

Physics Review
Unit 11

1. What is the drift velocity of an electron? 0.000246m/s
2. How can energy be available immediately if energy is carried in the electrons, and they move so slowly?
 - electric field is created almost instantly
 - applies a force to all electrons
 - potential energy available
3. State Ohm's Law.
 $V=IR$
4. What is a kilowatt-hour a measurement of?
energy
5. An electric car is designed to run on a bank of batteries with a total potential difference of 12 V and a total energy storage of 2.0×10^7 J.
 - A. If the electric motor draws 8.0 kW, what is the current delivered to the motor?
 $P = IV$
 $I = P/V = 8000/12 = 670\text{A}$
 - B. If the electric motor draws 8.0 kW as the car moves at a steady speed of 20.0 m/s how far will the car travel before it is "out of juice"?
 $P = 8000 = 8000\text{j/s}$
 $P=W/t$
 $t = W/P = 2.0 \times 10^7\text{j}/8000\text{j/s} = 2500\text{s}$
 $\Delta d = Vt = 20.0 \times 2500 = 5.0 \times 10^4\text{m}$
6. Determine the amount of energy used by each appliance below.
 - A. a 75.0 W stereo
 $W = Pt = (0.075\text{kW})(24) = 1.8 \text{ kW-h}$
 $(1.8 \text{ kW-h})(.080) = \0.14
 - B. an electric oven that draws 20.0 A of current
 $P = IV = (20.0)(115) = 2300\text{W} = 2.30 \text{ kW}$
 $E = Pt = (2.3)(24) = 55.2 \text{ kW-h}$
 $(55.2)(.080) = \$4.4$
 - C. a television with a resistance of 60.0Ω
 $P = V^2/R = (115)^2/(60) = 220 \text{ W} = 0.22 \text{ kW}$
 $E = (0.22)(24) = 5.3 \text{ kW-h}$
 $(5.3)(.080) = \$0.42$
7. An electric heater is operated by applying a potential difference of 50.0V across a nichrome wire of total resistance 8.00Ω . Find the current in the wire and the power rating of the heater.
 $I = V/R = (50)/(8) = 6.25\text{A}$
 $P = V^2/R = (50)^2/(8) = 312\text{W}$
8. The current in a certain resistor is 0.50 A when it is connected to a potential difference of 110 V. What is the current in this same resistor if
 - A. the operating potential difference is 90.0 V?
 $R = V/I = (110)/(.5) = 220\Omega$
 $I = V/R = (90)/(220) = 0.41\text{A}$
 - B. the operating potential difference is 130 V?
 $I = V/R = (130)/(220) = 0.59\text{A}$
9. Find the current in the following devices when they are connected across a potential difference of 120 V.
 - A. a hot plate with a resistance of 48Ω
 $I=V/R$
 $I=(120)/(48) = 2.5\text{A}$
 - B. a microwave oven with a resistance of 20Ω

$$I=V/R$$

$$I=(120)/(20) = 6.0A$$

10. If a metal wire carries a current of 80.0 mA, how long does it take for 3.00×10^{20} electrons to pass a given point on the wire?

$$80.0\text{mA} = 0.080\text{A} = 0.080\text{C/s}$$

$$0.080\text{C}(1\text{e-}/1.60 \times 10^{-19})/\text{s} = 5.0 \times 10^{17}\text{e-}/\text{s}$$

$$3.00 \times 10^{20}\text{e-} - (1\text{s}/5.0 \times 10^{17}\text{e-}) = 600\text{s}$$

11. In a particular television tube, the beam current is 60.0 μA . How long does it take for 3.75×10^{14} electrons to strike the screen?

$$60.0\mu\text{A} = 60.0 \times 10^{-6}\text{A} = 60.0 \times 10^{-6}\text{C/s}$$

$$60.0 \times 10^{-6}\text{C}(1\text{e-}/1.60 \times 10^{-19}\text{C})/\text{s} = 3.75 \times 10^{14}\text{e-}/\text{s}$$

$$(3.75 \times 10^{14}\text{e-}) - (1\text{s}/3.75 \times 10^{14}\text{e-}) = 1.00\text{s}$$

12. A wire that is 14.2 m long, and has a diameter of 0.0876 cm is connected across a 12.0 V battery. The wire produces a current of 7.2 A. What is the resistivity of the wire?

$$V=IR$$

$$R=V/I = 120/7.2=16.7\Omega$$

$$R=\rho l/A=\rho l/\pi r^2$$

$$\rho=R\pi r^2/l=(16.7)(3.14)(.000438)^2/14.2 =7.08 \times 10^{-7}\Omega\text{m}$$

