This print-out should have 14 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

Circuits 03
001 10.0 points

When electrons move back and forth, reversing their direction regularly, the current is called

1. induced current.

2. a short circuit.

3. alternating current. **correct**

4. direct current.

Explanation:

Meters 02
002 10.0 points

An instrument used to detect the current in a circuit is called

1. an ammeter. **correct**

2. an ohmmeter.

3. a generator.

4. a motor.

5. an electroscope.

6. a transformer.

7. a voltmeter.

Explanation:

Holt SF 19A 01
003 10.0 points

If the current in a wire of a CD player is 4.30 mA, how long would it take for 13.0 C of charge to pass a point in this wire?

Correct answer: 3023.26 s.

Explanation:

$$\text{Let}: \quad I = 4.30 \times 10^{-3}\ \text{A} \quad \text{and} \quad \Delta Q = 13.0\ \text{C}\,.$$

$$I = \frac{\Delta Q}{\Delta t}$$
$$\Delta t = \frac{\Delta Q}{I} = \frac{13\ \text{C}}{0.0043\ \text{A}} = \boxed{3023.26\ \text{s}}\,.$$

Hewitt CP9 23 03
004 10.0 points

What is drift velocity?

1. The speed of an electric field

2. The highest speed of an electron in a metal

3. The lowest speed of an electron in a metal

4. The average speed of atoms in a liquid

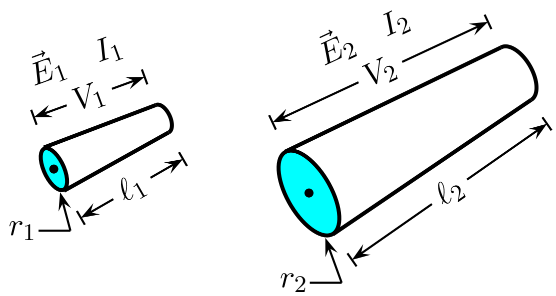
5. The average speed of electrons in a conductor in an electric field **correct**

Explanation:

When an electric field is applied to a conductor, the electrons continue their random motions while simultaneously being nudged by this field. The collisions interrupt the motion of the electrons along the field lines. The average speed at which they migrate along a wire is known as drift velocity.

Comparisons in Conductors 01
005 (part 1 of 2) 10.0 points

Consider two conductors 1 and 2 made of the same ohmic material; *i.e.*, $\rho_1 = \rho_2$. Denote the length by ℓ, the cross sectional area by A. The same voltage V is applied across the ends of both conductors and the field E is inside of the conductor.



If $A_2 = 2\,A_1\,, \ell_2 = 2\,\ell_1$ and $V_2 = V_1\,,$ find the ratio $\dfrac{E_2}{E_1}$ of the electric fields.

1. $\dfrac{E_2}{E_1} = \dfrac{1}{8}$

2. $\dfrac{E_2}{E_1} = \dfrac{1}{3}$

3. $\dfrac{E_2}{E_1} = \dfrac{1}{2}$ **correct**

4. $\dfrac{E_2}{E_1} = \dfrac{1}{12}$

5. $\dfrac{E_2}{E_1} = 2$

6. $\dfrac{E_2}{E_1} = 1$

7. $\dfrac{E_2}{E_1} = \dfrac{1}{4}$

8. $\dfrac{E_2}{E_1} = 4$

9. $\dfrac{E_2}{E_1} = \dfrac{1}{16}$

10. $\dfrac{E_2}{E_1} = 8$

Explanation:

$E = \dfrac{V}{\ell} \propto \dfrac{1}{\ell}$ when $V_1 = V_2\,,$ so

$$\frac{E_2}{E_1} = \frac{\ell_1}{\ell_2} = \frac{\ell_1}{2\,\ell_1} = \frac{1}{2}\,.$$

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006 (part 2 of 2) 10.0 points

Find the ratio $\dfrac{I_2}{I_1}$ of the currents.

