Name: Key

Practice – 20.1 Current

1. Car batteries are rated in ampere-hours ($A \cdot h$). To what physical quantity do ampere-hours correspond (voltage, charge, . . .)?

$1\,A \cdot h = 1\frac{C}{s} \cdot h = 1\frac{C}{s}(3600s) = 3600C$ **Charge**

2. If two different wires having identical cross-sectional areas carry the same current, will the drift velocity be higher or lower in the better conductor?

**Better conductor** – fewer collisions – easier for the $e^-$ to move $\Rightarrow$ higher $v_d$

3. Why are two conducting paths from a voltage source to an electrical device needed to operate the device?

**A continuous path is needed** Current cannot flow if there is a break in the line

4. Why isn't a bird sitting on a high-voltage power line electrocuted? Contrast this with the situation in which a large bird hits two wires simultaneously with its wings.

**Both feet are at the same potential** There is no driving force to move current through the bird.

5. What is the current in milliamperes produced by the solar cells of a pocket calculator through which 4.00 C of charge passes in 4.00 h?

$$I = \frac{\Delta Q}{\Delta t} = \frac{4.00C}{4.00h\left(\frac{3600s}{1h}\right)} = 2.78 \times 10^{-4} A = \boxed{0.278\,mA}$$

6. What is the current when a typical static charge of 0.250 μC moves from your finger to a metal doorknob in 1.00 μs?

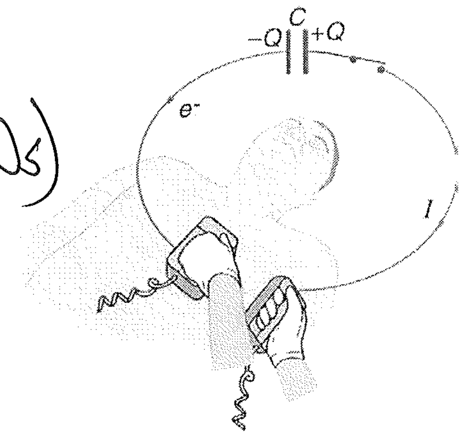
$$I = \frac{\Delta Q}{\Delta t} = \frac{0.250 \times 10^{-6} C}{1.00 \times 10^{-6} s} = \boxed{0.250\,A}$$

7. A large lightning bolt had a 20,000-A current and moved 30.0 C of charge. What was its duration?

$$I = \frac{\Delta Q}{\Delta t} \Rightarrow \Delta t = \frac{\Delta Q}{I} = \frac{30.0C}{20,000A} = \boxed{1.50 \times 10^{-3} s}$$

$= 1.50\,ms$

8. A defibrillator passes 12.0 A of current through the torso of a person for 0.0100 s. How much charge moves?




$$I = \frac{\Delta Q}{\Delta t} \Rightarrow \Delta Q = I \Delta t = (12.0\,A)(0.0100\,s) = \boxed{0.120\,C}$$

9. A clock battery wears out after moving 10,000 C of charge through the clock at a rate of 0.500 mA.

A. How long did the clock run?

$$I = \frac{\Delta Q}{\Delta t} \Rightarrow \Delta t = \frac{\Delta Q}{I} = \frac{10{,}000\,C}{0.500 \times 10^{-3}\,A} = \boxed{2.00 \times 10^{7}\,s} = 0.634\,y$$

B. How many electrons per second flowed?

$$\#e^- \text{ per sec} = \left(0.500 \times 10^{-3}\,\frac{C}{s}\right)\left(\frac{1e^-}{1.60 \times 10^{-19}\,C}\right) = \boxed{3.13 \times 10^{15}\,\frac{e^-}{s}}$$

10. A large cyclotron directs a beam of He++ nuclei onto a target with a beam current of 0.250 mA.

A. How many He++ nuclei per second is this?

$$\#He^{++} \text{ per sec} = \left(0.250 \times 10^{-3}\,\frac{C}{s}\right)\left(\frac{1\,He^{++}}{2(1.60 \times 10^{-19}\,C)}\right) = \boxed{7.81 \times 10^{14}\,\frac{He^{++}}{s}}$$

B. How long does it take for 1.00 C to strike the target?

$$I = \frac{\Delta Q}{\Delta t} \Rightarrow \Delta t = \frac{\Delta Q}{I} = \frac{1.00\,C}{0.250 \times 10^{-3}\,\frac{C}{s}} = \boxed{4.00 \times 10^{3}\,s}$$