Electric Circuits:
Problem Set 1 - Ohm's Law (V=IR)

Key

Name:
Date:

1. Over the course of an 8 hour day, 3.8×10^4 C of charge pass through a typical computer (presuming it is in use the entire time). Determine the current for such a computer.

$t = 8\text{hrs} = 480 = 28{,}800\text{s}$

$q = 3.8 \times 10^{14}\text{ C}$

$I = \frac{q}{t} = 1.3\text{ A}$

2. The large window air conditioner in Anita Breeze's room draws 11 amps of current. The unit runs for 8.0 hours during the course of a day. Determine the quantity of charge that passes through Anita's window AC during these 8.0 hours.

$I = 11\text{A}$

$t = 8\text{hrs} = 28{,}800\text{s}$

$q = ? = I \cdot t = 3.2 \times 10^5\text{C}$

3. Determine the amount of time that the following devices would have to be used before 1.0×10^6 C (1 million Coulombs) of charge passes through them.
a. LED night light (I=0.0042 A)
b. Incandescent night light (I=0.068 A)
c. 60-Watt incandescent light bulb (I=0.50 A)
d. Large bathroom light fixture (I=2.0 A)

a) $I = .0042\text{A}$ b) $I = .068\text{A}$ c) $I = 0.50\text{A}$ d) $I = 2.0\text{A}$

$I = q/t$

$t = q/I$

$= 2.4 \times 10^8\text{s}$ $= 1.5 \times 10^7\text{s}$ $= 2.0 \times 10^6\text{s}$ $= 5 \times 10^5\text{s}$

$= 7.5\text{yrs}$ $= 170\text{ days}$ $= 23\text{ days}$ $= 5.8\text{ days}$

4. A power saw at the local hardware store boasts of having a 15-Amp motor. Determine its resistance when plugged into a 110-Volt outlet.

$V = 110\text{V}$ $R = V/I = 7.3\,\Omega$

$I = 15\text{A}$

$R = ?$

$V = IR$

5. A coffee cup immersion heater utilizes a heating coil with a resistance of 8.5 Ω. Determine the current through the coil when operated at 110 V.

$V = 110V$
$R = 8.5\Omega$
$I = ?$
$V = IR$
$I = V/R = 12.9A$

6. Defibrillator machines are used to deliver an electric shock to the human heart in order to resuscitate an otherwise non-beating heart. It is estimated that a current as low as 17 mA (m = millli = $x10^{-3}$) through the heart is required to resuscitate. Using 100,000 Ω as the overall resistance, determine the output voltage required of a defibrillator device.

$I = 17 \times 10^{-3} A$
$R = 1.0 \times 10^{5} \Omega$
$V = ? = 1700\ V$
$V = IR$

7. A stun gun is designed to put out a few seconds worth of electric pulses that impress a voltage of about 1200 V across the human body. This results in an average current of approximately 3 mA into a human body. Using these figures, estimate the resistance of the human body.

$V = 1200V$
$I = 3 \times 10^{-3} A$
$R =$
$V = IR \quad R = V/I = 4 \times 10^{5} \Omega$

Answers:

1. 1.3A
2. 3.2×10^5 C
3. a. 2.4×10^8 sec = 6.6×10^4 hr = 2.8×10^3 d = 7.5 yr
   b. 1.5×10^7 sec = 4.1×10^3 hr = 170 d
   c. 2.0×10^6 s = 560 hr = 23 d
   d. 5.0×10^5 s = 140 hr = 5.8 d
4. 7.3 Ω
5. 13 A
6. 1700 V
7. 4×10^5 Ω