Current Electricity JEE Main PYQ - 3

Total Time: 25 Minute **Total Marks:** 40

Instructions

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1. Test will auto submit when the Time is up.
2. The Test comprises of multiple choice questions (MCQ) with one or more correct answers.
3. The clock in the top right corner will display the remaining time available for you to complete the examination.

Navigating & Answering a Question

1. The answer will be saved automatically upon clicking on an option amongst the given choices of answer.
2. To deselect your chosen answer, click on the clear response button.
3. The marking scheme will be displayed for each question on the top right corner of the test window.

Current Electricity

1. Drift speed of electrons, when $1.5\,A$ 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 is close to (Take charge of electron to be = $1.6 \times 10^{-19}C$) **(+4, -1)**

[9•Jan.•2019•I]

a. 0.2

b. 3

c. 2

d. 0.02

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2. 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 the electric mains is $220\,V$. The minimum capacity of the main fuse of the building will be : **(+4, -1)**

[2014]

a. 8 A

b. 10 A

c. 12 A

d. 14 A

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3. 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 $39.5\,cm$ 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 ? **(+4, -1)**

[Online April 9, 2017]

a. $8.16\,\Omega$ and $60.5\,cm$

b. $19.15\,\Omega$ and $39.5\,cm$

c. $8.16\,\Omega$ and $39.5\,cm$

d. $19.15\,\Omega$ and $60.5\,cm$

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4. In a meter bridge, the wire of length $1\,m$ 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 ? **(+4, -1)**

[2004]

a. 0.25 m

b. 0.3 m

c. 0.35 m

d. 0.2 m

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5. 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: **(+4, -1)** **[Online•April•15,•2018]**

a. 80 cm

b. 75 cm

c. 67 cm

d. 50 cm

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6. 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 5Ω , a balance is found when the cell is connected across $40\,cm$ of the wire. Find the internal resistance of the cell. **(+4, -1)**

[2018]

a. 1Ω

b. 1.5Ω

c. 2Ω

d. 2.5Ω

7. In the above circuit the current in each resistance is **[2017]** **(+4, -1)**

   a. 1 A

   b. 0.25 A

   c. 0.5 A

   d. 0 A

8. In the circuit shown, current (in A) through the 50 V and 30 V batteries are, respectively : **[Online April 11, 2014]** **(+4, -1)**

