0.4A$

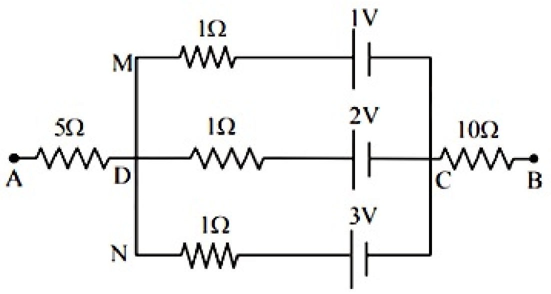
$I_2 = 0.4 + 0.4 + 0.3$

$= 1.1A$

and $I_6 = 0.4A$

Question209

In the circuit shown, the potential difference between A and B is :



[11 Jan. 2019 II]

Options:

A. 1 V

B. 2 V

C. 3 V

D. 6 V

Answer: B

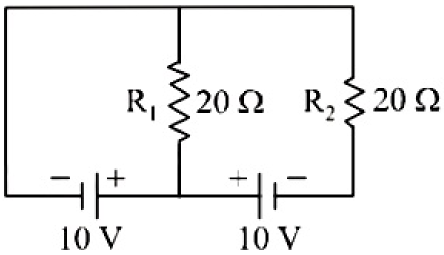
Solution:

Solution:
Given, $E_1 = 1V$, $E_2 = 2V$, $E_3 = 3V$, $r_1 = 1\Omega$
$r_2 = 1\Omega$ and $r_3 = 1\Omega$

$$V_{AB} = V_{CD} = \frac{\frac{E_1}{r_1} + \frac{E_2}{r_2} + \frac{E_3}{r_3}}{\frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}} = \frac{\frac{1}{1} + \frac{2}{1} + \frac{3}{1}}{\frac{1}{1} + \frac{1}{1} + \frac{1}{1}} = \frac{6}{3} = 2V$$

Question210

In the given circuit the cells have zero internal resistance. The currents (in Amperes) passing through resistance R_1 and R_2 respectively, are:



[10 Jan. 2019 I]

Options:

A. 1, 2

B. 2, 2

C. 0.5, 0

D. 0, 1

Answer: C

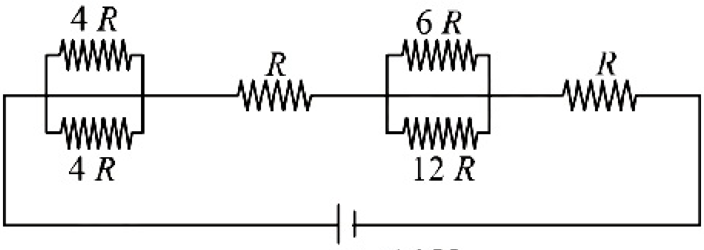
Solution:

Solution:
Current passing through resistance R_1,
$i_1 = \frac{v}{R_1} = \frac{10}{20} = 0.5A$
and, $i_2 = 0$

Question211

The resistive network shown below is connected to a D.C. source of 16

V. The power consumed by the network is 4 Watt. The value of R is :



[12 Apr. 2019 I]

Options:

A. 6Ω

B. 8Ω

C. 1Ω

D. 16Ω

Answer: B

Solution:

Solution:
Equivalent resistance,

$$R_{eq} = \frac{4R \times 4R}{4R + 4R} + R + \frac{6R \times 12R}{6R + 12R} + R$$
$$= 2R + R + 4R + R$$
$$= 8R$$

Using, $P = \frac{V^2}{R_{eq}} \Rightarrow 4 = \frac{16^2}{8R}$

$\therefore R = \frac{16^2}{4 \times 8} = 8\Omega$

Question212

One kg of water, at 20°C, is heated in an electric kettle whose heating element has a mean (temperature averaged)resistance of 20 Ω. The rms voltage in the mains is 200 V. Ignoring heat loss from the kettle, time taken for water to evaporate fully, is close to :
[Specific heat of water = 4200 J/(kg°C), Latent heat of water = 2260 kJ/kg]
[12 Apr. 2019 II]

Options:

A. 16 minutes

B. 22 minutes

C. 3 minutes

D. 3 minutes

Answer: B

Solution:

Solution:

$Q = P \times t$

$Q = mc\,\Delta T + mL$

$P = \frac{V_{rms}^{2}}{R}$

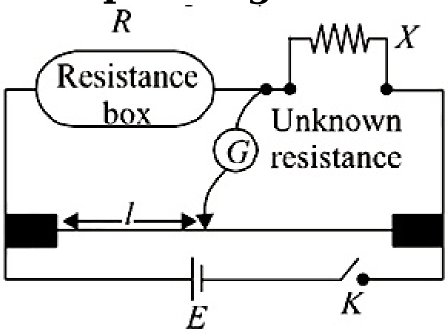
$4200 \times 80 + 2260 \times 10^{3} = \frac{(200)^{2}}{20} \times t$

$t = 1298 sec$

$t \simeq eq22min$

Question213

In a meter bridge experiment, the circuit diagram and the corresponding observation table are shown in figure.



Sl.No.	RΩ	l (cm)
1.	1000	60
2.	100	13
3.	10	1.5
4.	1	1.0

Which of the reading is consistent ?
[10 Apr. 2019 I]

Options:

A. 3

B. 2

C. 4

D. 1

Answer: C

Solution:

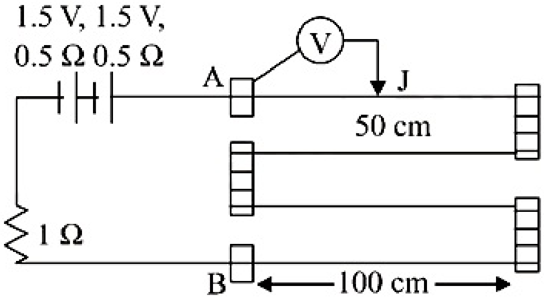
For a balanced bridge

$R_2 \quad l_1$

So $\frac{R}{X} = \frac{l}{100 - l}$
Using the above expression
$X = \frac{R(100 - l)}{l}$
for observation (1) $X = \frac{100 \times 40}{60} = \frac{2000}{3}\Omega$
for observation(2) $X = \frac{100 \times 87}{13} = \frac{8700}{13}\Omega$
for observation(3) $X = 10 \times 98.51.5 = \frac{1970}{3}\Omega$
for observation(4) $X = 1 \times 991 = 99\Omega$
Clearly we can see that the value of x calculated in observation (4) is inconsistent than other.

Question214

In the circuit shown, a four-wire potentiometer is made of a 400 cm long wire, which extends between A and B. The resistance per unit length of the potentiometer wire is r = 0.01 Ω/cm. If an ideal voltmeter is connected as shown with jockey J at 50 cm from end A, the expected reading of the voltmeter will be :



[8 Apr. 2019 II]

Options:

A. 0.50 V

B. 0.75 V

C. 0.25 V

D. 0.20 V

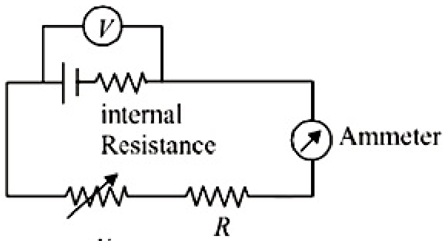
Answer: C

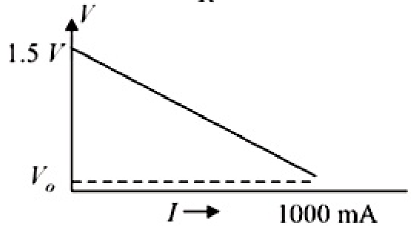
Solution:

Solution:
The resistance of potentiometer wire $R = 0.01 \times 400 = 4\Omega$
Current in the wire
$i = \frac{V}{R_T} = \frac{3}{4 + 0.5 + 0.57 + 1} = \frac{1}{2}A$
Now $V = iR_{AJ} = \frac{1}{2} \times (0.01 \times 50) = 0.25V$

Question215

To verify Ohm's law, a student connects the voltmeter across the battery as, shown in the figure. The measured voltage is plotted as a function of the current, and the following graph is obtained :





If V_0 is almost zero, identify the correct statement:
[12 Apr. 2019 I]

Options:

A. The emf of the battery is 1.5 V and its internal resistance is 1.5 Ω

B. The value of the resistance R is 1.5 Ω

C. The potential difference across the battery is 1.5 V whenit sends a current of 1000 ı

D. The emf of the battery is 1.5 V and the value of R is 1.5 Ω

Answer: A

Solution:

Solution:
When i = 0, V = ε = 1.5 volt

Question216

A current of 5 A passes through a copper conductor (resistivity) $= 1.7 \times 10^{-8}\Omega m$) of radius of cross-section 5mm. Find the mobili the charges if their drift velocity is $1.1 \times 10^{-3} m / s$.
[10 Apr. 2019 I]

Options:

A. $1.8 m^2 / V s$

B. $1.5 m^2 / V s$

Solution:

Solution:
Charge mobility

$(\mu) = \frac{V_d}{E}$ [Where V_d = drift velocity]

and resistivity $(\rho) = \frac{E}{j} = \frac{EA}{I} \Rightarrow E = \frac{I(\rho)}{A}$

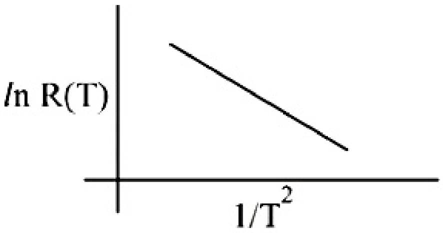
$\Rightarrow \mu = \frac{V_d}{E} = \frac{V_d A}{I_\rho}$

$= \frac{1.1 \times 10^{-3} \times \pi \times (5 \times 10^{-3})^2}{5 \times 1.7 \times 10^{-8}}$

$\mu = 1.0 \frac{m^2}{V_s}$

Question217

In an experiment, the resistance of a material is plotted as a function of temperature (in some range). As shown in the figure, it is a straight line.



[10 Apr. 2019 I]

Options:

A. $R(T) = \frac{R_0}{T^2}$

B. $R(T) = R_0 e^{-T_0^2/T^2}$

C. $R(T) = R_0 e^{-T^2/T_0^2}$

D. $R(T) = R_0 e^{T^2/T_0^2}$

Answer: B

Solution:

Solution:
Equation of straight line from graph $y = -mx + c$

$\Rightarrow \ln R = -m\left(\frac{1}{T^2}\right) + c$

here, m&c are constants

$R = e^{\left[-m\left(\frac{1}{T^2}\right) + c\right]} = e^{-m\left(\frac{1}{T^2}\right)} \times e^c$

$R(T) = R_0 e^{\frac{-T_0^2}{T^2}}$

Question218

Space between two concentric conducting spheres of radii a and b(b > a) is filled with a medium of resistivity ρ. The resistance between the two spheres will be :
[10 Apr.2019 II]

Options:

A. $\frac{\rho}{4\pi}\left(\frac{1}{a}-\frac{1}{b}\right)$

B. $\frac{\rho}{2\pi}\left(\frac{1}{a}-\frac{1}{b}\right)$

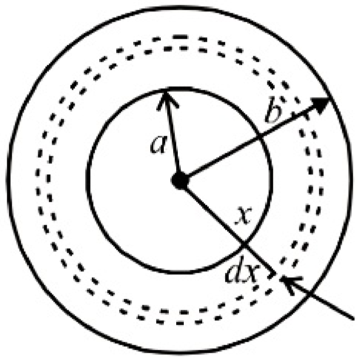
C. $\frac{\rho}{2\pi}\left(\frac{1}{a}+\frac{1}{b}\right)$

D. $\frac{\rho}{4\pi}\left(\frac{1}{a}+\frac{1}{b}\right)$

Answer: A

Solution:

Solution:



$d R = \frac{(\rho)(d x)}{4\pi x^2}$

$R = \int d R$

$\int d R = \rho \int_a^b \frac{d x}{4\pi x^2}$

$\Rightarrow R = \frac{\rho}{4\pi}\left[\frac{-1}{x}\right]_a^b$

$R = \left(\frac{\rho}{4\pi}\right) \cdot \left(\frac{1}{a}-\frac{1}{b}\right)$

Question219

In a conductor, if the number of conduction electrons per unit volume is $8.5 \times 10^{28} m^{-3}$ and mean free time is 25f s (femto second), it's approximate resistivity is: $(m_e = 9.1 \times 10^{-31} kg)$
[9 Apr. 2019 II]

Options:

A. $10^{-6}\Omega m$

B. $10^{-7}\Omega m$

C. $10^{-8}\Omega m$

D. $10^{-5}\Omega m$

Answer: C

Solution:

Solution:

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

$= \frac{9.1 \times 10^{-31}}{8.5 \times 10^{28} \times (1.6 \times 10^{-19})^2 \times 25 \times 10^{-15}}$

$= 10^{-8}\Omega - m$

Question220

A 200 Ωresistor has a certain color code. If one replaces the red color by green in the code, the new resistance will be :
[8 April 2019 I]

Options:

A. 100 Ω

B. 400 Ω

C. 300 Ω

D. 500 Ω

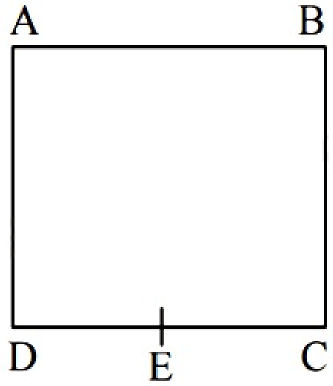
Answer: D

Solution:

Solution:
Number 2 is associated with the red colour. This colour is replaced by green.
∵ Colour code figure for green is 5
∴ New resistance $= 500\Omega$

Question221

A wire of resistance R is bent to form a square ABCD as shown in the figure. The effective resistance between E and C is: (E is mid-point of arm CD)



[9 April 2019 I]

Options:

A. R

B. $\frac{7}{64}$R

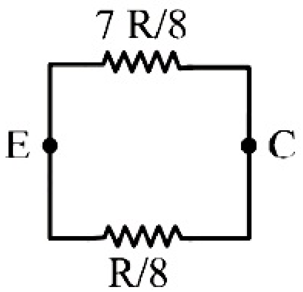
C. $\frac{3}{4}$R

D. $\frac{1}{16}$R

Answer: B

Solution:

$$R_{eq} = \frac{\left(\frac{7R}{8}\right)\left(\frac{R}{8}\right)}{R} = \frac{7R}{64}$$



Question222

A metal wire of resistance 3 Ω is elongated to make a uniform wire of double its previous length. This new wire is now bent and the ends joined to make a circle. If two points on the circle make an angle 60° at the centre, the equivalent resistance between these two points will be: [9 April 2019 II]

