Current Electricity Test 1

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. An electrical power line, having a total resistance of 2Ω, delivers $1\,kW$ at $220\,V$. The efficiency of the transmission line is approximately: **(+4, -1)**

[Sep. 05, 2020 (I)]

a. 72%

Click for Solution

b. 96%

c. 91%

d. 85%

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2. 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 : **(+4, -1)**

[Sep 03, 2020 (II)]

a. $R = \frac{2\rho}{\pi l}\ln\left(\frac{b}{a}\right)$

Click for Solution

b. $R = \frac{\rho}{\pi l}\ln\left(\frac{b}{a}\right)$

c. $R = \frac{\rho}{2\pi l}\left(\frac{b}{a}\right)$

d. $R = \frac{\rho}{2\pi l}\ln\left(\frac{b}{a}\right)$

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3. 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: **(+4, -1)**

[Jan 07, 2020 (II)]

a. $25\,A$

Click for Solution

b. $15\,A$

c. $10\,A$

d. $20\,A$

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4. 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 $r = 0.01\ \Omega/cm$. 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 : **(+4, -1)**

[Apr 08, 2019 (II)]

a. 0.20 V

Click for Solution

b. 0.25 V

c. 0.75 V

d. 0.50V

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5. 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 **(+4, -1)**

[Apr 08, 2019 (II)]

a. R = 1000 r

Click for Solution

b. R = 0.001 r

c. R = 2r

d. R = r

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6. 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 : **(+4, -1)**

[Jan 10, 2019 (I)]

a. 63 mA

Click for Solution

b. 0.4 mA

c. 100 mA

d. 20 mA

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7. When $5\,V$ potential difference is applied across a wire of length $0.1\,m$, 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 **(+4, -1)**

2015

a. $1.6 \times 10^{-8}\Omega\,m$

b. $1.6 \times 10^{-7}\Omega\,m$

Click for Solution

c. $1.6 \times 10^{-5}\Omega\,m$

d. $1.6 \times 10^{-6}\Omega\,m$

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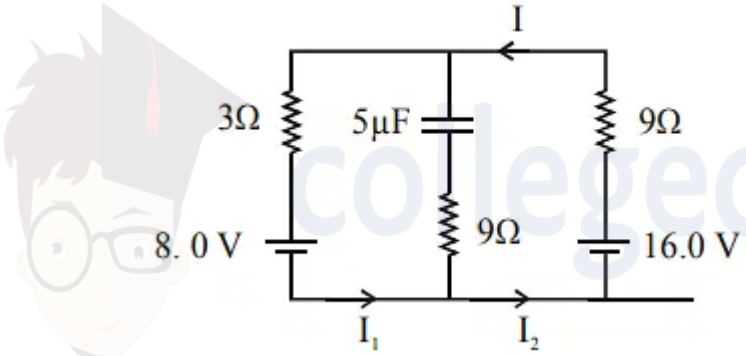
8. The circuit shown here has two batteries of $8.0\,V$ and $16.0\,V$ and three resistors $3\Omega, 9\Omega$ and 9Ω and a capacitor $5.0\mu F$. **(+4, -1)**

[Apr 12, 2014]



How much is the current I in the circuit in steady state ?