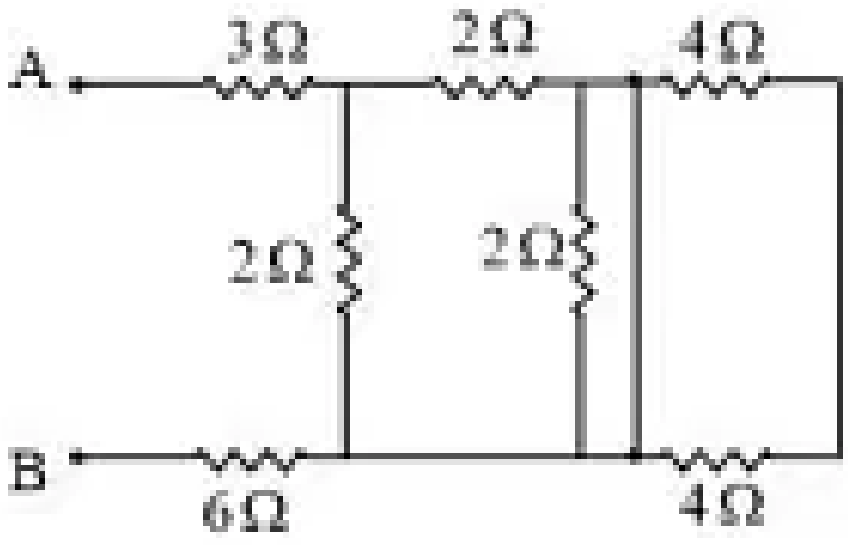
   a. 2.5 and 3

   b. 3.5 and 2

   c. 4.5 and 1

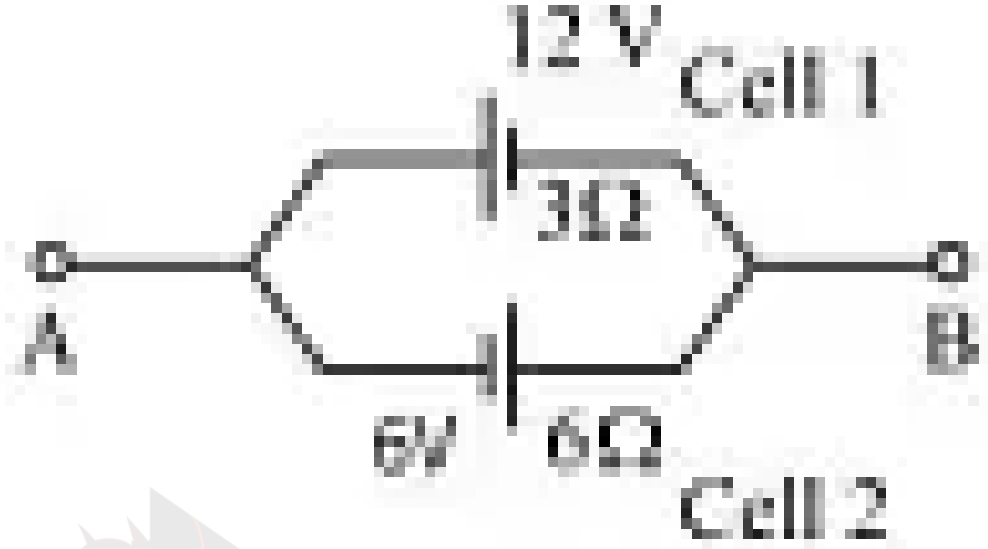
   d. 3 and 2.5

9. In the given circuit, the equivalent resistance between the terminal A and B is $\_\_^{\Omega}$ **[29-Jan-2024•Shift•2]** **(+4, -1)**



10. 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 **(+4, -1)**

[25-Jan-2023 Shift 2]



Answers

1. **Answer: d**

Explanation:

$$I = neAv_d$$
$$\Rightarrow v_d = \frac{I}{neA} = \frac{1.5}{9\times10^{28}\times1.6\times10^{-19}\times5\times10^{-6}}$$
$$= 0.02\, m/s$$

Concepts:

1. Current Electricity:

Current electricity is defined as the flow of electrons from one section of the circuit to another.

Types of Current Electricity

There are two types of current electricity as follows:

Direct Current

The current electricity whose direction remains the same is known as direct current. Direct current is defined by the constant flow of electrons from a region of high electron density to a region of low electron density. DC is used in many household appliances and applications that involve a battery.

Alternating Current

The current electricity that is bidirectional and keeps changing the direction of the charge flow is known as alternating current. The bi-directionality is caused by a sinusoidally varying current and voltage that reverses directions, creating a periodic back-and-forth motion for the current. The electrical outlets at our homes and industries are supplied with **alternating current**.

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2. **Answer: c**

Explanation:

$15 \times 40 + 5 \times 100 + 5 \times 80 + 1000 = V \times I$
$600 + 500 + 400 + 1000 = 220\, I$
$I = \frac{2500}{220} = 11.36$
$I = 12\, A$

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3. Answer: a

Explanation:

The balanced condition of Wheatstone bridge is

$X\left(100-l_1\right)=Y\times l_1$

Given $l_1=39.5cm;Y=12.5\square$. Therefore,

$X(100-39.5)=12.5(39.5)$

$\Rightarrow X(60.5)=12.5(39.5)$

$\Rightarrow X=\frac{12.5\times39.5}{60.5}=8.16\Omega$

Now, if X and Y are interchanged then balanced condition of Wheatstone bridge becomes

$Y\left(100-l_2\right)=Xl_2$

In this condition, $Y=12.5\square;X=8.16$. Therefore,

$12.5\left(100-l_1\right)=8.16l_2$

$\Rightarrow 1250-12.5l_2=8.16l_2$

$\Rightarrow 1250=20.66l_2$

$\Rightarrow l_2=\frac{1250}{20.66}=60.6\,cm$

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4. Answer: a

Explanation:

For the given wire : $dR = C\frac{d\ell}{\sqrt{\ell}}$, where $C = constant.$
Let resistance of part AP is R_1 and PB is R_2
$\therefore \frac{R'}{R'} = \frac{R_1}{R_2}$ or $R_1 = R_2$ By balanced
WSB concept.
Now $\int dR = c\int \frac{d\ell}{\sqrt{\ell}}$
$\therefore R_1 = C\int_0^{\ell} \ell^{-1/2} d\ell = C.2.\sqrt{\ell}$
$R_2 = C\int_{\ell}^{1} \ell^{-1/2} d\ell = C.\left(2 - 2\sqrt{\ell}\right)$
Putting $R_1 = R_2$
$C_2\sqrt{\ell} = C\left(2 - 2\sqrt{\ell}\right)$
$\therefore 2\sqrt{\ell} = 1$
$\sqrt{\ell} = \frac{1}{2}$
i.e. $\ell = \frac{1}{4}m \Rightarrow 0.25\,m$

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5. **Answer: c**

Explanation:

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 $Z = 67$ cm
Therefore new position of null point
$?67\,cm$

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6. **Answer: b**

Explanation:

$\because E \propto I_1$
and $E - ir \propto I_2$
$\therefore \frac{E}{E-ir} = \frac{I_1}{I_2}$
$\Rightarrow \frac{E}{E-\left(\frac{E}{r+5}\right)\times r} = \frac{52}{40}$
$\Rightarrow \frac{r+5}{5} = \frac{13}{10}$
$\Rightarrow r = 1.5\,\Omega$

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7. **Answer: d**

Explanation:

The potential difference in each loop is zero.
∴ No current will flow.