Options:

A. $\frac{12}{5}\Omega$

B. $\frac{5}{2}\Omega$

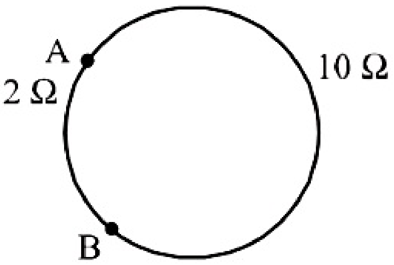
C. $\frac{5}{3}\Omega$

D. $\frac{7}{2}\Omega$

Answer: C

Solution:

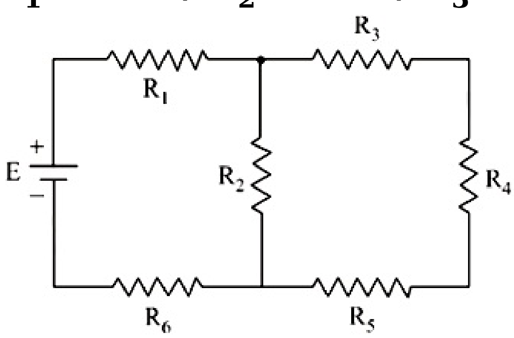
Solution:



When length becomes double its resistance becomes ($R \propto l^2$)
$R = 4 \times 3 = 12\Omega$
$R_{eq} = \frac{2 \times 10}{12} = \frac{5}{3}\Omega$

Question223

In the figure shown, what is the current (in Ampere) drawn from the battery? You are given :
$R_1 = 15\Omega, R_2 = 10\Omega, R_3 = 20\Omega, R_4 = 5\Omega, R_5 = 25\Omega$ $R_6 = 30\Omega$, $E = 15V$



[8 Apr. 2019 II]

Options:

A. 13/24

B. 7/18

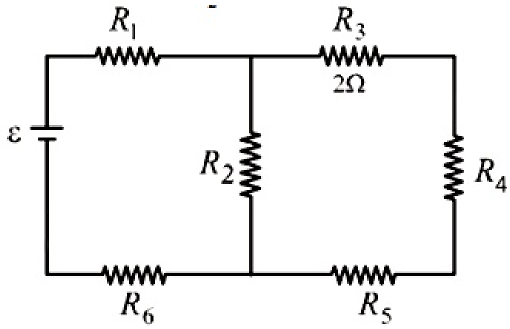
C. 9/32

D. 20/3

Answer: C

Solution:

Solution:
R_3, R_4 and R_5 are in series so their equivalent $R = 20 + 5 + 25 = 50\Omega$
This is parallel with R_2, and so net resistance of the circuit

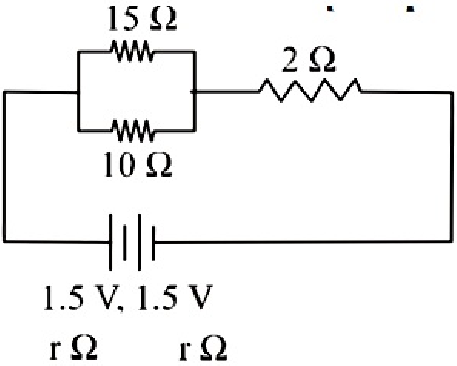


$R_{eq} = \left(\frac{10 \times 50}{10 + 50}\right) + 15 + 30 = \frac{160}{3}\Omega$

So, $i = \frac{\varepsilon}{R_{eq}} = \frac{15}{(100/3)} = \frac{9}{32}A$

Question224

In the given circuit, an ideal voltmeter connected across the 10 Ω resistance reads 2V. The internal resistance r, of each cell is :



[10 Apr. 2019 I]

Options:

A. 1 Ω

B. 0.5 Ω

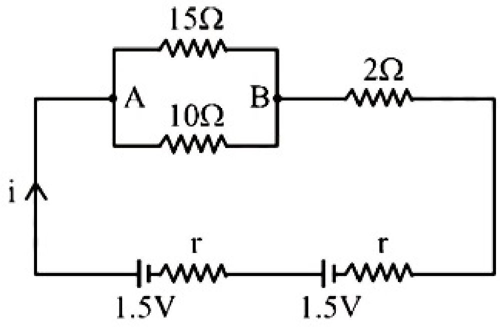
C. 1.5 Ω

D. 0 Ω

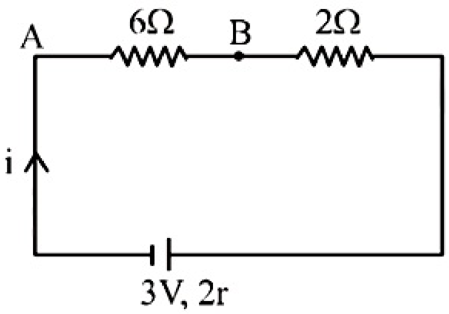
Answer: B

Solution:

Solution:
For the given circuit



$i = \frac{3}{8+2r}$



Now voltage across AB

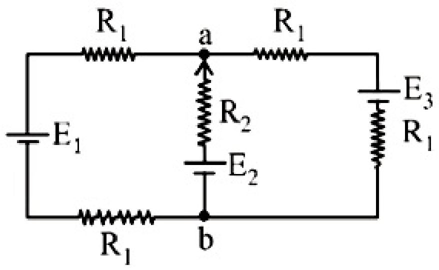
$i \times 6 = \frac{3}{8+2r} \times 6 = 2$

$\Rightarrow 9 = 8 + 2r$

$\Rightarrow r = \frac{1}{2}\Omega$

Question225

For the circuit shown, with $R_1 = 1.0\Omega$, $R_2 = 2.0\ \Omega$, $E_1 = 2V$ and $E_2 = E_3 = 4V$, the potential difference between the points ' a ' and ' b ' is approximately (in V) :



[8 April 2019 I]

Options:

A. 2.7

B. 2.3

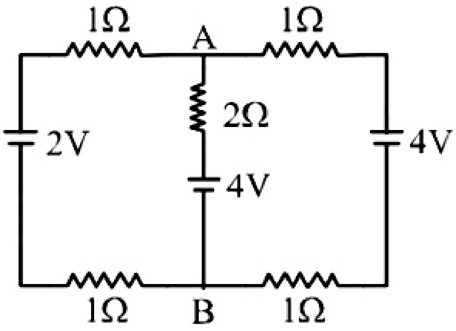
C. 3.7

D. 3.3

Answer: D

Solution:

Applying parallel combination of batteries $\frac{\frac{E_1}{1+1}+\frac{E_2}{2}+\frac{E_3}{1+1}}{\frac{1}{1+1}+\frac{1}{2}+\frac{1}{1+1}}$



$$\frac{\frac{2}{2}+\frac{4}{2}+\frac{4}{2}}{\frac{1}{2}+\frac{1}{2}+\frac{1}{2}}=\frac{5\times 2}{3}$$

$=\frac{10}{3}=3.3\,\text{Volt}$

Question226

A cell of internal resistance r drives current through an external resistance R. The power delivered by the cell to the external resistance will be maximum when :
[8 Apr. 2019 II]

Options:

A. R = 0.001 r

B. R = 1000 r

C. R = 2r

D. R = r

Answer: D

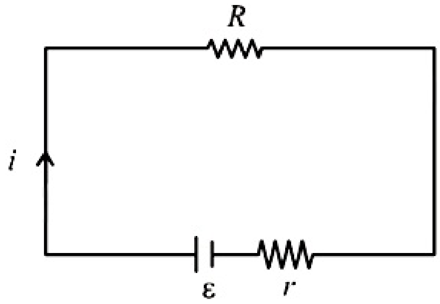
Solution:

Solution:

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

Power delivered to R.

$P=i^2R=\left(\frac{\varepsilon}{R+r}\right)^2R$



P to be maximum, $\frac{dP}{dR}=0$

or $\frac{d}{dR}\left[\left(\frac{\varepsilon}{R+r}\right)^2 R\right] = 0$
or $R = r$

Question227

A heating element has a resistance of 100Ω at room temperature. When it is connected to a supply of 220V a steady current of 2 A passes in it and temperature is 500°C more than room temperature. What is the temperature coefficient of resistance of the heating element?
[Online April 16, 2018]

Options:

A. $1 \times 10^{-4°}C^{-1}$

B. $5 \times 10^{-4°}C^{-1}$

C. $2 \times 10^{-4°}C^{-1}$

D. $0.5 \times 10^{-4°}C^{-1}$

Answer: C

Solution:

Solution:
Resistance after temperature increases by 500°C i.e., $R_t = \frac{V}{I} = \frac{220}{2} = 110\Omega$
$R_0 = 100$ (given) temperature coefficient of resistance, $\alpha = ?$
using $R_t = R_0(1 + \alpha t)$
$110 = 100(1 + \alpha 500)$
$\alpha = \frac{10}{100 \times 500}$
or, $\alpha = 2 \times 10^{-4}°C^{-1}$

Question228

A copper rod of cross-sectional area A carries a uniform current I through it. At temperature T, if the volume charge density of the rod is ρ, how long will the charges take to travel a distance d?
[Online April 15, 2018]

Options:

A. $\frac{2\rho d A}{IT}$

B. $\frac{2\rho d A}{I}$

C. $\frac{\rho d A}{I}$

D. $\frac{\rho d A}{IT}$

Answer: C

Solution:

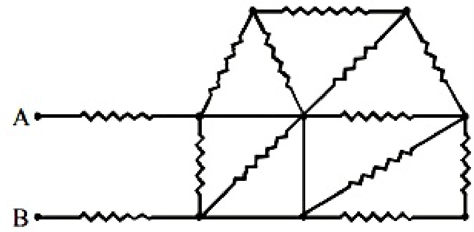
Solution:

Charge density $\rho = \frac{\text{charge}}{\text{volume}} = \frac{q}{Ad} \Rightarrow q = \rho Ad$

Also, $q = IT \Rightarrow T = \frac{q}{I} = \frac{\rho Ad}{I}$

Question229

In the given circuit all resistances are of value R ohm each. The equivalent resistance between A and B is :



[Online April 15, 2018]

Options:

A. 2R

B. $\frac{5R}{2}$

C. $\frac{5R}{3}$

D. 3R

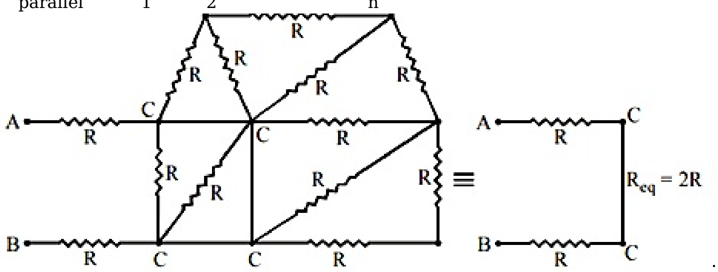
Answer: A

Solution:

Solution:

$R_{series} = R_1 + R_2 + \ldots\ldots + R_n$

$\frac{1}{R_{parallel}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots\ldots\ldots + \frac{1}{R_n}$



Question230

Two batteries with e.m.f. 12 V and 13 V are connected in parallel across a load resistor of 10Ω. The internal resistances of the two batteries are 1Ω and 2Ω respectively. The voltage across the load lies between: [2018]

Options:

A. 11.6 V and 11.7 V

B. 11.5 V and 11.6 V

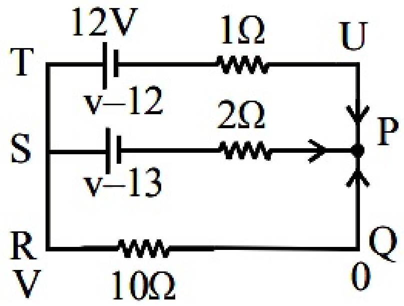
C. 11.4 V and 11.5 V

D. 11.7 V and 11.8 V

Answer: B

Solution:

Solution:



Using Kirchhoff's law at P we get

$\frac{V-12}{1}+\frac{V-13}{2}+\frac{V-0}{10}=0$ [Let potential at P, Q, U $=0$ and at R = V]

$\Rightarrow \frac{V}{1}+\frac{V}{2}+\frac{V}{10}=\frac{12}{1}+\frac{13}{2}+\frac{0}{10}$

$\Rightarrow \frac{10+5+1}{10}V=\frac{24+13}{2} \Rightarrow V\left(\frac{16}{10}\right)=\frac{37}{2}$

$\Rightarrow V=\frac{37\times 10}{16\times 2}=\frac{370}{32}=11.56\,\text{volt}$

Question231

A constant voltage is applied between two ends of a metallic wire. If the length is halved and the radius of the wire is doubled, the rate of heat developed in the wire will be:
[Online April 15, 2018]

Options:

A. Increased 8 times

B. Doubled

C. Halved

D. Unchanged

Answer: A

Solution:

Solution:

Rate of heat i.e., Power developed in the wire = $P = \frac{V^2}{R}$

Resistance of the wire of length, $L\ R_1 = \frac{\rho L}{A} = \frac{\rho L}{\pi r^2}$

$\therefore$ Power, $P_1 = \frac{V^2}{R_1}$

Resistance of the wire when length is halved i.e., $L / 2$

$$R_2 = \frac{\rho \frac{L}{2}}{\pi (2r)^2} = \frac{\rho L}{\pi 8 r^2} = \frac{R_1}{8}$$

$\therefore$ Power, $P_2 = \frac{V}{\frac{R_1}{8}} = \frac{8V}{R_1}$

or, $P_2 = 8P_1$ i.e., power increased 8 times of previous or original wire.

Question232

. In a potentiometer experiment, it is found that no current passes through the galvanometer when the terminals of the cell are connected across 52 cm of the potentiometer wire. If the cell is shunted by a resistance of 5 Ω, a balance is found when the cell is connected across 40 cm of the wire. Find the internal resistance of the cell.
[2018]

Options:

A. 1 Ω

B. 1.5 Ω

C. 2 Ω

D. 2.5 Ω

Answer: B

Solution:

Solution:
Using formula, internal resistance,

$$r = \left(\frac{l_1 - l_2}{l_2}\right) s = \left(\frac{52 - 40}{40}\right) \times 5 = 1.5\Omega$$

Question233

On interchanging the resistances, the balance point of a meter bridge shifts to the left by 10 cm. The resistance of their series combination is 1kΩ. How much was the resistance on the left slot before interchanging the resistances?

