This print-out should have 10 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

**Current in Tungsten Wire**

A 1.2 V potential difference is maintained across a 0.7 m length of tungsten wire that has a cross-sectional area of 0.94 mm$^2$ and the resistivity of the tungsten is $5.6 \times 10^{-8} \, \Omega \cdot m$.

What is the current in the wire?

Correct answer: 28.7755 A.

**Drift Speed in Copper Wire**

Calculate the average drift speed of electrons traveling through a copper wire with a cross-sectional area of 90 mm$^2$ when carrying a current of 80 A (values similar to those for the electric wire to your study lamp). Assume one electron per atom of copper contributes to the current. The atomic mass of copper is 63.5 g/mol and its density is 8.93 g/cm$^3$. Avogadro’s number $N_A$ is $6.02 \times 10^{23}$.

Correct answer: $6.56226 \times 10^{-5}$ m/s.

**Electric Shock**

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 50000 $\Omega$. When skin is wet, the resistance drops to about 4800 $\Omega$.

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: 50 V.

Using the same electric potential as in Part 1, what would be the current if the person had wet skin?

Correct answer: 10.4167 mA.

**Decreasing Current**

Suppose that the current through a conductor decreases exponentially with time according to $I(t) = I_0 e^{-t/\tau}$ where $I_0$ is the initial current at $t = 0$, and $\tau$ is a constant having dimensions of time. Consider a fixed observation point within the conductor.

How much charge passes this point between $t = 0$ and $t = \infty$?

1. $0.632 I_0^2 \tau$
2. $Q = \frac{1.72 I_0}{\tau}$
3. $Q = \frac{I_0}{\tau}$
4. $Q = I_0^2$
5. $Q = 1.72 I_0$
6. $Q = \frac{0.632 I_0}{\tau}$
7. $0.632 I_0$ correct
8. $Q = 0.632 I_0 \tau$
9. $Q = \frac{2.72 I_0}{\tau}$
10. $Q = 2.72 I_0$

**006** (part 1 of 2) 10.0 points

How much charge passes this point between $t = 0$ and $t = \tau$?

1. $0.632 I_0^2 \tau$
2. $Q = \frac{1.72 I_0}{\tau}$
3. $Q = \frac{I_0}{\tau}$
4. $Q = I_0^2$
5. $Q = 1.72 I_0$
6. $Q = \frac{0.632 I_0}{\tau}$
7. $0.632 I_0$ correct
8. $Q = 0.632 I_0 \tau$
9. $Q = \frac{2.72 I_0}{\tau}$
10. $Q = 2.72 I_0$
2. \( Q = 0.632 I_0 \)

3. an infinite amount

4. \( Q = \frac{I_0}{\tau} \)

5. \( Q = 2.72 I_0 \tau \)

6. \( Q = I_0 \tau \) correct

7. \( Q = I_0^2 \)

8. \( Q = 0.632 I_0^2 \tau \)

9. \( Q = \frac{2.72 I_0}{\tau} \)

10. \( Q = 0.632 I_0 \tau \)

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Reforming a Wire
008 10.0 points
A 17.8 \( \Omega \) metal wire is cut into three equal pieces that are then connected side by side to form a new wire the length of which is equal to one-third the original length.
What is the resistance of this new wire?

Correct answer: 1.97778 \( \Omega \).

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Electric Heater
009 (part 1 of 2) 10.0 points
An electric heater operating at full power draws a current of 11 A from a 144 V circuit.
What is the resistance of the heater?

Correct answer: 13.0909 \( \Omega \).

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010 (part 2 of 2) 10.0 points
Assuming constant \( R \), how much current should the heater draw in order to dissipate 920 W?

Correct answer: 8.38318 A.