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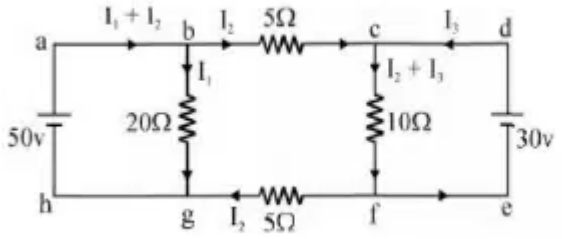
8. **Answer: c**

Explanation:



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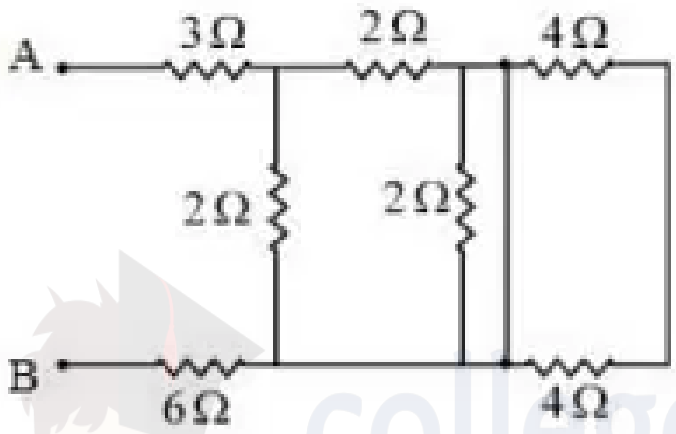
9. **Answer: 10 - 10**

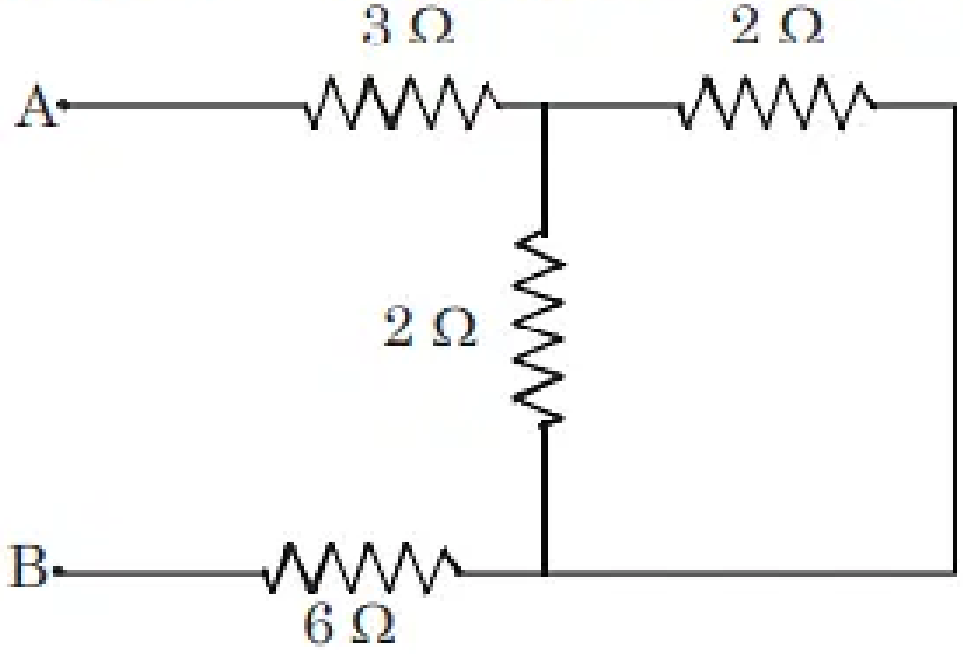
Explanation:

The correct answer is 10.



Both 4Ω resistance gets short.

Remove the resistors that have no current.