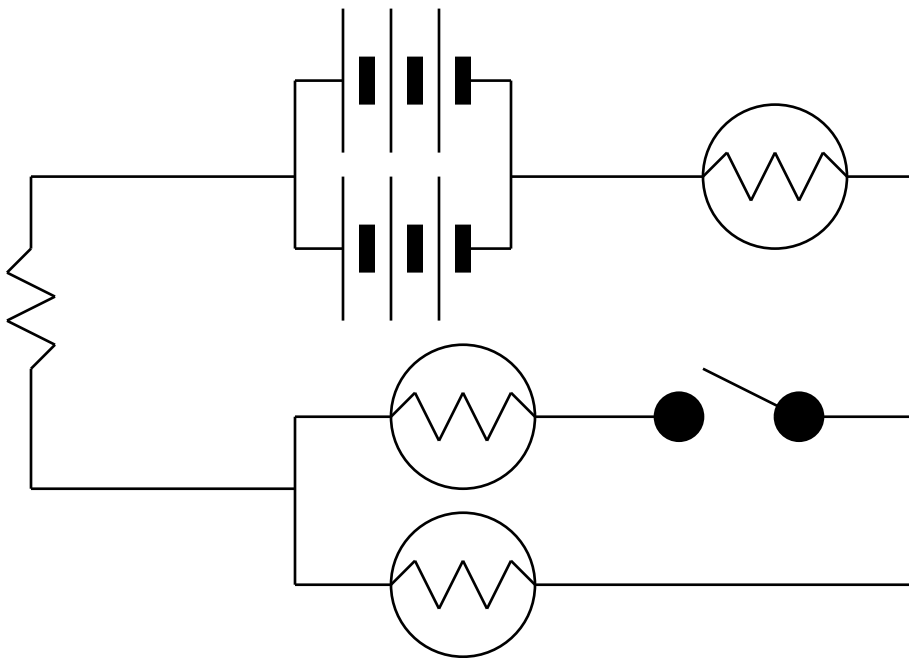
13. What is the resistance of the following resistors

A. red blue black gold $26\Omega \pm 10\%$

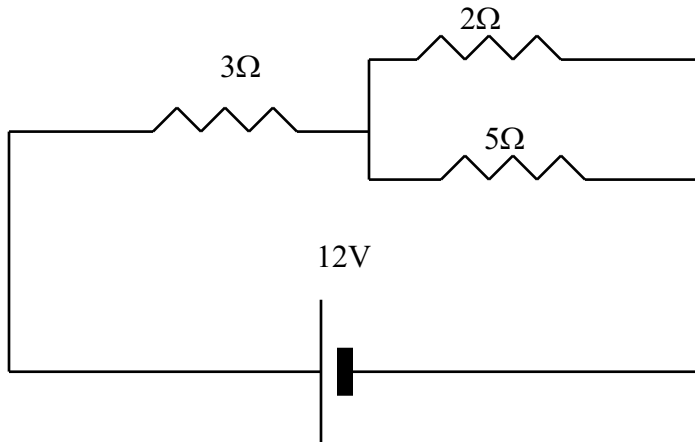
B. green green green silver $55 \times 10^6\Omega \pm 20\%$

C. grey brown orange gold $91 \times 10^3\Omega \pm 10\%$

14. Draw a circuit diagram that has three cells in series to each other, that has a second parallel branch that is identical to the first. All the cells that make up the battery are 1.5V. This battery is connected to a circuit that has three light bulbs. One bulb is series to the whole circuit, and the other two are parallel to each other. Also place one resistor in series with the entire circuit. Put a switch into the diagram that will only control one light bulb. (Example: lots of possible answers)



15. Use the circuit diagram below to solve for the equivalent resistance, and potential drop and current across each resistor.



parallel branch $1/R_2 + 1/R_1 = 1/R_{eq}$
 $1/2 + 1/5 = 0.7$
 $R_{eq} = 1.43$

Series $R_1 + R_2 = R_{eq}$
 $1.43 + 3 = 4.43\Omega$
 $I_T = V/R = 12/4.43 = 2.71A$

