PH 221 Homework Assignment Chapter on Ohm's Law – 19 Problems Total

1. A current of $7.83\ \mathrm{A}$ flows in a wire. How many electrons are moving past a reference point per second?

Solution for Problem 1

2. What is the current in amperes if $1450\ \mathrm{Na}^{+}$ ions flow across a cell membrane in a time of $2.75\ \mu\mathrm{s}$? The charge on a sodium ion is the same as an electron only it is positive.

Solution for Problem 2

3. A typical room sized space heater uses $15.0\ \mathrm{A}$ when plugged into a $110.\ \mathrm{V}$ wall socket.

(a) What is the resistance of the space heater?

(b) If the current was direct current instead of alternating current how much charge would be moved through the heater in a $20.0\ \mathrm{min}$ time period?

Solution for Problem 3

4. A bird is sitting on a high-power electrical transmission wire. The wire is carrying $5500.\ \mathrm{A}$. The wire has a resistance per meter value of $3.00\ \mathrm{x}\ 10^{-5}\ \Omega/\mathrm{m}$. The bird's feet are approximately $4.00\ \mathrm{x}\ 10^{-2}\ \mathrm{m}$ apart. What is the potential difference between the bird's feet?

Solution for Problem 4

5. An unknown electrical device is found to draw a current of $9.85\ \mathrm{A}$ when it is powered by a voltage of $365.\ \mathrm{V}$.

(a) What is the effective resistance of the electrical device?

(b) Assuming nothing else changes, and the voltage powering the device increases by 25%, what is the new current being drawn?

(c) If the effective resistance were decreased by 35%, what would be the current drawn if the voltage supplied is $365.\ \mathrm{V}$?

Solution for Problem 5

6. The resistivity of copper is $\rho_{Cu} = 1.68 \text{ x } 10^{-8} \ \Omega \text{ m}$. No 14-gauge wire has a diameter of $D = 1.628 \text{ x } 10^{-3} \text{ m}$. What is the voltage drop along a 56.0 m length of wire which is carrying 14.0 A of current?

Solution for Problem 6

7. Aluminum wire has a resistivity $(\rho_{Al} = 2.65 \text{ x } 10^{-8} \ \Omega \text{ m})$ and a temperature coefficient $(\alpha_{Al} = 0.00429 \ /°C)$. A length of wire is connected to a constant voltage supply which is set to a value of 15.00 V. At exactly $20.00°C$, a current is measured in the wire

$(i_{20} = 0.5313 \text{ A})$. The wire is moved to a new location where the temperature has changed. Now a current $(i_{New} = 0.3945 \text{ A})$. What is the new temperature of the wire??

Solution for Problem 7

8. An old 1980's boom box uses eight "D-Cell" batteries $(V_{D-Cell} = 1.50 \text{ V})$ to power it. These are used in series, so a total supply voltage of $(8 \text{ x } 1.50 \text{ V} = 12.0 \text{ V})$. If the total power used is 28.0 W. How much current is drawn from the batteries?

Solution for Problem 8

9. What is the maximum voltage that can be applied across a $1200. \ \Omega$ resistor which is rated for $1/4$ watts?

Solution for Problem 9

10. Consider two light bulbs. One is a 60.0 W light bulb. The other is a $1200. \text{ W}$ floodlight. Both lights are powered by a standard wall outlet with a voltage of $110. \text{ V}$.

(a) Determine the resistance of the light bulb.

(b) Determine the current used by the light bulb.

(c) Determine the resistance of the floodlight.

(d) Determine the current used by the floodlight.

Solution for Problem 10

11. A thirty-gallon fish tank uses a $150.\,\mathrm{W}$ water heater to maintain a temperature of the water to be $15.0°\mathrm{F}$ above room temperature. The heater plugs into a standard wall outlet which has a voltage of $110.\,\mathrm{V}$.

(a) Determine the resistance of the water heater.

(b) Determine the current used by the water heater.

Solution for Problem 11

12. A D-Cell battery has a capacity of $8.00\ \mathrm{A\ hr}$. The voltage across the battery is of course $1.50\ \mathrm{V}$. What is the amount of energy stored in the battery?

Solution for Problem 12

13. A small flashlight with an incandescent filament bulb uses two C-Cell batteries $(\mathrm{V}_{\mathrm{C-Cell}} = 1.50\ \mathrm{V})$ connected in series. The flashlight bulb draws a current of $51.7\ \mathrm{mA}$.

(a) Determine the resistance of the light bulb.

(b) Determine the power dissipated by the light bulb.

(c) If you could wire in two more C -Cell batteries so that all four batteries are wired in series, by what factor would the power expended by the light bulb change?

Solution for Problem 13

14. A power company delivers $9.80\ \mathrm{kW}$ of power to a factory over a collection of wires with a total resistance of $4.00\ \Omega$.

Solution for Problem 14

15. A person's SUV has a batter that has a charge capacity of $75.0\ \mathrm{A\ hr}$ and a terminal voltage of $12.0\ \mathrm{V}$. The vehicle's head lights use $55.0\ \mathrm{W}$ of power. The tail lights use $8.00\ \mathrm{W}$. So, adding these lights up assuming two each of headlights and tail lights, a vehicle uses $126.\,\mathrm{W}$ of power. If the driver leaves the lights on while the SUV is not running its motor, how long will it take to drain a fully charged battery?

Solution for Problem 15

16. What is the average current drawn by an electric clothes dryer which uses a $0.500\ \mathrm{hp}$ motor that is attached to a standard wall socket which has a voltage of $110.\,\mathrm{V}$? Note: $1.00\ \mathrm{hp} = 746.\,\mathrm{W}$.

Solution for Problem 16

17. Fuses and circuit breakers are placed in building wiring circuits are to prevent current carrying wires from getting hot enough to cause a fire in the building materials they are attached to. For copper, the electrical resistivity is $(\rho_{Cu} = 1.68 \text{ x } 10^{-8} \ \Omega \text{ m})$. Assume the copper wires might carry up to 40.0 A of current. Further assume, that the heat generated per time is below 1.25 W per meter of wire. What is the minimum diameter of the copper wire being used?

Solution for Problem 17

18. Consider two wires made of aluminum. The electrical resistivity of aluminum is $(\rho_{Al} = 2.72 \text{ x } 10^{-8} \ \Omega \text{ m})$. Wire A has a length of (L_A) and a radius (R_A). Wire B has a length of $(L_B = 2L_A)$ and a radius $(R_B = 2R_A)$. Assume both wires have the same voltage (V_S) across their lengths. What is the ratio $\left(\frac{P_B}{P_A}\right)$ of the power transmitted along the wires?

Solution for Problem 18

19. The electrical resistivity of copper is $(\rho_{E-Cu} = 1.68 \text{ x } 10^{-8} \ \Omega \text{ m})$. The mass density of copper is $\left(\rho_{m-Cu} = 8.90 \text{ x } 10^{3} \ {}^{kg}/_{m^3}\right)$. A resistor is needed that should have a resistance of $(R_{Cu} = 14.6 \ \Omega)$. The resistor is to be made from wrapping copper wire into a coil, and the total mass of copper is to be $(m_{Cu} = 17.9 \text{ x } 10^{-3} \text{ kg})$.

(a) What is the length of the copper wire used?

(b) What is the diameter of the copper wire used?

Solution for Problem 19

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