a. 1.6 A

Click for Solution

b. 0.67 A

c. 2.5 A

d. 0.25 A

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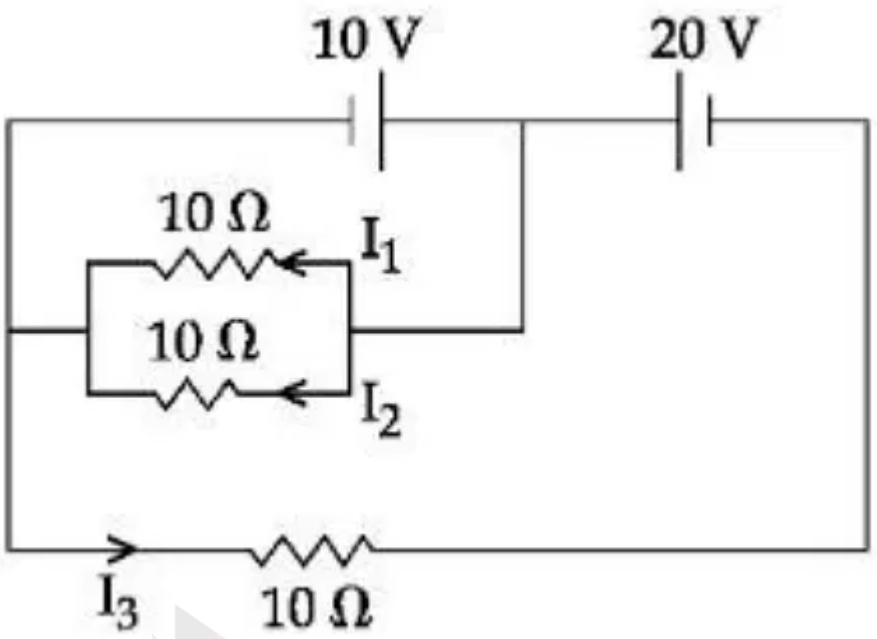
9. In an experiment to find emf of a cell using potentiometer, the length of null point for a cell of emf $15\,V$ is found to be $60\,cm$ If this cell is replaced by another cell of emf E, the length-of null point increases by $40\,cm$ The value of E is $\frac{x}{10}V$ The value of x is _____ **(+4, -1)**

Click for Solution **[Jan 07, 2020 (II)]**

10. In the given circuit, the value of $\left|\frac{I_1+I_3}{I_2}\right|$ is ___ **[Feb 01, 2023 (I)]** **(+4, -1)**

Click for Solution



Answers

1. **Answer: b**

Explanation:

$vi = 10^3$
$i = \frac{1000}{220}$
loss $= i^2R = \left(\frac{50}{11}\right)^2 \times 2$
efficiency $= \frac{1000}{1000+i^2R} \times 100 = 96\%$

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.

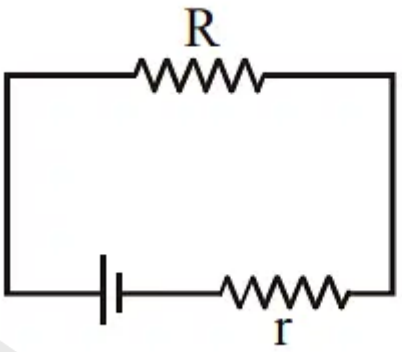
Alternating Current

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**.

2. **Answer: d**

Explanation:

Maximum power in external resistance is generated when it is equal to internal resistance of battery.



$$P_R = \left(\frac{\in}{r+R}\right)^2 R$$

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3. **Answer: d**

Explanation:

$220\, I = P = 15?45 + 15?100 + 15?10 + 2?10^3$
$I = \frac{4325}{220} = 19.66$
$I \simeq 20\, A$

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4. **Answer: b**

Explanation:

Resistance of wire $AB = 400 \times 0.01 = 4\Omega$
$i = \frac{3}{6} = 0.5A$
Now voltmeter reading = i (Resistance of 50 cm length)
$= (0.5A)(0.01 \times 50) = 0.25$ volt

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5. **Answer: d**

Explanation:

Current $i = \frac{E}{r+R}$
Power generated in R
$P = i^2R$
$P = \frac{E^2R}{(r+R)^2}$
for maximum power $\frac{dP}{dR} = 0$
$E^2\left[\frac{(r+R)^2 \times 1 - R \times 2(r+R)}{(r+R)^4}\right] = 0$
$\Rightarrow r = R$

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6. Answer: d

Explanation:

$P = i^2R.$
$\therefore$ for i_{max}, R must be minimum from color coding $R = 50 \times 10^2\Omega$
$\therefore\ i_{max} = 20\,mA$

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7. Answer: c

Explanation:

The correct answer is C:$1.6 \times 10^{-5}\Omega m$
i =neAV$_d$

$\Rightarrow \frac{V}{R} = \text{neAV}_{d} \quad \left\{R = \frac{\rho l}{A}\right\}$
$\Rightarrow \frac{V \times A}{\rho \ell} = neAV_d$
$\Rightarrow \frac{5}{\rho \times 0.1} = 8 \times 10^{28} \times 1.6 \times 10^{-19} \times 2.5 \times 10^{-4}$
$\Rightarrow \rho = 1.56 \times 10^{-5}\,\Omega\,m$
$\Rightarrow \rho \simeq 1.6 \times 10^{-5}\,\Omega\,m$

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8. **Answer: b**

Explanation:

In steady state capacitor is fully charged hence no current will flow through line 2. By simplyfing the circuit

Hence resultant potential difference across resistances will be $8.0\,V$.
Thus current $I = \frac{V}{R} = \frac{8.0}{3+9} = \frac{8}{12}$
or, $I = \frac{2}{3} = 0.67\,A$

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9. Answer: 25 - 25

Explanation:

The correct answer is 25.