Series Resistor $I = 2.71$
 $V = IR = (2.71)(3) = 8.13V$

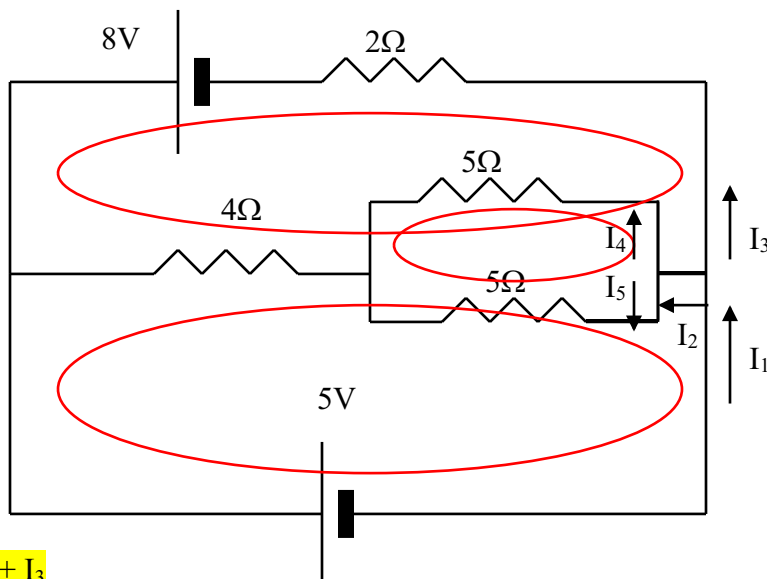
Parallel Branch $V = IR = (2.71)(1.43) = 3.88V$

Parallel Resistors (Potential is Constant)
 $I = V/R = 3.88/2 = 1.94A$
 $I = V/R = 3.88/5 = 0.776A$
 V for both is $3.88V$

16. State Kirchhoff's rules.

1. Sum of the currents entering a junction equals the sum of the currents leaving.
2. The total potential across a loop is zero.

17. Use Kirchhoff's rules to solve the current in each branch of the following circuit.



eq 1 $I_1 = I_2 + I_3$

eq 2 $I_2 = I_4 + I_5$

3 Loops, all clockwise starting from the top

$$\text{eq 3} \quad 0 = 8 - 2I_3 + 5I_4 + 4I_2$$

$$\text{eq 4} \quad 0 = -5I_4 + 5I_5$$

$$\text{eq 5} \quad 0 = -5 - 4I_2 - 5I_5$$

$$\text{solve eq 4} \quad I_4 = I_5$$

sub into eq 5 and eq 2

$$I_2 = 2I_4$$

$$0 = -5 - 4I_2 - 5I_4$$

In equation 1, 3, 5 substitute $2I_4$ for I_2

$$I_1 = I_4 + I_3$$

$$0 = 8 - 2I_3 + 5I_4 + 4(2I_4) = 8 - 3I_3 + 13I_4$$

$$0 = -5 - 4(2I_4) - 5I_4 = -5 - 13I_4$$

$$5 = -13I_4$$

$$I_4 = -0.385\text{A}$$

Solve for I_3

$$0 = 8 - 3I_3 + 13I_4$$

$$-8 = -3I_3 + 13(-0.385) = 3I_3 - 5.00$$

$$-3 = 3I_3$$

$$I_3 = -1.00\text{A}$$

Solve for I_1

$$I_1 = I_4 + I_3$$

$$I_1 = -0.385 - 1.00$$

$$I_1 = -1.38$$

Solve for I_2

$$I_2 = 2I_4$$

$$I_2 = 2(-0.385)$$

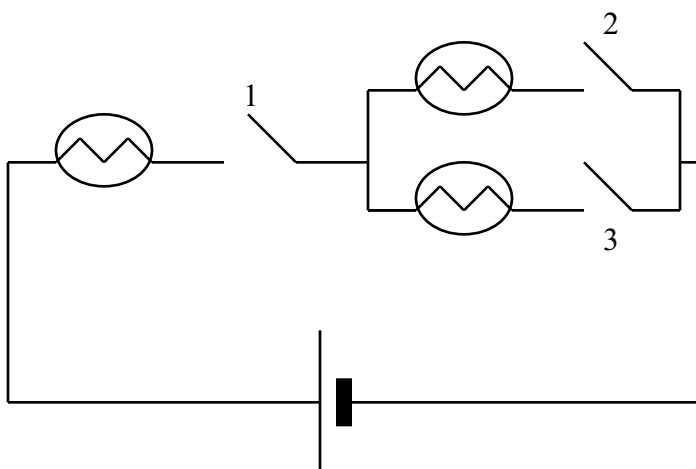
$$I_2 = -0.770\text{A}$$

Solve for I_5

$$I_4 = I_5$$

$$I_5 = -0.385\text{A}$$

18. Using the following diagram to explain what happens to the brightness of the bulbs as the following switches are placed in the open position (all others are assumed to be closed) – note that the switches are shown in the open position.



- switch 1 - current is cut off, all bulbs dark
- switch 2 - current through bulbs decreases 1 and 3 dimmer, 2 off
- switch 3 - current through bulbs decreases 1 and 2 dimmer, 3 off
- switch 1 and 2 current is cut off, all bulbs dark
- switch 1 and 3 current is cut off, all bulbs dark