1. $\dfrac{I_2}{I_1} = 4$

2. $\dfrac{I_2}{I_1} = \dfrac{1}{16}$

3. $\dfrac{I_2}{I_1} = 8$

4. $\dfrac{I_2}{I_1} = 2$

5. $\dfrac{I_2}{I_1} = \dfrac{1}{2}$

6. $\dfrac{I_2}{I_1} = \dfrac{1}{12}$

7. $\dfrac{I_2}{I_1} = \dfrac{1}{3}$

8. $\dfrac{I_2}{I_1} = \dfrac{1}{8}$

9. $\dfrac{I_2}{I_1} = 1$ **correct**

10. $\dfrac{I_2}{I_1} = \dfrac{1}{4}$

Explanation:

$I = \dfrac{V}{R} \propto \dfrac{1}{R}$ and $R = \rho\,\dfrac{\ell}{A} \propto \dfrac{\ell}{A}$ when $V_1 = V_2$ and $\rho_1 = \rho_2\,,$ so

$$\frac{I_2}{I_1} = \frac{R_1}{R_2} = \frac{\ell_1\,A_2}{\ell_2\,A_1} = \frac{\ell_1\,(2\,A_1)}{(2\,\ell_1)\,A_1} = 1\,.$$

Tipler PSE5 25 43
007 10.0 points

A carbon rod with a radius of 0.6 mm is used to make a resistor.

What length of the carbon rod should be used to make a 4.6 Ω resistor? The resistivity of this material is $2.1 \times 10^{-5}\ \Omega \cdot \mathrm{m}\,.$

Correct answer: 247.737 mm.

Explanation:

$$\begin{aligned}\text{Let :}\quad & r = 0.6\ \mathrm{mm} = 0.0006\ \mathrm{m}\,,\\ & \rho = 2.1 \times 10^{-5}\ \Omega \cdot \mathrm{m}\,, \quad \text{and}\\ & R = 4.6\ \Omega\,.\end{aligned}$$

The cross-sectional area of the rod is

$$\begin{aligned}A &= \pi\,r^2 = \pi(0.0006\ \mathrm{m})^2\\ &= 1.13097 \times 10^{-6}\ \mathrm{m}^2 \quad \text{and}\end{aligned}$$

$$\begin{aligned} R &= \frac{\rho\,\ell}{A} \\ \ell &= \frac{A\,R}{\rho} \\ &= \frac{(1.13097\times 10^{-6}\text{ m}^2)(4.6\ \Omega)}{2.1\times 10^{-5}\ \Omega\cdot\text{m}} \cdot \frac{10^3\text{ mm}}{1\text{ m}} \\ &= \boxed{247.737\text{ mm}}\,. \end{aligned}$$

Serway CP 17 16
008 10.0 points

A length of copper wire has a resistance 45 Ω. The wire is cut into three pieces of equal length, which are then connected as parallel lengths between points A and B.

What resistance will this new "wire" of length $\frac{L_0}{3}$ have between points A and B?

Correct answer: 5 Ω.

Explanation:

$$\text{Let :}\quad R_0 = 45\ \Omega\,.$$

The new wire has length $L = \frac{L_0}{3}$ and cross-sectional area $A = 3\,A_0$, so its resistance is

$$\begin{aligned} R &= \frac{\rho\,L}{A} = \frac{\rho\left(\frac{L_0}{3}\right)}{3\,A_0} = \frac{1}{9}\left(\frac{\rho\,L_0}{A_0}\right) \\ &= \frac{R_0}{9} = \frac{45\ \Omega}{9} = \boxed{5\ \Omega}\,. \end{aligned}$$

Current in a TV
009 10.0 points

A typical color television draws about 2.7 A when connected to an 82 V source.

What is the effective resistance of the T.V. set?

Correct answer: 30.3704 Ω.

Explanation:

$$\begin{aligned} \text{Let :}\quad I &= 2.7\text{ A} \quad\text{and} \\ V &= 82\text{ V}\,. \end{aligned}$$

The resistance is

$$R = \frac{V}{I} = \frac{82\text{ V}}{2.7\text{ A}} = \boxed{30.3704\ \Omega}\,.$$

Current in Tungsten Wire
010 10.0 points

A 1.04 V potential difference is maintained across a 1.3 m length of tungsten wire that has a cross-sectional area of 0.56 mm^2 .