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

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

$R_{eq} = 10\Omega$

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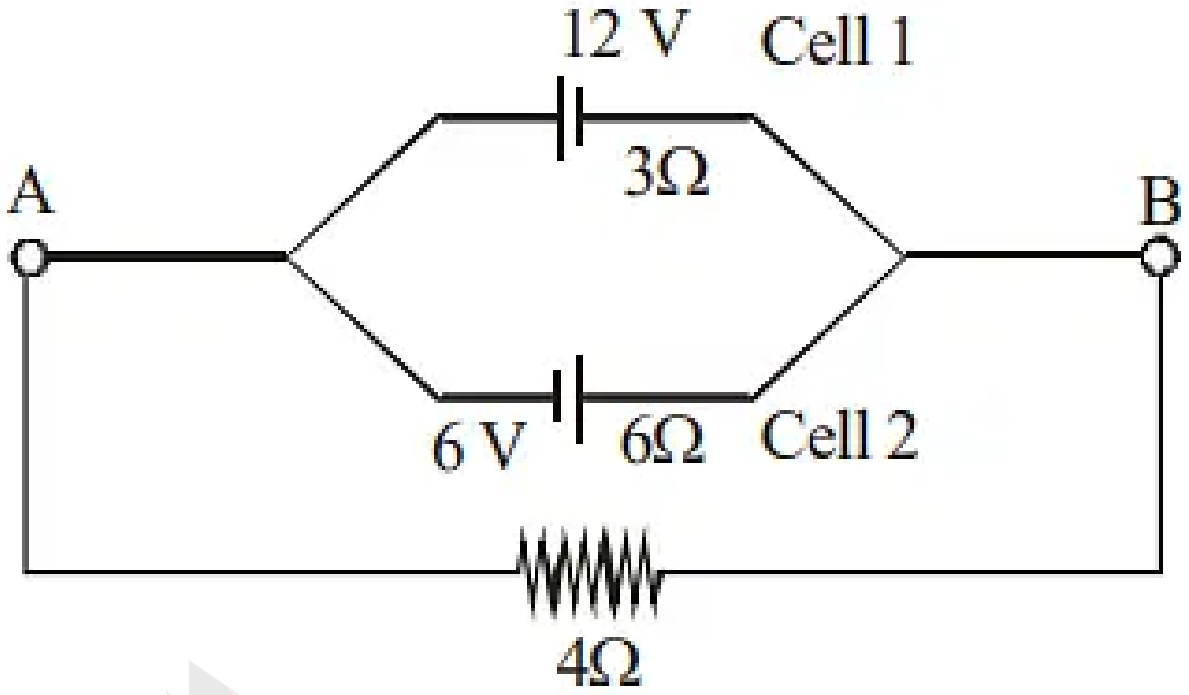
10. **Answer: 1 - 1**

Explanation:

The correct answer is 1.

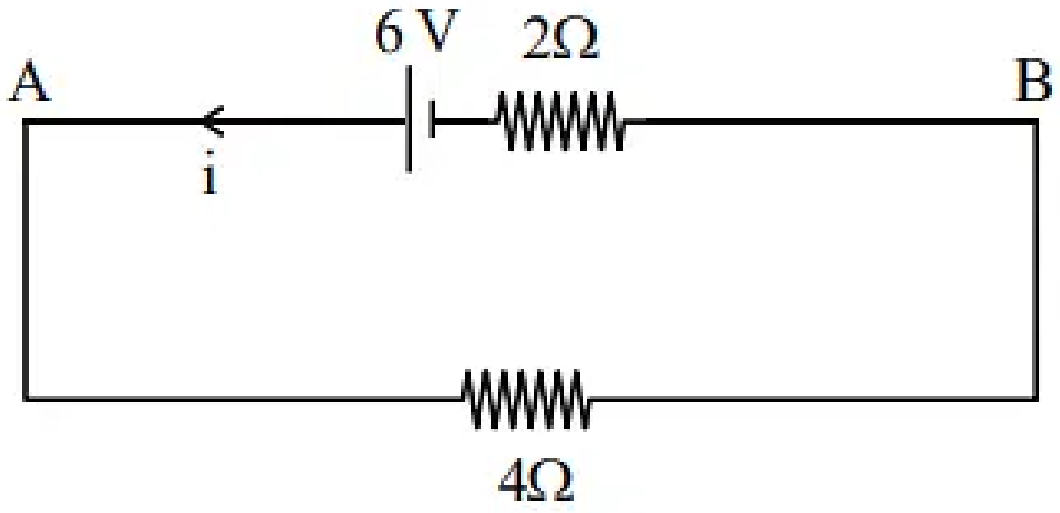


$E_{eq} = \frac{\frac{12}{3} - \frac{6}{6}}{\frac{1}{3} + \frac{1}{6}}$

$E_{eq} = 6V$

$r_{eq} = 2\Omega$

$R = 4\Omega$



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

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