[2018]

Options:

A. 990 Ω

B. 505 Ω

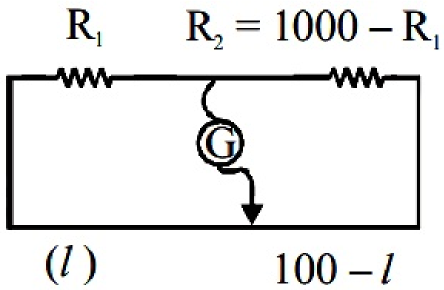
C. 550 Ω

D. 910 Ω

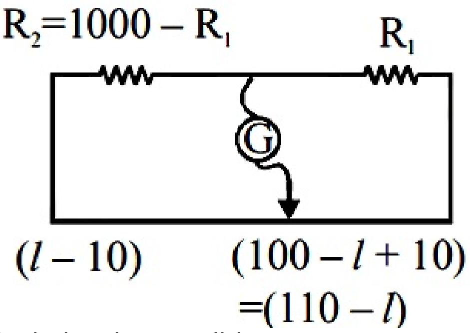
Answer: C

Solution:

Solution:
$R_1 + R_2 = 1000$
$\Rightarrow R_2 = 1000 - R_1$



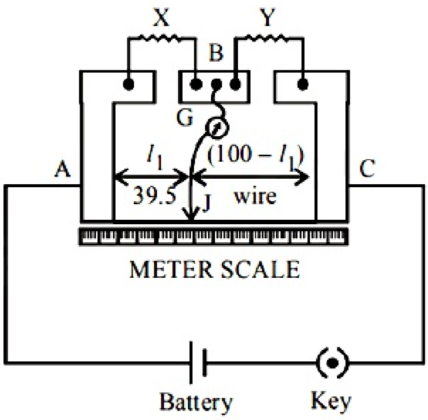
On balancing condition
$R_1(100 - l) = (1000 - R_1)l$ .....(i)
On Interchanging resistance balance point shifts left by 10cm



On balancing condition
$(1000 - R_1)(110 - l) = R_1(l - 10)$
or, $R_1(l - 10) = (1000 - R_1)(110 - l)$ .....(ii)
Dividing eqn (i) by (ii)
$\frac{100 - l}{l - 10} = \frac{l}{110 - l}$
$\Rightarrow (100 - l)(110 - l) = l(l - 10)$
$\Rightarrow 11000 - 100l - 110l + l^2 = l^2 - 10l$
$\Rightarrow 11000 = 200l$
or, $l = 55$
Putting the value of ' l ' in eqn (i)
$R_1(100 - 55) = (1000 - R_1)55$
$\Rightarrow R_1(45) = (1000 - R_1)55$
$\Rightarrow R_1(9) = (1000 - R_1)11$
$\Rightarrow 20R_1 = 11000$
$\therefore R_1 = 550K\,\Omega$

Question234

In a meter bridge, as shown in the figure, it is given that resistance $Y = 12.5\Omega$ and that the balance is obtained at a distance 39.5cm from end A (by jockey J). After interchanging the resistances X and Y, a new balance point is found at a distance l_2 from end A. What are the values of X and l_2?



[Online April 15, 2018]

Options:

A. 19.15 Ω and 39.5 cm

B. 8.16 Ω and 60.5 cm

C. 19.15 Ω and 60.5 cm

D. 8.16 Ω and 39.5 cm

Answer: B

Solution:

Solution:
For a balanced meter bridge,
$\frac{X}{39.5} = \frac{Y}{(100 - 39.5)} \Rightarrow Y = 39.5 = X \times (100 - 39.5)$
or, $X = \frac{12.5 \times 39.5}{60.5} = 8.16\Omega$
When X and Y are interchanged l_1 and $(100 - l_1)$ will also interchange so, $l_2 = 60.5cm$

Question235

A uniform wire of length l and radius r has a resistance of 100Ω. It recast into a wire of radius $\frac{r}{2}$. The resistance of new wire will be:
[Online April 9, 2017]

Options:

A. 1600 Ω

D. 100 Ω

Answer: A

Solution:

Solution:
Given, $R_1 = 100\Omega$, $r' = r / 2$, $R_2 = ?$

Resistivity of wire, $R = \frac{\rho l}{A}$ ∵ Area × length = volume

Hence, $R = \frac{\rho V}{A^2}$

Since, ρ→ constant, V → constant

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

or $R \propto \frac{1}{r^4}$ ∵ $A = \pi r^2$

$\frac{R_2}{R_1} = 16 \Rightarrow R_2 = 16 \times 100 = 1600\Omega$, Resistance of new wire

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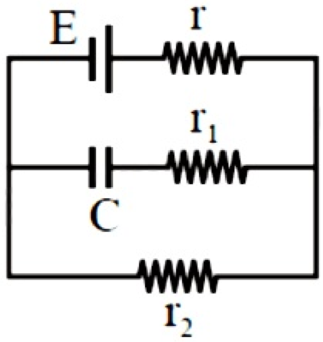
Question236

In the given circuit diagram when the current reaches steady state in the circuit, the charge on the capacitor of capacitance C will be :



[2017]

Options:

A. $CE \frac{r_2}{(r + r_2)}$

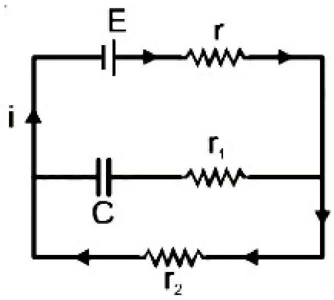
B. $CE \frac{r_1}{(r_1 + r)}$

C. CE

D. $CE \frac{r_1}{(r_2 + r)}$

Answer: A

Solution:



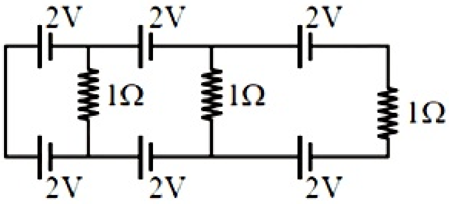
In steady state, flow fo current through capacitor will be be zero. Current through the circuit,$i = \frac{E}{r + r_2}$

Potential difference through capacitor $V_c = \frac{Q}{C} = E - ir = E - \left(\frac{E}{r + r_2}\right) r$

$\therefore Q = CE \frac{r_2}{r + r_2}$

Question237

In the above circuit the current in each resistance is



[2017]

Options:

A. 0.5A

B. 0 A

C. 1 A

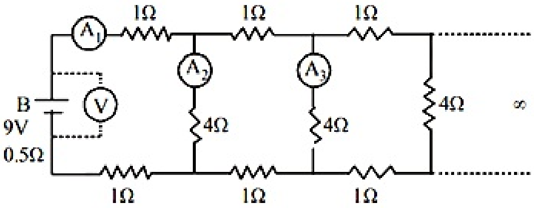
D. 0.25 A

Answer: B

Solution:

Solution:
The potential difference in each loop is zero.
∴ No current will flow or current in each resistance is Zero.

Question238



A 9 V battery with internal resistance of 0.5 Ω is connected across an infinite network as shown in the figure. All ammeters A_1, A_2, A_3 and

voltmeter V are ideal.
Choose correct statement.
[Online April 8, 2017]

Options:

A. Reading of A_1 is 2 A

B. Reading of A_1 is 18 A

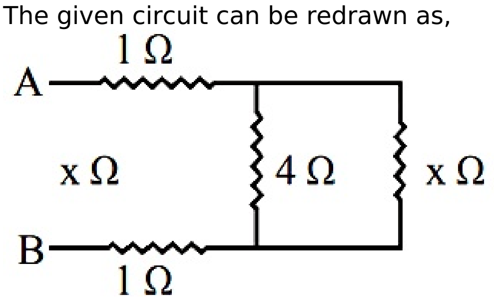
C. Reading of V is 9 V

D. Reading of V is 7 V

Answer: A

Solution:

Solution:
The given circuit can be redrawn as,



as 4Ω and $x\Omega$ are parallel $x' = \frac{1}{4} + \frac{1}{x} = \frac{(4+x)}{4x}$

$x' = \frac{4x}{4+x}$

& 1Ω and 1Ω are also parallel $x" = 2\Omega$

Now equivalent resistance of circuit

$x = \frac{4x}{4+x} + 2 = \frac{8+6x}{4+x}$

$4x + x^2 = 8 + 6x$

$x^2 - 2x - 8 = 0$

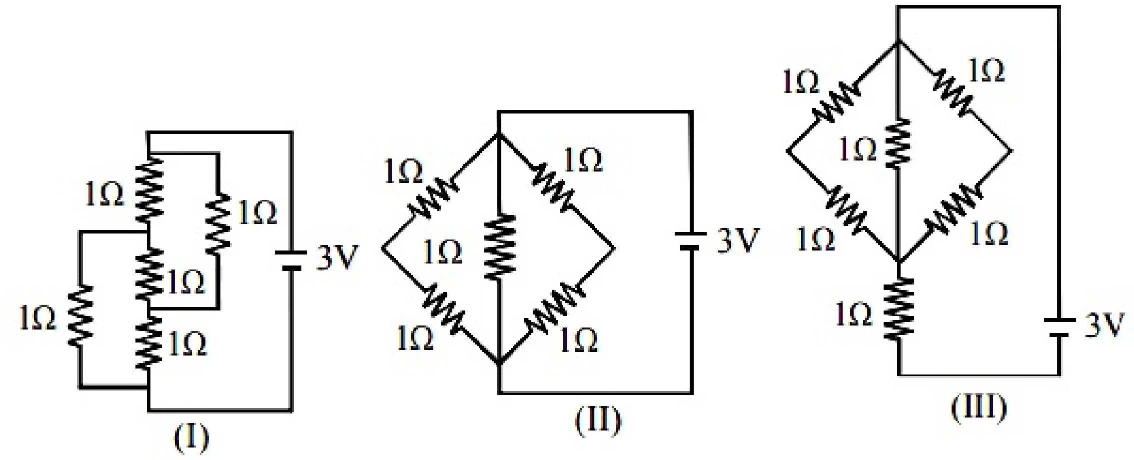
$x = \frac{2 \pm \sqrt{4 - 4(1)(-8)}}{2} = \frac{2 \pm \sqrt{36}}{2} = \frac{2 \pm 6}{2} = 4\Omega$

Reading of Ammeter $A_1 = \frac{V}{(R+r)}$

$A_1 = \frac{9}{4 + 0.5} = 2$ Ampere

Question239

The figure shows three circuits I, II and III which are connected to a 3V battery. If the powers dissipated by the configurations I, II and III are P_1, P_2 and P_3 respectively, then:



[Online April 9, 2017]

Options:

A. $P_1 > P_2 > P_3$

B. $P_1 > P_3 > P_2$

C. $P_2 > P_1 > P_3$

D. $P_3 > P_2 > P_1$

Answer: C

Solution:

Solution:
From the given circuit, net resistances
$R_I = 1\Omega, R_{II} = 1/2\Omega, R_{III} = \frac{3}{2}\Omega$
It is clear that $R_3 > R_1 > R_2$
Hence, $P_3 < P_1 < P_2$
As Power (P) $= \frac{V^2}{R} \Rightarrow P \propto \frac{1}{R}$

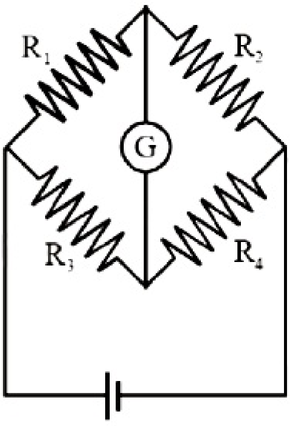
Question240

D. In a balanced wheatstone bridge if the cell and the galvanometer are exchanged, the null point is disturbed

Answer: D

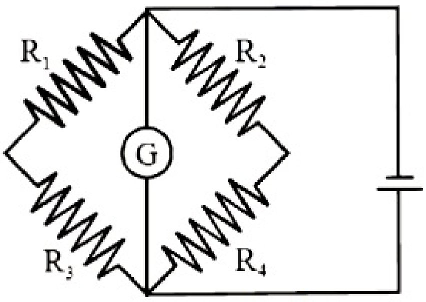
Solution:

Solution:
There is no change in null point, if the cell and the galvanometer are exchanged in a balanced wheatstone bridge.



On balancing condition $\frac{R_1}{R_3} = \frac{R_2}{R_4}$

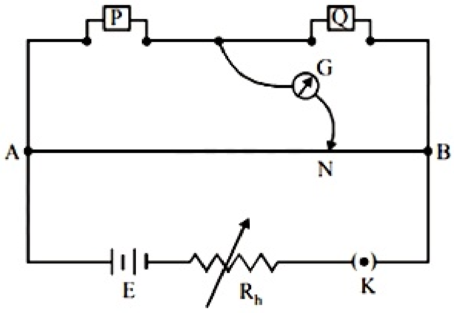
After exchange



On balancing condition $\frac{R_1}{R_2} = \frac{R_3}{R}$

Question241

In a meter bridge experiment resistances are connected as shown in the figure. Initially resistance P = 4 Ω and the neutral point N is at 60 cm from A. Now an unknown resistance R is connected in series to P and the new position of the neutral point is at 80 cm from A. The value of unknown resistance R is :



[Online April 9, 2017]

Options:

A. $\frac{33}{5}\Omega$

B. 6Ω

C. 7Ω

D. $\frac{20}{3}\Omega$

Answer: D

Solution:

Solution:

In balance position of bridge, $\frac{P}{Q}=\frac{l}{(100-l)}$

Initially neutral position is $60\mathrm{cm}$. from A, so

$\frac{4}{60}=\frac{Q}{40}\Rightarrow Q=\frac{16}{6}=\frac{8}{3}\Omega$

Now, when unknown resistance R is connected in series to P, neutral point is $80\mathrm{cm}$ from A then,

$\frac{4+R}{80}=\frac{Q}{20}$

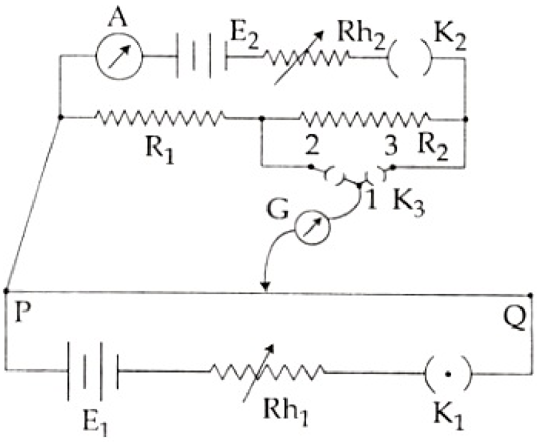
$\frac{4+R}{80}=\frac{8}{60}$

$R=\frac{64}{6}-4=\frac{64-24}{6}=\frac{40}{6}\Omega$

Hence, the value of unknown resistance R is $=\frac{20}{3}\Omega$

Question242

A potentiometer PQ is set up to compare two resistances as shown in the figure. The ammeter A in the circuit reads 1.0A when two way key K_3 is open. The balance point is at a length $l_1$cm from P when two way key K_3 is plugged in between 2 and 1 , while the balance point is at a length $l_2$cm from P when key K_3 is plugged in between 3 and 1. The ratio of two resistances $\frac{R_1}{R_2}$, is found to be:



[Online April 8, 2017]

Options:

A. $\frac{l_1}{l_1+l_2}$

B. $\frac{l_2}{l_2 - l_1}$

C. $\frac{l_1}{l_1 - l_2}$

D. $\frac{l_1}{l_2 - l_1}$

Answer: D

Solution:

Solution:
When key is at point (1)
$V_1 = iR_1 = xl_1$
When key is at (3)
$V_2 = i(R_1 + R_2) = xl_2$
$R_1 R_1 + R_2 = \frac{l_1}{l_2} \Rightarrow \frac{R_1}{R_2} = \frac{l_1}{l_2 - l_1}$

Question243

The resistance of an electrical toaster has a temperature dependence given by $R(T) = R_0[1 + \alpha(T - T_0)]$ in its range of operation. At $T_0 = 300K$, $R = 100\Omega$ and at $T = 500K$, $R = 120\Omega$. The toaster is connected to a voltage source at 200 V and its temperature is raised at a constant rate from 300 to 500K in 30s. The total work done in raising the temperature is :
[Online April 10, 2016]

Options:

A. $400 \ln \frac{5}{6} J$

B. $200 \ln \frac{2}{3} J$

C. 300J

D. $400 \ln \frac{1.5}{1.3} J$

E. None

Answer: E

Solution:

Solution:
Work done in 30s, $W = \int_0^{30} \frac{V^2}{R} dt$

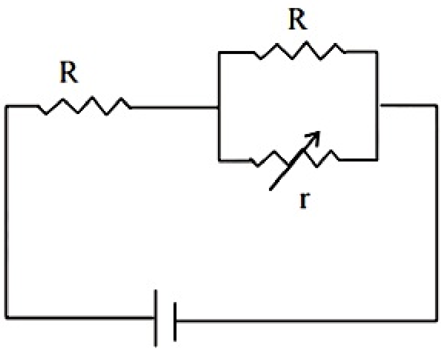
or, $W = \int_0^{30} \frac{(200)^2}{100\left(1 + \alpha \frac{20t}{3}\right)} dt = \frac{(200)^2}{100} \int_0^{30} \frac{dt}{1 + \frac{20\alpha}{3} t}$

$= \frac{400 \times 3}{20\alpha} \ln\left(\frac{1 + 20\alpha}{3} \times 301\right) = 60,000 \ln\left(\frac{6}{5}\right)$

$\because 120 = 100[1 + \alpha(200)]$

$\therefore \alpha = \frac{1}{1000}$

Question244



In the circuit shown, the resistance ris a variable resistance. If for r = f R, the heat generation in r is maximum then the value of f is: [Online April 9, 2016]

Options:

A. $\frac{1}{2}$

B. 1

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

D. $\frac{3}{4}$

Answer: C

Solution:

Solution:
Heat energy will be maximum when resistance will be minimum

Question245

When 5V potential difference is applied across a wire of length 0.1m, the drift speed of electrons is $2.5 \times 10^{-4} ms^{-1}$ If the electron density in the wire is $8 \times 10^{28} m^{-3}$, the resistivity of the material is close to : [2015]

Options:

A. $1.6 \times 10^{-6} \Omega m$

B. $1.6 \times 10^{-5} \Omega m$

C. $1.6 \times 10^{-8} \Omega m$

D. $1.6 \times 10^{-7} \Omega m$

Answer: B

Solution:

Solution:

$V = IR = (neAv_d)\rho\frac{l}{A}$

$\therefore \rho = \frac{V}{V_d \, l n e}$

Here $V =$ potential difference

$l =$ length of wire

$n =$ no. of electrons per unit volume of conductor.

$e =$ no. of electrons

Placing the value of above parameters we get resistivity

$\rho = \frac{5}{8 \times 10^{28} \times 1.6 \times 10^{-19} \times 2.5 \times 10^{-4} \times 0.1}$

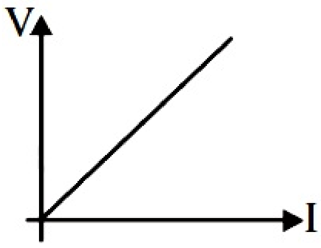
$= 1.6 \times 10^{-5} \Omega m$

Question246

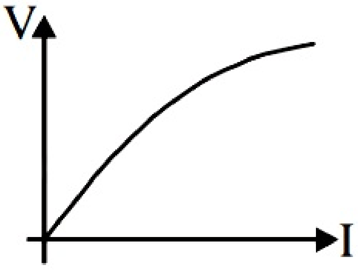
Suppose the drift velocity v_d in a material varied with the applied electric field E as $v_d \propto \sqrt{E}$. Then $V - I$ graph for a wire made of such a material is best given by:
[Online April 10, 2015]

Options:

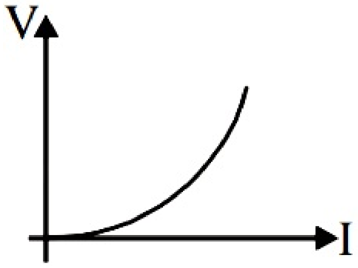
A.



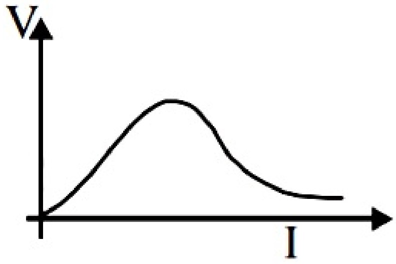
B.



C.



D.



Answer: C

Solution:

Solution:

$i = neAV_d$ and $V_d \propto \sqrt{E}$ (Given)

or, $i \propto \sqrt{E}$

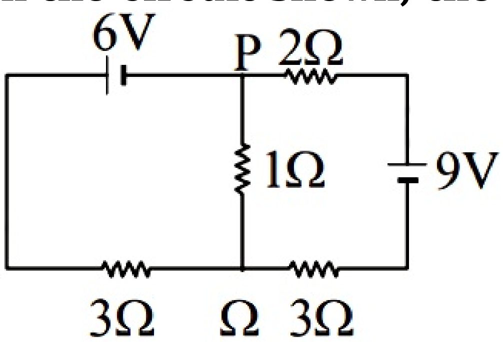
$i^2 \propto E$

$i^2 \propto V$

Hence graph (c) correctly dipicts the $V - I$ graph for a wire made of such type of material.

Question247

In the circuit shown, the current in the 1Ω resistor is:



[2015]

Options:

A. 0.13 A, from Q to P

B. 0.13 A, from P to Q

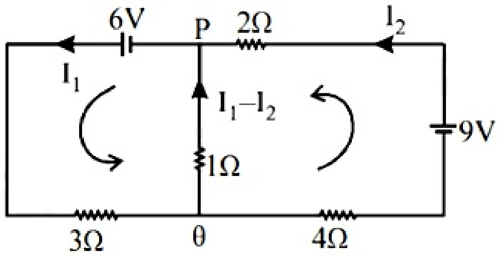
C. 1.3A from P to Q

D. 0A

Answer: A

Solution:

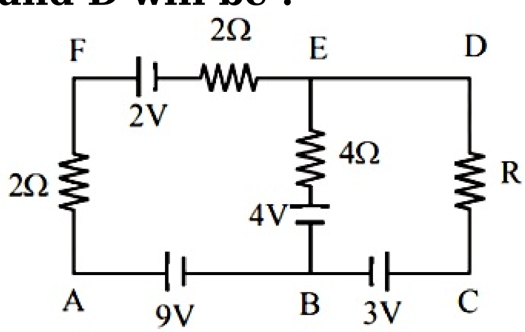
Solution:
From KVL
$-6 + 3I_1 + 1(I_i - I_2) = 0$



$6 = 3I_1 + I_1 - I_2; 4I_1 - I_2 = 6$ ......(1)
$-9 + 2I_2 - (I_1 - I_2) + 3I_2 = 0$
$-I_1 + 6I_2 = 9$ ....(2)
On solving(1) and (2)
$I_1 = 0.13A$
Direction Q to P, since $I_1 > I_2$

Question248

In the electric network shown, when no current flows through the 4Ω resistor in the arm EB, the potential difference between the points A and D will be :



[Online April 11, 2015]

Options:

A. 6 V

B. 3 V

C. 5 V

D. 4 V

Answer: C

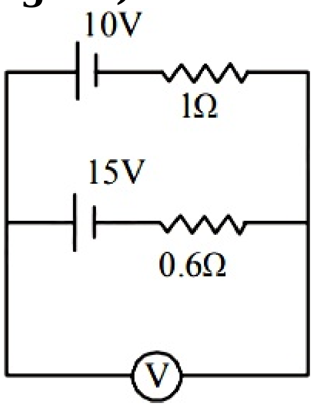
Solution:

Solution:
As no current flows through arm E B then
$V_n = 0V$
$V_F^D = 0V$
$V_B^L = -4V$
$V_A^D = 5V$

So, potential difference between the points A and D
$V_A - V_D = 5V$

Question249

A 10V battery with internal resistance 1Ω and a 15V battery with internal resistance 0.6 Ω are connected in parallel to a voltmeter (see figure). The reading in the voltmeter will be close to :



[Online April 10, 2015]

Options:

A. 12.5 V

B. 24.5 V

C. 13.1 V

D. 11.9 V

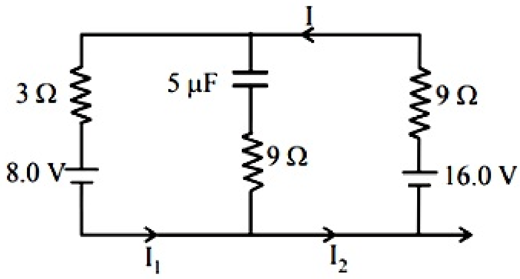
Answer: C

Solution:

Solution:
As the two cells oppose each other hence, the effective emf in closed circuit is $15 - 10 = 5V$ and net resistance is $1 + 0.6 = 1.6\Omega$ (because in the closed circuit the internal resistance of two cells are in series.
Current in the circuit,
$I = \frac{\text{effective emf}}{\text{total resistance}} = \frac{5}{1.6}A$
The potential difference across voltmeter will be same as the terminal voltage of either cell.
Since the current is drawn from the cell of $15V$
$\therefore V_1 = E_1 - I r_1$
$= 15 - \frac{5}{1.6} \times 0.6 = 13.1V$

Question250

The circuit shown here has two batteries of 8.0 V and 16.0 V and three resistors 3 Ω, 9 Ω and 9 Ω and a capacitor of 5.0 μF.



How much is the current I in the circuit in steady state?
[Online April 12, 2014]

Options:

A. 1.6 A

B. 0.67 A

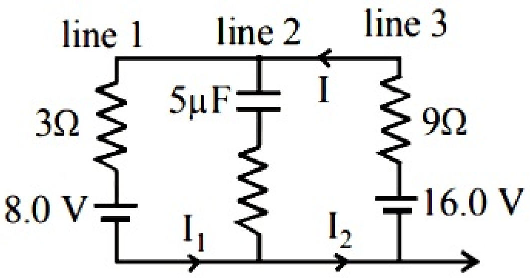
C. 2.5 A

D. 0.25 A

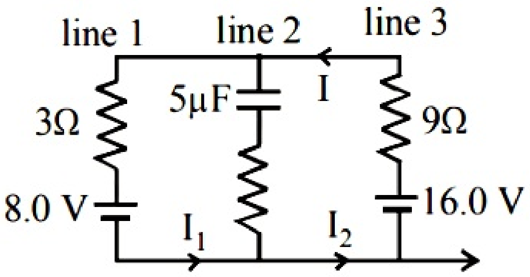
Answer: B

Solution:

Solution:



In steady state capacitor is fully charged hence no current will flow through line 2 .
By simplifying the circuit



Hence resultant potential difference across resistances will be 8.0V

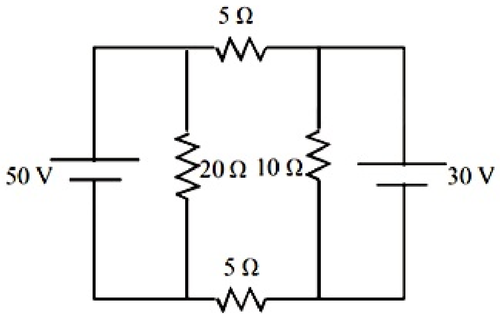
Thus current I $= \frac{V}{R}$

$= \frac{8.0}{3+9} = \frac{8}{12}$

or, I $= \frac{2}{3} = 0.67A$

Question251

In the circuit shown, current (in A) through 50 V and 30 V batteries are, respectively.



[Online April 11, 2014]

Options:

A. 2.5 and 3

B. 3.5 and 2

C. 4.5 and 1

D. 3 and 2.5

Answer: A

Solution:

Solution:
Current through $50V$ and $30V$ batteries are respectively $2.5A$ and $3A$

Question252

A d.c. main supply of e.m.f. 220 V is connected across a storage battery of e.m.f. 200 V through a resistance of 1Ω . The battery terminals are connected to an external resistance ‘R’. The minimum value of ‘R’, so that a current passes through the battery to charge it is: [Online April 9, 2014]

Options:

A. 7 Ω

B. 9 Ω

C. 11 Ω

D. Zero

Answer: C

Solution:

Solution:
Given, emf of cell $E = 200V$
Internal resistance of cells $= 1\Omega$
D. C. main supply voltage $V = 220V$
External resistance $R = ?$

$r = \left(\frac{E - V}{V}\right) R$

$1 = \left(\frac{20}{220}\right) \times R \therefore R = 11\Omega$

Question253

In a large building, there are 15 bulbs of 40 W, 5 bulbs of 100 W, 5 fans of 80 W and 1 heater of 1 kW. The voltage of electric mains is 220 V. The minimum capacity of the main fuse of the building will be:
[2014]

Options:

A. 8 A

B. 10 A

C. 12 A

D. 14 A

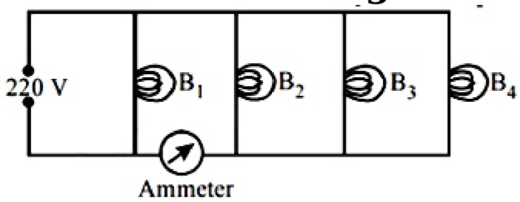
Answer: C

Solution:

Solution:
Total power consumed by electrical appliances in the building, $P_{total} = 2500W$
Watt = Volt × ampere
$\Rightarrow 2500 = V \times I \Rightarrow 2500 = 220I$
$\Rightarrow I = \frac{2500}{220} = 11.36 \approx 12A$ (Minimum capacity of main fuse)

Question254

Four bulbs B_1, B_2, B_3 and B_4 of 100 W each are connected to 220 V main as shown in the figure.