What is the current in the wire? The resistivity of the tungsten is $5.6\times 10^{-8}\ \Omega\cdot\text{m}$.

Correct answer: 8 A.

Explanation:

$$\begin{aligned} \text{Let :}\quad V &= 1.04\text{ V}\,, \\ A &= 0.56\text{ mm}^2 = 5.6\times 10^{-7}\text{ m}^2\,, \\ \ell &= 1.3\text{ m}\,,\quad\text{and} \\ \rho &= 5.6\times 10^{-8}\ \Omega\cdot\text{m}\,. \end{aligned}$$

The resistance is

$$\begin{aligned} R &= \frac{V}{I} = \frac{\rho\,\ell}{A} \\ I &= \frac{V\,A}{\rho\,\ell} = \frac{(1.04\text{ V})(5.6\times 10^{-7}\text{ m}^2)}{(5.6\times 10^{-8}\ \Omega\cdot\text{m})(1.3\text{ m})} \\ &= \boxed{8\text{ A}}\,. \end{aligned}$$

Ohms Law 01
011 10.0 points

According to Ohm's Law, if the resistance in a circuit is 62 Ω and the voltage is 8.8 V, what will be the current flow in the circuit?

1. 70.8 A

2. 545.6 A

3. 0.141935 A **correct**

4. 53.2 A

5. 7.04545 A

Explanation:

$$\text{Let}: \quad R = 62\ \Omega \quad \text{and}$$
$$V = 8.8\ \text{V}\,.$$

From Ohm's Law, $\Delta V = I\,R$, so

$$I = \frac{V}{R} = \frac{8.8\ \text{V}}{62\ \Omega} = \boxed{0.141935\ \text{A}}\,.$$

Electric Shock

012 (part 1 of 3) 10.0 points

The damage caused by electric shock depends on the current flowing through the body; 1 mA can be felt and 5 mA is painful. Above 15 mA, a person loses muscle control, and 70 mA can be fatal. A person with dry skin has a resistance from one arm to the other of about 60000 Ω. When skin is wet, the resistance drops to about 5600 Ω.

What is the minimum voltage placed across the arms that would produce a current that could be felt by a person with dry skin?

Correct answer: 60 V.

Explanation:

$$\text{Let}: \quad I_{min} = 1\ \text{mA} \quad \text{and}$$
$$R_{dry} = 60000\ \Omega\,.$$

The minimum voltage depends on the minimum current for a given resistance, so

$$\begin{aligned} V_{min} &= I_{min}\,R_{dry} \\ &= (1\ \text{mA})\left(\frac{1\ \text{A}}{1000\ \text{mA}}\right)(60000\ \Omega) \\ &= \boxed{60\ \text{V}}\,. \end{aligned}$$

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013 (part 2 of 3) 10.0 points

For the same electric potential what would be the current if the person had wet skin?

Correct answer: 10.7143 mA.

Explanation:

$$\text{Let}: \quad R_{wet} = 5600\ \Omega\,.$$

$$\begin{aligned} I &= \frac{V_{min}}{R_{wet}} = \frac{60\ \text{V}}{5600\ \Omega}\left(\frac{1000\ \text{mA}}{1\ \text{A}}\right) \\ &= \boxed{10.7143\ \text{mA}}\,. \end{aligned}$$

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014 (part 3 of 3) 10.0 points

What would be the minimum voltage that would produce a current that could be felt when the skin is wet?

Correct answer: 5.6 V.

Explanation:

$$\begin{aligned} V_1 &= I_{min}\,R_{wet} \\ &= (1\ \text{mA})\left(\frac{1\ \text{A}}{1000\ \text{mA}}\right)(5600\ \Omega) \\ &= \boxed{5.6\ \text{V}}\,. \end{aligned}$$