$\frac{E_1}{E_2} = \frac{l_1}{l_2}$
$\frac{1.5}{E_2} = \frac{60}{60+40} = \frac{6}{10} = \frac{3}{5}$

$E_2 = \frac{5}{2} = \frac{x}{10}$
$x = 25$

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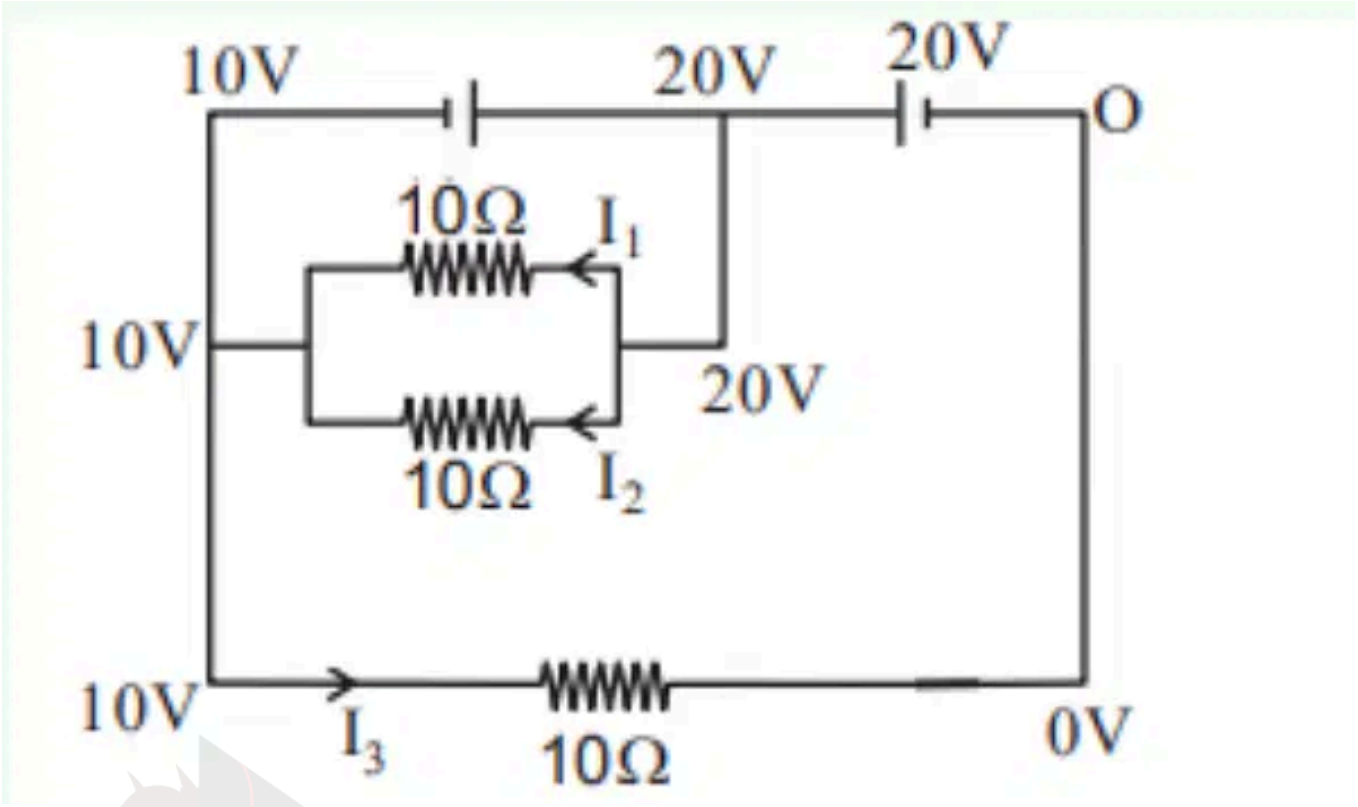
10. **Answer: 2 - 2**

Explanation:

The correct answer is 2.



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

$I_3 = 1A$

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

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