The reading in an ideal ammeter will be:
[Online April 19, 2014]

Options:

A. 0.45 A

B. 0.90 A

C. 1.35 A

D. 1.80 A

Answer: C

Solution:

Solution:

Current in each bulb $= \frac{\text{Power}}{\text{Voltage}}$

$= \frac{100}{220} = 0.45\text{A}$

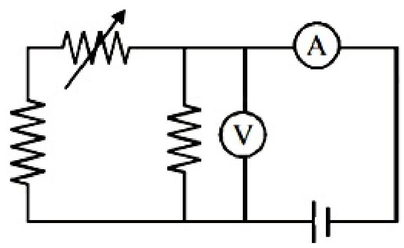
Current through ammeter $= 0.45 \times 3 = 1.35\text{A}$

Question255

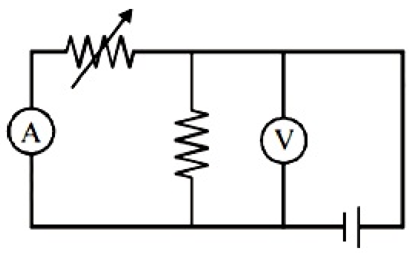
Correct set up to verify Ohm's law is : [Online April 23, 2013]

Options:

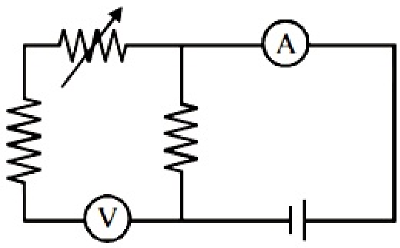
A.



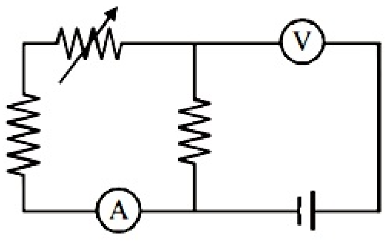
B.



C.



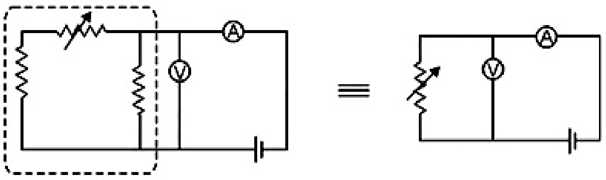
D.



Answer: A

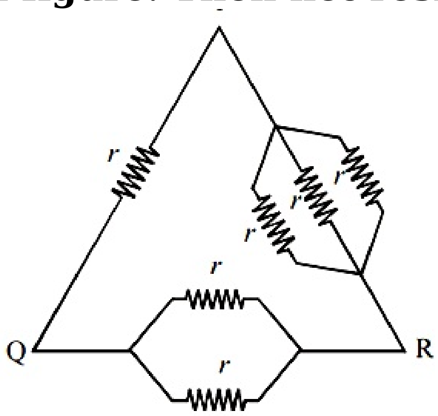
Solution:

Solution:
In ohm's law, we check $V = IR$ where I is the current flowing through a resistor and V is the potential difference across that resistor. Only option (a) fits the above criteria. Remember that ammeter is connected in series with resistance and voltmeter parallel with the resistance.



Question256

Six equal resistances are connected between points P, Q and R as shown in figure. Then net resistance will be maximum between :



[Online April 25, 2013]

Options:

A. P and R

B. P and Q

C. Q and R

D. Any two points

Answer: B

Solution:

Solution:
Resistance between P and Q

$$r_{PQ} = r \parallel \left(\frac{r}{3} + \frac{r}{2}\right) = \frac{r \times \frac{5}{6}r}{r + \frac{5}{6}r} = \frac{5}{11}r$$

Resistance between Q and R

$$r_{QR} = \frac{r}{2} \parallel \left(r + \frac{r}{3}\right) = \frac{\frac{r}{2} \times \frac{4}{3}r}{\frac{r}{2} + \frac{4}{3}r} = \frac{4}{11}r$$

Resistance between P and R

$$r_{PR} = \frac{r}{3} \parallel \left(\frac{r}{2} + r\right) = \frac{\frac{r}{3} \times \frac{3}{2}r}{\frac{r}{3} + \frac{3}{2}r} = \frac{3}{11}r$$

Hence, it is clear that r_{PQ} is maximum

Question257

A letter 'A' is constructed of a uniform wire with resistance 1.0 Ω per cm, The sides of the letter are 20 cm and the cross piece in the middle is 10 cm long. The apex angle is 60 . The resistance between the ends of the legs is close to:
[Online April 9, 2013]

Options:

A. 50.0 Ω

B. 10 Ω

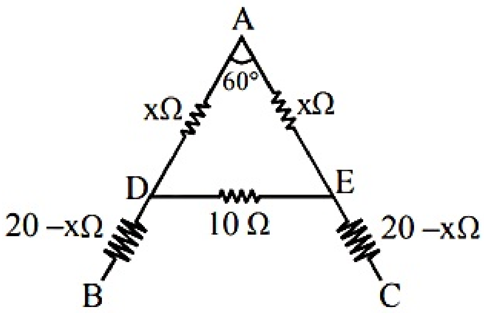
C. 36.7 Ω

D. 26.7 Ω

Answer: D

Solution:

Solution:



For ADE $\frac{1}{R'} = \frac{1}{2x} + \frac{1}{10}$

or $R' = \frac{20x}{10 + 2x}$

$R_{BC} = \frac{20x}{10 + 2x} + 20 - x + 20 - x$ .....(i)

or $\frac{20x}{10 + 2x} + 40 = 2x$

Solving we get

$x = 10\Omega$

Putting the value of $x = 10\Omega$ in equation (i)

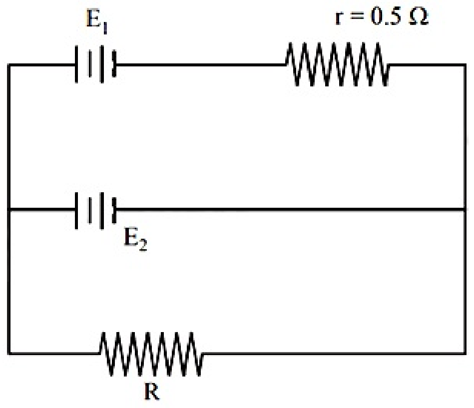
We get

$R_{BC} = \frac{20 \times 10}{10 + 2 \times 10} + 20 - 10 + 20 - 10$

$= \frac{80}{3} = 26.7\Omega$

Question258

A dc source of emf $E_1 = 100V$ and internal resistance r = 0.5 Ω, a storage battery of emf $E_2 = 90V$ and an external resistance R are connected as shown in figure. For what value of R no current will pass through the battery?



[Online April 22, 2013]

Options:

A. 5.5 Ω

B. 3.5 Ω

C. 4.5 Ω

D. 2.5 Ω

Answer: C

Solution:

Solution:

$$\frac{100}{R+r} = \frac{90}{R} \Rightarrow \frac{R+r}{R} = \frac{10}{9} \Rightarrow 1 + \frac{0.5}{R} = \frac{10}{9}$$

$$\Rightarrow \frac{0.5}{R} = \frac{1}{9} \therefore R = 4.5\Omega$$

Question259

The supply voltage to room is 120V. The resistance of the lead wires is 6W. A 60Ω bulb is already switched on. What is the decrease of voltage across the bulb, when a 240 W heater is switched on in parallel to the bulb?
[2013]

Options:

A. zero

B. 2.9 Volt

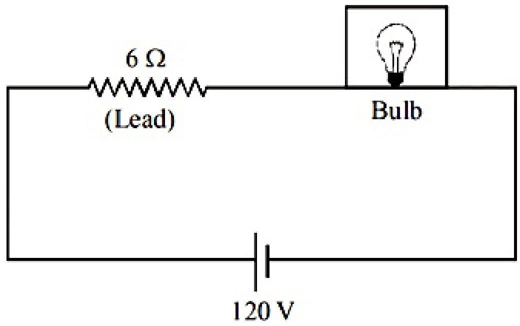
C. 13.3 Volt

D. 10.04 Volt

Answer: D

Solution:

Solution:



Power of bulb $= 60W$ (given)

Resistance of bulb $= \frac{120 \times 120}{60} = 240\Omega \left[\because P = \frac{V^2}{R} \right]$

Power of heater $= 240W$ (given)

Resistance of heater $= \frac{120 \times 120}{240} = 60\Omega$

Voltage across bulb before heater is switched on,

$V_1 = \frac{240}{246} \times 120 = 117.73 \text{ volt}$

Voltage across bulb after heater is switched on,

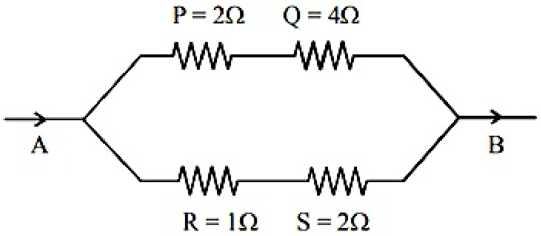
$V_2 = \frac{48}{54} \times 120 = 106.66 \text{ volt}$

Hence decrease in voltage

$V_1 - V_2 = 117.073 - 106.66 = 10.04$ Volt (approximately)

Question260

Which of the four resistances P, Q, R and S generate the greatest amount of heat when a current flows from A to B?



[Online April 23, 2013]

Options:

A. Q

B. S

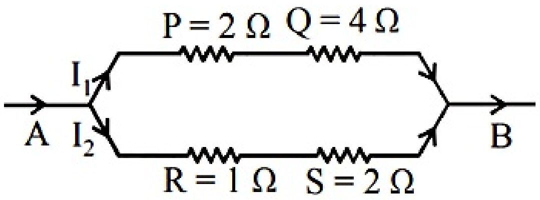
C. P

D. R

Answer: B

Solution:

Solution:



$R_1 = P + Q = 2\Omega + 4\Omega = 6\Omega$
$R_2 = R + S = 1\Omega + 2\Omega = 3\Omega$
$I_1R_1 = I_2R_2$
$I_1 = \frac{R_2}{R_1}I_2 = \frac{3}{6}I_2 = \frac{I_2}{2}$
or $I_2 = 2I_1$
Heat flow $H = I^2Rt$
For Q, $H_Q = I_1^2Qt = \frac{I_2^2}{4} \times 4t = I_2^2t$
For S, $H_S = I_2^2St = I_2^2 . 2t = 2I_2^2t$
∴ Greatest amount of heat generated by S.

Question261

In a metre bridge experiment null point is obtained at 40 cm from one end of the wire when resistance X is balanced against another resistance Y. If X < Y, then the new position of the null point from the same end, if one decides to balance a resistance of 3X against Y, will be close to :
[Online April 9, 2013]

Options:

A. 80 cm

B. 75 cm

C. 67 cm

D. 50 cm

Answer: C

Solution:

Solution:
From question, $\frac{x}{y} = \frac{40}{100 - 40} = \frac{2}{3}$
$\Rightarrow x = \frac{2}{3}y$
Again, $\frac{3x}{y} = \frac{Z}{100 - Z}$
or $\frac{3 \times \frac{2y}{3}}{y} = \frac{Z}{100 - Z}$
Solving we get $Z = 67\text{cm}$
Therefore new position of null point $\cong 67\text{cm}$

Question262

This question has Statement 1 and Statement 2. Of the four choices given after the Statements, choose the one that best describes the two Statements.
Statement 1: The possibility of an electric bulb fusing is higher at the time of switching ON.
Statement 2: Resistance of an electric bulb when it is not lit up is much smaller than when it is lit up.
[Online May 7, 2012]

Options:

A. Statement 1 is true, Statement 2 is false

B. Statement 1 is false, Statement 2 is true, Statement 2 is not a correct explanation of Statement 1.

C. Statement 1 is true, Statement 2 is true, Statement 2 is a correct explanation of Statement 1.

D. Statement 1 is false, Statement 2 is true

Answer: C

Solution:

Solution:

Question263

The resistance of a wire is R. It is bent at the middle by 180° and both the ends are twisted together to make a shorter wire. The resistance of the new wire is
[Online May 26, 2012]

Options:

A. 2 R

B. R/2

C. R/4

D. R/8

Answer: C

Solution:

Solution:
Resistance of wire (R) = $\rho \frac{l}{A}$
If wire is bent in the middle then
$l' = \frac{l}{2}, A' = 2A$
$\therefore$ New resistance, $R' = \rho \frac{l'}{A'}$

$= \frac{\rho \frac{l}{2}}{2A} = \frac{\rho l}{4A} = \frac{R}{4}.$

Question264

Two electric bulbs rated 25W – 220 V and 100W – 220V are connected in series to a 440 V supply. Which of the bulbs will fuse?
[2012]

Options:

A. Both

B. 100 W

C. 25 W

D. Neither

Answer: C

Solution:

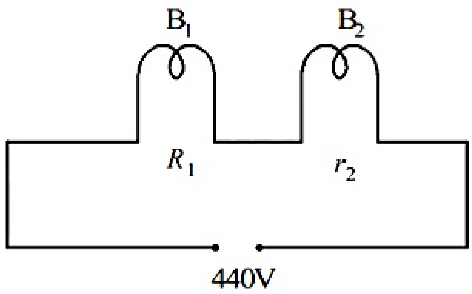
Solution:
Current capacity of 25W bulb

$I_1 = \frac{W_1}{V_1} = \frac{25}{220} \text{Amp}$

Current capacity of 100W bulb

$I_2 = \frac{W_2}{V_2} = \frac{100}{220} \text{Amp}$

The current flowing through the circuit



Resistance of 25W bulb,

$R_1 = \frac{V_1^2}{P_1} = \frac{(220)^2}{25}$

Resistance of 100W bulb

$R_2 = \frac{V_2^2}{P} = \frac{(220)^2}{100}$

$R_{eff} = R_1 + R_2$

Current flowing through circuit

$I = \frac{440}{R_{eff}}$

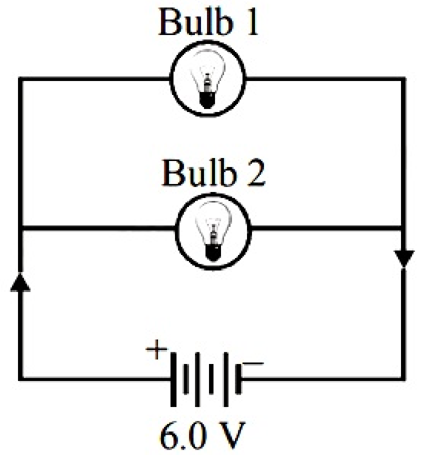
$I = \frac{440}{\frac{(220)^2}{25} + \frac{(220)^2}{100}}$

$= \frac{440}{(220)^2 \left[\frac{1}{25} + \frac{1}{100}\right]}; I = \frac{40}{220} \text{Amp}$

$\because I_1 \left(= \frac{25}{220} A \right) < I \left(= \frac{40}{220} A \right)$ $ Thus the bulb rated 25W − 220 will fuse

Question265

A 6.0 volt battery is connected to two light bulbs as shown in figure. Light bulb 1 has resistance 3 ohm while light bulb 2 has resistance 6 ohm. Battery has negligible internal resistance. Which bulb will glow brighter?



[Online May 19, 2012]

Options:

A. Bulb 1 will glow more first and then its brightness will become less than bulb 2

B. Bulb 1

C. Bulb 2

D. Both glow equally

Answer: B

Solution:

Solution:

Total resistance $= \frac{6 \times 3}{6+3} = 2\Omega$

Current in circuit $= \frac{6}{2} = 3\mathrm{A}$

Therefore current through bulb 1 is 2A and bulb 2 is 1A.
So bulb 1 will glow more

Question266

Three resistors of 4 Ω, 6 Ω and 12 Ω are connected in parallel and the combination is connected in series with a 1.5 V battery of 1 W internal resistance. The rate of Joule heating in the 4 W resistor is
[Online May 12, 2012]

Options:

A. 0.55 W

B. 0.33 W

C. 0.25 W

D. 0.86 W

Answer: C

Solution:

Solution:
Resistors 4Ω, 6Ω and 12Ω are connected in parallel, its equivalent resistance (R) is given by
$\frac{1}{R}=\frac{1}{4}+\frac{1}{6}+\frac{1}{12} \Rightarrow R=\frac{12}{6}=2\Omega$
Again R is connected to 1.5V battery whose internal resistance $r=1\Omega$
Equivalent resistance now,
$R'=2\Omega+1\Omega=3\Omega$
Current, $I_{total}=\frac{V}{R'}=\frac{1.5}{3}=\frac{1}{2}A$
$I_{total}=\frac{1}{2}=3x+2x+x=6x$
$\Rightarrow x=\frac{1}{12}$
$\therefore$ Current through 4Ω resistor $=3x$
$=3\times\frac{1}{12}=\frac{1}{4}A$
Therefore, rate of Joule heating in the 4Ω resistor
$=I^2R=\left(\frac{1}{4}\right)^2\times 4=\frac{1}{4}=0.25W$

Question267

In an experiment of potentiometer for measuring the internal resistance of primary cell a balancing length l is obtained on the potentiometer wire when the cell is open circuit. Now the cell is short circuited by a resistance R. If R is to be equal to the internal resistance of the cell the balancing length on the potentiometer wire will be
[Online May 26, 2012]

Options:

A. l

B. 2l

C. l/2

D. l/4

Answer: C

Solution:

Solution:
Balancing length l will give emf of cell
$\therefore E=Kl$
Here K is potential gradient.
If the cell is short circuited by resistance ' R'
Let balancing length obtained be l' then

$V = kl'$

$r = \left(\frac{E - V}{V}\right)R$

$\Rightarrow V = E - V$ [$\because r = R$ given]

$\Rightarrow 2V = E$

or, $2Kl' = Kl$

$\therefore l' = \frac{l}{2}$

Question268

It is preferable to measure the e.m.f. of a cell by potentiometer than by a voltmeter because of the following possible reasons.
(i) In case of potentiometer, no current flows through the cell.
(ii) The length of the potentiometer allows greater precision.
(iii) Measurement by the potentiometer is quicker.
(iv) The sensitivity of the galvanometer, when using a potentiometer is not relevant.
Which of these reasons are correct?
[Online May 12, 2012]

Options:

A. (i), (iii), (iv)

B. (i), (iii), (iv)

C. (i), (ii)

D. (i), (ii), (iii), (iv)

Answer: C

Solution:

Solution:
To measure the emf of a cell we prefer potentiometer rather than voltmeter because
(i) the length of potentiometer which allows greater precision.
(ii) in case of potentiometer, no current flows through the cell.
(iii) of high sensitivity.

Question269

In a sensitive meter bridge apparatus the bridge wire should possess
[Online May 12, 2012]

Options:

A. high resistivity and low temperature coefficient.

B. low resistivity and high temperature coefficient.

C. low resistivity and low temperature coefficient.

D. high resistivity and high temperature coefficient.

Answer: A

Solution:

Solution:
Bridge wire in a sensitive meter bridge wire should be of high resistivity and low temperature coefficient.

Question270

If a wire is stretched to make it 0.1% longer, its resistance will : [2011]

Options:

A. increase by 0.2%

B. decrease by 0.2%

C. decrease by 0.05%

D. increase by 0.05%

Answer: A

Solution:

Solution:
Resistance of wire $R = \frac{\rho l}{A} = \frac{\rho l^2}{V} (\because V = Al)$
Hence, $R = \rho\frac{l^2}{V} =$ constant $\times l^2$
∴ Fractional change in resistance
$\frac{\Delta R}{R} = 2\frac{\Delta l}{l}$
$100 \times \frac{\Delta R}{R} = 200 \times \left(\frac{dl}{l}\right)$
$\because dl/l = 0.1\%$
∴% change in $R = \left[200 \times \left\{\frac{0.1}{100}\right\}\right] = 0.2\%$
∴ Resistance will increase by 0.2%.

Question271

The current in the primary circuit of a potentiometer is 0.2 A. The specific resistance and cross-section of the potentiometer wire are 4×10^{-7} ohm metre and $8 \times 10^{-7} m^2$, respectively. The potential gradient will be equal to [2011 RS]

Options:

A. 1 V /m

B. 0.5V/m

C. 0.1 V/m

D. 0.2 V/m

Answer: C

Solution:

Solution:
Potential gradient

$\Rightarrow k = \frac{V}{l} = \frac{IR}{l} = \frac{I}{l}\left(\frac{\rho l}{A}\right) = \frac{I\rho}{A}$

$k = \frac{0.2 \times 4 \times 10^{-7}}{8 \times 10^{-7}} = \frac{0.8}{8} = 0.1V\ /\ m$

Question272

Two conductors have the same resistance at 0°C but their temperature coefficients of resistance are α_1 and α_2. The respective temperature coefficients of their series and parallel combinations are nearly [2010]

Options:

A. $\frac{\alpha_1 + \alpha_2}{2}, \alpha_1 + \alpha_2$

B. $\alpha_1 + \alpha_2, \frac{\alpha_1 + \alpha_2}{2}$

C. $\alpha_1 + \alpha_2, \frac{\alpha_1\alpha_2}{\alpha_1 + \alpha_2}$

D. $\frac{\alpha_1 + \alpha_2}{2}, \frac{\alpha_1 + \alpha_2}{2}$

Answer: D

Solution:

Solution:
Let R_1 and R_2 be the resistances of two conductors, then

$R_1 = R_0[1 + \alpha_1\Delta t]$

$R_2 = R_0[1 + \alpha_2\Delta t]$

Here, R_0 is the resistance of conductor at 0°C

In Series, $R = R_1 + R_2$

$= R_0[2 + (\alpha_1 + \alpha_2)\Delta t]$

$= 2R_0\left[1 + \left(\frac{\alpha_1 + \alpha_2}{2}\right)\Delta t\right]$

$\therefore \alpha_{eq} = \frac{\alpha_1 + \alpha_2}{2}$

In Parallel, $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

$= \frac{1}{R_0[1 + \alpha_1\Delta t]} + \frac{1}{R_0[1 + \alpha_2\Delta t]}$

$$\Rightarrow \frac{1}{\frac{R_0}{2}(1+\alpha_{eq}\Delta t)} = \frac{1}{R_0(1+\alpha_1\Delta t)} + \frac{1}{R_0(1+\alpha_2\Delta t)}$$

$$2(1-\alpha_{eq}\Delta t) = (1-\alpha_1\Delta t)(1-\alpha_2\Delta t)$$

$$\therefore \alpha_{eq} = \frac{\alpha_1+\alpha_2}{2}$$

Question273

ΔV measured between B and C is [2008]

Options:

A. $\frac{\rho I}{\pi a} - \frac{\rho I}{\pi(a+b)}$

B. $\frac{\rho I}{a} - \frac{\rho I}{(a+b)}$

C. $\frac{\rho I}{2\pi a} - \frac{\rho I}{2\pi(a+b)}$

D. $\frac{\rho I}{2\pi(a-b)}$

Answer: A

Solution:

Solution:

Let j be the current density.

Then $j \times 2\pi r^2 = I \Rightarrow j = \frac{I}{2\pi r^2}$

$\therefore E = \rho j = \frac{\rho I}{2\pi r^2}$

Now, $V_B - V_C$

$$= -\int_{a+b}^{a} \vec{E}\cdot d\vec{r} = -\int_{a+b}^{a} \frac{\rho I}{2\pi r^2} dr$$

$$= -\frac{\rho I}{2\pi}\left[-\frac{1}{r}\right]_{a+b}^{a} = \frac{\rho I}{2\pi a} - \frac{\rho I}{2\pi(a+b)}$$

On applying superposition as mentioned we get

$$\Delta V_{BC} = 2 \times \Delta V_{BC}' = \frac{\rho I}{\pi a} - \frac{\rho I}{\pi(a+b)}$$

Question274

For current entering at A, the electric field at a distance 'r' from A is [2008]

Options:

A. $\frac{\rho I}{8\pi r^2}$

B. $\frac{\rho I}{r^2}$

C. $\frac{\rho I}{2\pi r^2}$

D. $\frac{\rho I}{4\pi r^2}$

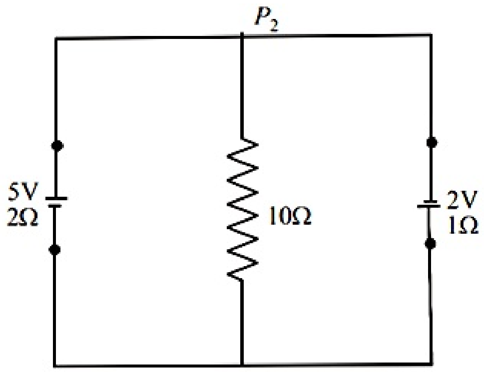
Answer: C

Solution:

Solution:
As shown in Answer (a) $E = \frac{\rho I}{2\pi r^2}$

Question275

A 5V battery with internal resistance 2Ω and a 2V battery with internal resistance 1Ω are connected to a 10Ω resistor as shown in the figure.



The current in the 10Ω resistor is
[2008]

Options:

A. $0.27 A P_2$ to P_1

B. $0.03 A P_1$ to P_2

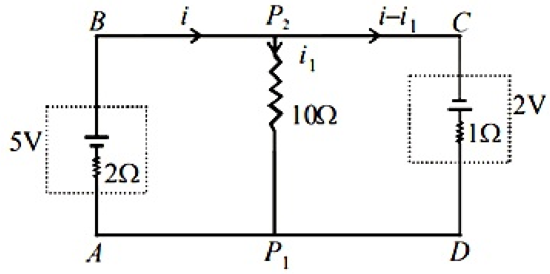
C. $0.03 A P_2$ to P_1

D. $0.27 A P_1$ to P_2

Answer: C

Solution:

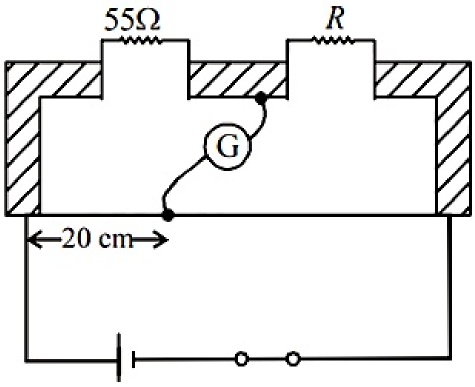
Solution:
Applying Kirchoff's second law in ABP_2P_1A, we get
$-2i + 5 - 10i_1 = 0$
$2i + 10i_1 = 5$ ......(i)



Again applying Kirchoff's second law in $P_2CDP_1P_2$ we get,
$10i_1 + 2 - i + i_1 = 0$
$2_i - 22i_1 = 4$ .....(ii)
From (i) and (ii) $32i_1 = 1$
$\Rightarrow i_1 = \frac{1}{32}$ A from P_2 to P_1

Question276

Shown in the figure below is a meter-bridge set up with null deflection in the galvanometer.



The value of the unknown resistor R is [2008]

Options:

A. 13.75 Ω

B. 220 Ω

C. 110 Ω

D. 55 Ω

Answer: B

Solution:

Solution:
Given,
Balance point from one end, $l_1 = 20\text{cm}$
From the condition for balance of metre bridge, we have
$\frac{55}{R} = \frac{l_1}{100 - l_1}$
$\frac{55}{R} = \frac{20}{80}$
$\Rightarrow R = 220\Omega$

Question277

**The resistance of a wire is 5 ohm at 50°C and 6 ohm at 100°C. The resistance of the wire at 0°C will be
[2007]**

Options:

A. 3 ohm

B. 2 ohm

C. 1 ohm

D. 4 ohm

Answer: D

Solution:

Solution:
Resistance of a metal conductor at temperature t°C is given by
$R_t = R_0(1 + \alpha t)$
R_0 is the resistance of the wire at 0°C
and α is the temperature coefficient of resistance.
Resistance at 50°C, $R_{50} = R_0(1 + 50\alpha)$ ....(i)
Resistance at 100°C, $R_{100} = R_0(1 + 100\alpha)$ ....(ii)
From (i), $R_{50} - R_0 = 50\alpha R_0$ ....(iii)
From (ii), $R_{100} - R_0 = 100\alpha R_0$ ....(iv)
Dividing (iii) by (iv), we get
$\frac{R_{50} - R_0}{R_{100} - R_0} = \frac{1}{2}$
Here, $R_{50} = 5\Omega$ and $R_{100} = 6\Omega$
$\therefore \frac{5 - R_0}{6 - R_0} = \frac{1}{2}$
or, $6 - R_0 = 10 - 2R_0$ or, $R_0 = 4\Omega$

Question278

**A battery is used to charge a parallel plate capacitor till the potential difference between the plates becomes equal to the electromotive force of the battery. The ratio of the energy stored in the capacitor and the work done by the battery will be
[2007]**

Options:

A. 1/2

B. 1

C. 2

D. 1/4

Answer: A

Solution:

Solution:

Energy in capacitor $= \frac{1}{2} CV^2$

Work done by battery $= QV = CV^2$

where C = Capacitance of capacitor

V = Potential difference,

e = emf of battery

Required ratio $= \frac{\frac{1}{2} CV^2}{CV^2} = \frac{1}{2} (\because V = e)$

Question279

A material ' B ' has twice the specific resistance of 'A′. A circular wire made of ' B ' has twice the diameter of a wire made of 'A'. then for the two wires to have the same resistance, the ratio l_B / l_A of their respective lengths must be
[2006]

Options:

A. 1

B. $\frac{1}{2}$

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

D. 2

Answer: D

Solution:

Solution:

Let d_A and d_B are the diameter of wire A and B respectively. Let ρ_B and ρ_A be the resistivity of wire A and B. We have given

$\rho_B = 2\rho_A$

$d_B = 2d_A$

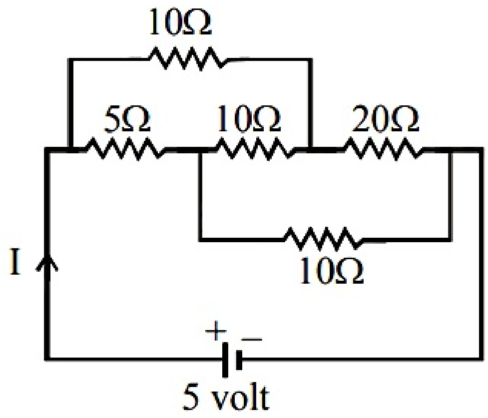
If both resistances are equal $R_B = R_A$

$\Rightarrow \frac{\rho_B l_B}{A_B} = \frac{\rho_A l_A}{A_A}$

$\therefore \frac{l_B}{l_A} = \frac{\rho_A}{\rho_B} \times \frac{d_B^2}{d_A^2} = \frac{\rho_A}{2\rho_A} \times \frac{4d_A^2}{d_A^2} = 2$

Question280

The current I drawn from the 5 volt source will be



[2006]

Options:

A. 0.33 A

B. 0.5 A

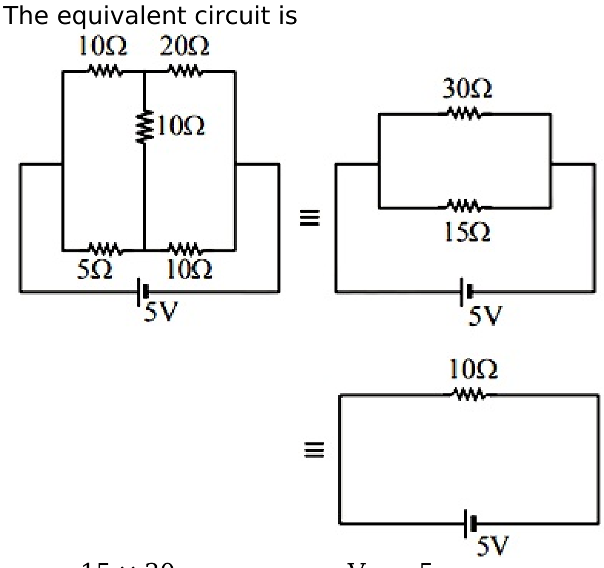
C. 0.67 A

D. 0.17 A

Answer: B

Solution:

Solution:
The network of resistors is a balanced wheatstone bridge. Hence, no current will flow through centre resistor.
The equivalent circuit is



$R_{eq} = \frac{15 \times 30}{15 + 30} = 10\Omega \Rightarrow I = \frac{V}{R} = \frac{5}{10} = 0.5A$

Question281

The Kirchhoff's first law ($\sum i = 0$) and second law ($\sum iR = \sum E$), where the symbols have their usual meanings, are respectively based on
[2006]

Options:

A. conservation of charge, conservation of momentum

B. conservation of energy, conservation of charge

C. conservation of momentum, conservation of charge

D. conservation of charge, conservatrion of energy

Answer: D

Solution:

Solution:
Note : Kirchhoff's first law is based on conservation of charge and Kirchhoff's second law is based on conservation of energy.

Question282

A thermocouple is made from two metals, Antimony and Bismuth. If one junction of the couple is kept hot and the other is kept cold, then, an electric current will [2006]

Options:

A. flow from Antimony to Bismuth at the hot junction

B. flow from Bismuth to Antimony at the cold junction

C. now flow through the thermocouple

D. flow from Antimony to Bismuth at the cold junction

Answer: D

Solution:

Solution:
At cold junction, current flows from Antimony to Bismuth because current flows from metal occurring later in the series to metal occurring earlier in the thermoelectric series. In thermoelectric series, Bismuth comes earlier than Antimony so at cold junction, current. Flow from Antimony to Bismuth.

Question283

The resistance of a bulb filmanet is 100Ω at a temperature of 100°C. If its temperature coefficient of resistance be 0.005 per °C, its resistance will become 200 Ω at a temperature of [2006]

Options:

A. 300°C

B. 400°C

C. 500°C

D. 200°C

Answer: B

Solution:

Solution:
Let resistance of bulb filament be R_0 at 0°C using $R = R_0(1 + \alpha\Delta t)$ we have
$R_1 = R_0[1 + \alpha \times 100] = 100......(1)$
$R_2 = R_0[1 + \alpha \times T] = 200......(2)$
On dividing we get
$\frac{200}{100} = \frac{1 + \alpha T}{1 + 100\alpha} \Rightarrow 2 = \frac{1 + 0.005T}{1 + 100 \times 0.005}$
$\Rightarrow T = 400°C$
Note : We may use this expression as an approximation because the difference in the answers is appreciable. For accurate results one should use $R = R_0 e^{\alpha\Delta T}$

Question284

An electric bulb is rated 220 volt - 100 watt. The power consumed by it when operated on 110 volt will be [2006]

Options:

A. 75 watt

B. 40 watt

C. 25 watt

D. 50 watt

Answer: C

Solution:

Solution:
The resistance of the electric bulb is
$R = \frac{V^2}{P} = \frac{(220)^2}{100}$
The power consumed when operated at 110V is
$P' = \frac{V^2}{R}$
$\Rightarrow P = \frac{(110)^2}{(220)^2 / 100} = \frac{100}{4} = 25W$

Question285

In a Wheatstone's bridge, three resistances P, Q and R connected in the three arms and the fourth arm is formed by two resistances S_1 and S_2 connected in parallel. The condition for the bridge to be balanced will

be
[2006]

Options:

A. $\frac{P}{Q} = \frac{2R}{S_1 + S_2}$

B. $\frac{P}{Q} = \frac{R(S_1 + S_2)}{S_1 S_2}$

C. $\frac{P}{Q} = \frac{R(S_1 + S_2)}{2S_1 S_2}$

D. $\frac{P}{Q} = \frac{R}{S_1 + S_2}$

Answer: B

Solution:

Solution:

From balanced wheat stone bridge $\frac{P}{Q} = \frac{R}{S}$ where $S = \frac{S_1 S_2}{S_1 + S_2}$

Question286

Two sources of equal emf are connected to an external resistance R. The internal resistance of the two sources are R_1 and R_2($R_1 > R_1$). If the potential difference across the source having internal resistance R_2 is zero, then
[2005]

Options:

A. $R = R_2 - R_1$

B. $R = R_2 \times (R_1 + R_2) / (R_2 - R_1)$

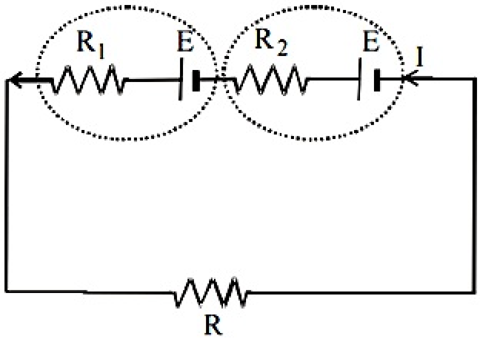
C. $R = R_1 R_2 / (R_2 - R_1)$

D. $R = R_1 R_2 / (R_1 - R_2)$

Answer: A

Solution:

Solution:



Let E be the emf of each source of current

Current in the circuit $I = \frac{2E}{R + R_1 + R_2}$

Potential difference across cell having internal resistance R_2

$V = E - iR_2 = 0$

$E - \frac{2E}{R + R_1 + R_2} . R_2 = 0$

$\Rightarrow R + R_1 + R_2 - 2R_2 = 0$

$\Rightarrow R + R_1 - R_2 = 0$

$\Rightarrow R = R_2 - R_1$

Question287

Two voltameters, one of copper and another of silver, are joined in parallel. When a total charge q flows through the voltameters, equal amount of metals are deposited. If the electrochemical equivalents of copper and silver are Z_1 and Z_2 respectively the charge which flows through the silver voltameter is [2005]

Options:

A. $\frac{q}{1 + \frac{Z_2}{Z_1}}$

B. $\frac{q}{1 + \frac{Z_1}{Z_2}}$

C. $q\frac{Z_2}{Z_1}$

D. $q\frac{Z_1}{Z_2}$

Answer: A

Solution:

Solution:

From Faraday's first law of electrolysis, mass deposited

$m = Zq$

$\Rightarrow Z \propto \frac{1}{q} \Rightarrow \frac{Z_1}{Z_2} = \frac{q_2}{q_1}$ ......(1)

Also $q = q_1 + q_2$ .....(ii)

$\Rightarrow \frac{q}{q_2} = \frac{q_1}{q_2} + 1$ (Dividing (ii) by q_2)

$\Rightarrow q_2 = \frac{q}{1 + \frac{q_1}{q_2}}$ ......(iii)

From equation (i) and (iii),

$q_2 = \frac{q}{1 + \frac{Z_2}{Z_1}}$

Question288

An energy source will supply a constant current into the load if its internal resistance is [2005]

Options:

A. very large as compared to the load resistance

B. equal to the resistance of the load

C. non-zero but less than the resistance of the load

D. zero

Answer: D

Solution:

Solution:
Current is given by

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

If internal resistance (r) is zero,

$I = \frac{E}{R} =$ constant .

Thus, energy source will supply a constant current if its internal resistance is zero.

Question289

A heater coil is cut into two equal parts and only one part is now used in the heater. The heat generated will now be [2005]

Options:

A. four times

B. doubled

C. halved

D. one fourth

Answer: B

Solution:

Solution:
Heat generated,
$H = \frac{V^2 t}{R}$
After cutting equal length of heater coil will become half.
As $R \propto l$
Resistance of half the coil $= \frac{R}{2}$
$H' = \frac{V^2 t}{\frac{R}{2}} = 2H$
$\therefore$ As R reduces to half, ' H ' will be doubled.

Question290

The resistance of hot tungsten filament is about 10 times the cold resistance. What will be the resistance of 100 W and 200 V lamp when not in use ?
[2005]

Options:

A. 20Ω

B. 40Ω

C. 200Ω

D. 400Ω

Answer: B

Solution:

Solution:
Power, $P = Vi = \frac{V^2}{R}$
$\therefore$ Resistance of tungsten filament when in use
$R_{hot} = \frac{V^2}{P} = \frac{200 \times 200}{100} = 400\Omega$
Resistance when not in use i.e., cold resistance
$R_{cold} = \frac{400}{10} = 40\Omega$

Question291

In a potentiometer experiment the balancing with a cell is at length 240 cm. On shunting the cell with a resistance of 2 Ω, the balancing length becomes 120 cm. The internal resistance of the cell is
[2005]

Options:

A. 5.0 Ω

B. 1 Ω

C. 2 Ω

D. 4 Ω

Answer: C

Solution:

Solution:
Initial balancing length, $l_1 = 240\text{cm}$ New balancing length, $l_2 = 120\text{cm}$.
The internal resistance of the cell,
$r = \left(\frac{l_1 - l_2}{l_2}\right) \times R = \frac{240 - 120}{120} \times 2 = 2\Omega$

Question292

An electric current is passed through a circuit containing two wires of the same material, connected in parallel. If the lengths and radii are in the ratio of $\frac{4}{3}$ and $\frac{2}{3}$, then the ratio of the current passing through the wires will be
[2004]

Options:

A. 8/9

B. 1/3

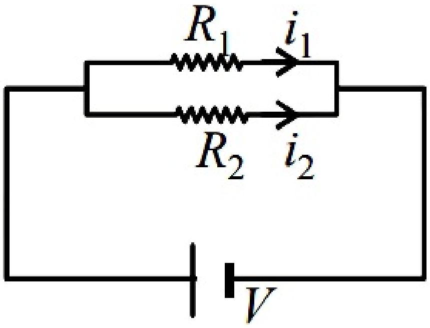
C. 3

D. 2

Answer: B

Solution:

Solution:



Given,
$\frac{l_1}{l_2} = \frac{4}{3}$ and $\frac{r_1}{r_2} = \frac{2}{3}$
$R_1 = \frac{\rho l_1}{\pi {r_1}^2}$; $R_2 = \frac{\rho l_2}{\pi {r_2}^2}$

When wires are in parallel to the circuit potential difference across each wire is same

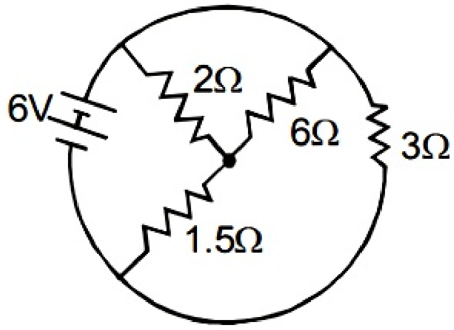
$i_1R_1 = i_2R_2$

$\therefore \frac{i_1}{i_2} = \frac{R_2}{R_1} = \frac{\rho l_2}{\pi r_2^2} \times \frac{\pi r_1^2}{\rho r_1} = \frac{l_2}{l_1} \times \frac{r_1^2}{r_2^2}$

$= \frac{3}{4} \times \frac{4}{9} = \frac{1}{3}$

Question293

The total current supplied to the circuit by the battery is



[2004]

Options:

A. 4 A

B. 2 A

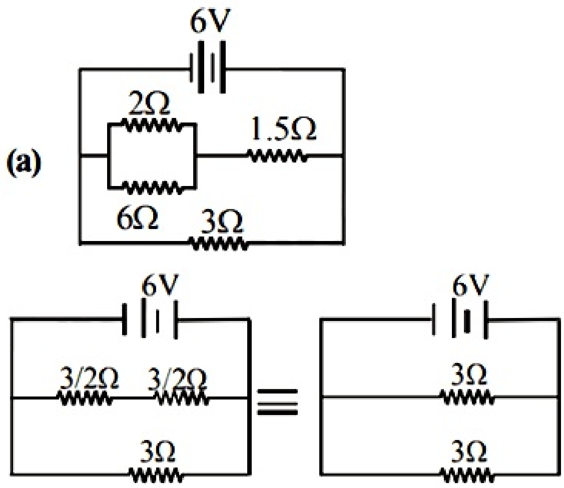
C. 1 A

D. 6 A

Answer: A

Solution:

Solution:



hence $R_{eq} = 3/2; \therefore I = \frac{6}{3/2} = 4A$

Question294

The resistance of the series combination of two resistances is S. when they are joined in parallel the total resistance is P. If S = nP then the minimum possible value of n is
[2004]

Options:

A. 2

B. 3

C. 4

D. 1

Answer: C

Solution:

Solution:
Let R_1 and R_2 be the two given resistances
Resistance of the series combination,
$S = R_1 + R_2$
Resistance of the parallel combination,
$P = \frac{R_1 R_2}{R_1 + R_2}$
As per question $S = nP$
$\Rightarrow R_1 + R_2 = \frac{n(R_1 R_2)}{(R_1 + R_2)}$
$\Rightarrow (R_1 + R_2)^2 = nR_1 R_2$
Minimum value of n is 4 for that
$(R_1 + R_2)^2 = 4R_1 R$
$\Rightarrow (R_1 - R_2)^2 = 0$

Question295

The thermo emf of a thermocouple varies with the temperature θ of the hot junction as $E = a\theta + b\theta^2$ in volts where the ratio a/b is 700°C. If the cold junction is kept at 0°C, then the neutral temperature is
[2004]

Options:

A. 1400°C

B. 350°C

C. 700°C

D. No neutral temperature is possible for this termocouple

Answer: D

Solution:

Solution:
Given $E = a\theta + b\theta^2$
$\Rightarrow \frac{dE}{d\theta} = a + 2b\theta$
At neutral temperature
$\theta = \theta_n : \frac{dE}{d\theta} = 0$
$\Rightarrow \theta_n = \frac{-a}{2b} = -350 \Rightarrow \frac{d^2E}{d\theta^2} = 2b$
hence no θ is possible for E to be maximum no neutral temperature is possible.

Question296

The electrochemical equivalent of a metal is 3.35×10^{-7}kg per Coulomb. The mass of the metal liberated at the cathode when a 3A current is passed for 2 seconds will be [2004]

Options:

A. 6.6×10^{57}kg

B. 9.9×10^{-7}kg

C. 19.8×10^{-7}kg

D. 1.1×10^{-7}kg

Answer: C

Solution:

Solution:
From the Faraday's first law of electrolysis,
$m = Z it$
$\Rightarrow m = 3.3 \times 10^{-7} \times 3 \times 2$
$= 19.8 \times 10^{-7}$kg

Question297

The thermistors are usually made of [2004]

Options:

A. metal oxides with high temperature coefficient of resistivity

B. metals with high temperature coefficient ofresistivity

C. metals with low temperature coefficient of resistivity

D. semiconducting materials having low temperature coefficient of resistivity

Answer: A

Solution:

Solution:
Thermistors are usually made of metaloxides with high temperature coefficient of resistivity.

Question298

Time taken by a 836 W heater to heat one litre of water from 10°C to 40°C is
[2004]

Options:

A. 150 s

B. 100 s

C. 50 s

D. 200 s

Answer: A

Solution:

Solution:
Heat supplied in time t for heating 1L water from 10°C to 40°C
$\Delta Q = mC_p \times \Delta T$
$= 1 \times 4180 \times (40 - 10) = 4180 \times 30$
But $\Delta Q = P \times t = 836 \times t$
$\Rightarrow t = \frac{4180 \times 30}{836} = 150s$

Question299

In a meter bridge experiment null point is obtained at 20 cm. from one end of the wire when resistance X is balanced against another resistance Y. If X < Y, then where will be the new position of the null point from the same end, if one decides to balance a resistance of 4 X against Y
[2004]

Options:

A. 40 cm

B. 80 cm

C. 50 cm

D. 70 cm

Answer: C

Solution:

Solution:
From the balanced wheat stone bridge
$\frac{R_1}{R_2} = \frac{l_1}{l_2}$
where $l_2 = 100 - l_1$
In the first case $\frac{X}{Y} = \frac{20}{80}$
$Y = 4X$
In the second case
$\frac{4X}{Y} = \frac{l}{100 - l}$
$\Rightarrow \frac{4X}{4X} = \frac{l}{100 - l}$
$\Rightarrow l = 50$

Question300

The length of a given cylindrical wire is increased by 100%. Due to the consequent decrease in diameter the change in the resistance of the wire will be [2003]

Options:

A. 200%

B. 100%

C. 50%

D. 300%

Answer: D

Solution:

Solution:
Since volume of wire remains unchanged on increasing length, hence $A \times l = \; = A' \times l'$
$\Rightarrow ell' = 2l$
$\therefore A' = A \times ll' = \frac{A \times l}{2l} = \frac{A}{2}$

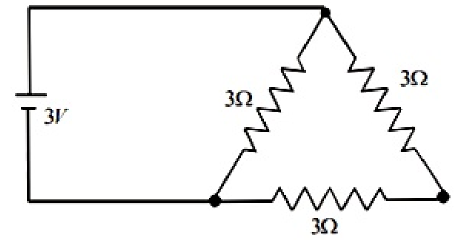
Percentage change in resistance $= \frac{R_f - R_i}{R_i} \times 100 = \frac{\rho \frac{l'}{A'} - \beta \frac{l}{A}}{\rho \frac{l}{A}} \times 100$

$= \left[\left(\frac{l'}{A'} \times \frac{A}{l} \right) - 1 \right] \times 100$
$= \left[\left(\frac{2l}{A/2} \times \frac{A}{l} \right) - 1 \right] \times 100 = (4 - 1) \times 100$
$= 300\%$

Question301

A 3 volt battery with negligible internal resistance is connected in a

circuit as shown in the figure. The current I, in the circuit will be



[2003]

Options:

A. 1 A

B. 1.5 A

C. 2 A

D. 1/3 A

Answer: B

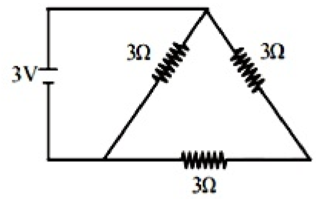
Solution:

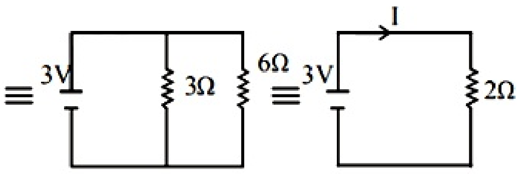
Solution:
In the given circuit, resistance of 3Ω is in parallel with series combination of two 3Ω resistance.

$R_p = \frac{3 \times 6}{3 + 6} = \frac{18}{9} = 2\Omega$

Using ohm's law $V = IR$

$\Rightarrow I = \frac{V}{R} = \frac{3}{2} = 1.5A$





Question302

The thermo e.m.f. of a thermo-couple is 25 μV/°C at room temperature. A galvanometer of 40 ohm resistance, capable of detecting current as low as 10^{-5} A, is connected with the thermo couple. The smallest temperature difference that can be detected by this system is
[2003]

Options:

A. 16°C

B. 12°C

C. 8°C

D. 20°C

Answer: A

Solution:

Solution:
Let the smallest temperature difference be θ°C that can be detected by the thermocouple, then
Thermo emf $= (25 \times 10^{-6})\theta$
Let I is the smallest current which can be detected by the galvanometer of resistance R.
Potential difference across galvanometer
$IR = 10^{-5} \times 40$
$\therefore 10^{-5} \times 40 = 25 \times 10^{-6} \times \theta$
$\Rightarrow \theta = 16°C$

Question303

The negative Zn pole of a Daniell cell, sending a constant current through a circuit, decreases in mass by 0.13g in 30 minutes. If the electeochemical equivalent of Zn and Cu are 32.5 and 31.5 respectively, the increase in the mass of the positive Cu pole in this time is [2003]

Options:

A. 0.180 g

B. 0.141g

C. 0.126 g

D. 0.242 g

Answer: C

Solution:

Solution:
According to Faraday's first law of electrolysis
$m = Z \times I \times t$
When I and t is same, $m \propto Z$
$\therefore \frac{m_{Cu}}{m_{Zn}} = \frac{Z_{Cu}}{Z_{Zn}} \Rightarrow m_{Cu} = \frac{Z_{Cu}}{Z_{Zn}} \times m_{Zn}$
$\Rightarrow m_{Cu} = \frac{31.5}{32.5} \times 0.13 = 0.126g$

Question304

A 220 volt, 1000 watt bulb is connected across a 110 volt mains supply. The power consumed will be [2003]

Options:

A. 750 watt

B. 500 watt

C. 250 watt

D. 1000 watt

Answer: C

Solution:

Solution:
We know that resistance,

$$R = \frac{V_{rated}{}^2}{P_{rated}} = \frac{(220)^2}{1000} = 48.4\Omega$$

When this bulb is connected to 110 volt mains supply we get

$$P = \frac{V^2}{R} = \frac{(110)^2}{48.4} = 250W$$

Question305

. The length of a wire of a potentiometer is 100 cm, and the e. m.f. of its standard cell is E volt. It is employed to measure the e.m.f. of a battery whose internal resistance is 0.5Ω. If the balance point is obtained at l = 30 cm from the positive end, the e.m.f. of the battery is where i is the current in the potentiometer wire [2003]

Options:

A. $\frac{30E}{100.5}$

B. $\frac{30E}{(100-0.5)}$

C. $\frac{30(E-0.5i)}{100}$

D. $\frac{30E}{100}$

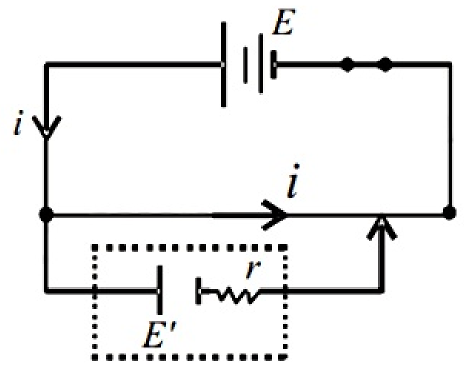
Answer: D

Solution:

Solution:
From the principle of potentiometer, $V \propto l$
If a cell of emF E is employed in the circuit between the ends of potentiometer wire of length L, then

$$\frac{V}{E} = \frac{l}{L}$$

$$\Rightarrow V = \frac{El}{L} = \frac{30E}{100}$$



Note : In this arrangement, the internal resistance of the battery E does not play any role as current is not passing through the battery.

Question306

An ammeter reads upto 1 ampere. Its internal resistance is 0.81ohm. To increase the range to 10 A the value of the required shunt is [2003]

Options:

A. 0.03Ω

B. 0.3Ω

C. 0.9Ω

D. 0.09Ω

Answer: D

Solution:

Solution:

$i_g \times G = (i - i_g)S$

$\therefore S = i_g \times G . i - i_g = \frac{1 \times 0.81}{10 - 1} = 0.09\Omega$

Question307

The mass of product liberated on anode in an electrochemical cell depends on (where t is the time period for which the current is passed). [2002]

Options:

A. $(I\,t)^{1/2}$

B. It

C. I/t

D. I^2t

Answer: B

Solution:

Solution:
From the Faraday's first law of electrolysis
$m = Z I t \Rightarrow m \propto I t$

Question308

A wire when connected to 220 V mains supply has power dissipation P_1. Now the wire is cut into two equal pieces which are connected in parallel to the same supply. Power dissipation in this case is P_2. Then $P_2 : P_1$ is
[2002]

Options:

A. 1

B. 4

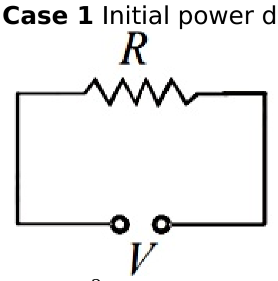
C. 2

D. 3

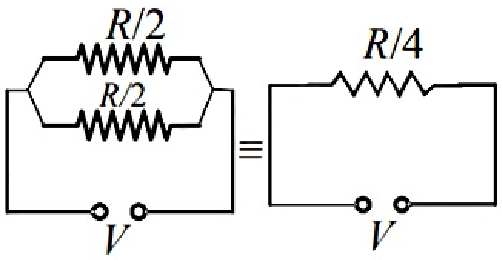
Answer: B

Solution:

Solution:
Case 1 Initial power dissipation,



$P_1 = \frac{V^2}{R}$
Case 2
When wire is cut into two equal pieces, the resistance of each piece is $\frac{R}{2}$. When they are connected in parallel
Equivalent resistance,
$R_{eq} = \frac{R/2}{2} = \frac{R}{4}$

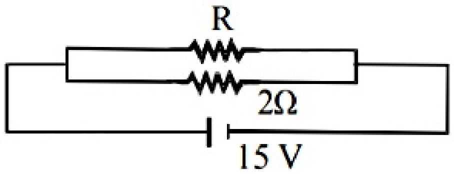


Power dissipated,

$$P_2 = \frac{V^2}{R/4} = 4\left(\frac{V^2}{R}\right) = 4P_1$$

Question309

If in the circuit, power dissipation is 150 W, then R is



[2002]

Options:

A. 2Ω

B. 6Ω

C. 5Ω

D. 4Ω

Answer: B

Solution:

Solution:
The equivalent resistance of parallel combination of 2Ω and R is
$R_{eq} = \frac{2 \times R}{2 + R}$
∴ Power dissipation $P = \frac{V^2}{R_{eq}}$ ∴ $150 = \frac{(15)^2}{R_{eq}}$
$\Rightarrow 150 = \frac{225 \times (R + 2)}{2R} \Rightarrow \frac{2R}{2 + R} = \frac{3}{2}$
$\Rightarrow 4R = 6 + 3R \Rightarrow R = 6\Omega$

Question310

If an ammeter is to be used in place of a voltmeter, then wemust connect with the ammeter a

[2002]

Options:

A. low resistance in parallel

B. high resistance in parallel

C. high resistance in series

D. low resistance in series.

Answer: C

Solution:

[illegible]mmeter in place of voltmeter, we must connect a high resistance in series with the ammeter. Connecting high resistance in series makes its resistance much higher.
