

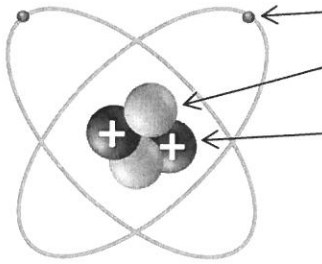
**Shedding Light on Electricity Episode 1: Sources of Electricity** Name: \_\_\_\_\_

**Part A**

1. To use electricity, four things are required:
- (a) a source of electricity, three examples of which are \_\_\_\_\_  
\_\_\_\_\_
  - (b) a load, three examples of which are \_\_\_\_\_  
\_\_\_\_\_
  - (c) \_\_\_\_\_ and
  - (d) \_\_\_\_\_.

**Part B**

2. Label the atom below.



3. What is electric current? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Part C**

4. (a) Draw a diagram of a coal-fired power station.  
(b) Describe how it works.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

5. What is a uranium-235 atom? \_\_\_\_\_  
\_\_\_\_\_

6. How do nuclear power stations generate heat? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

7. (a) Draw a diagram of a hydroelectric power station.  
(b) Describe how it works.

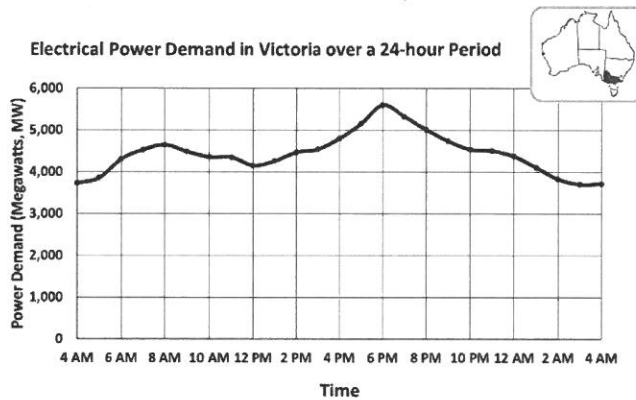
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Part D

8. Describe how wind turbines work. \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
9. Obviously when the wind isn't blowing, wind turbines don't produce electricity. How is this problem overcome? \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
10. Describe how solar panels work. \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
11. Why are wind turbines and solar panels called "intermittent" sources of energy? \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
12. Fill in the table below.

Source of Electricity	% production in Australia	% production globally
Coal-fired	X	
Gas-fired		
Nuclear		
Hydroelectric		
Wind		
Solar		

Part E



13. Describe, using examples, why electricity demand varies throughout the day. \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

14. Describe two ways that the electricity supply is increased when electricity demand increases. \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

15. What are some advantages and disadvantages of different forms of electricity generation?

Source of Electricity	Advantages	Disadvantage
Coal and gas		
Nuclear		
Hydroelectric		
Wind		
Solar		

16. A friend tells you that ~~Australia~~ <sup>the U.S.</sup> needs to shut down all of our coal- and gas-fired power stations because they produce too much pollution. How would you respond?

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### SKILL-BUILDING EXERCISES

The percentage increase in a quantity can be worked out by the following formulas:

$$\text{percentage increase} = \frac{\text{change in quantity}}{\text{initial quantity}} \times 100\% \quad \text{OR} \quad \text{percentage increase} = \left( \frac{\text{final quantity}}{\text{initial quantity}} \times 100\% \right) - 100\%$$

Eg. If a value increases from 8 to 14, the percentage increase is

$$\% \text{ increase} = \frac{\text{change in quantity}}{\text{initial quantity}} \times 100\% = \frac{\text{final quantity} - \text{initial quantity}}{\text{initial quantity}} \times 100\% = \frac{14-8}{8} \times 100\% = \frac{6}{8} \times 100\% = 75\%$$

OR

$$\% \text{ increase} = \left( \frac{\text{final quantity}}{\text{initial quantity}} \times 100\% \right) - 100\% = \left( \frac{14}{8} \times 100\% \right) - 100\% = 175\% - 100\% = 75\%$$

In other words, 75% of the original value (6 is 75% of 8) has been added to the original value.

17. Using the graph in Part E, determine the power demand for Victoria at 4 am? \_\_\_\_\_
18. Using the same graph, determine the power demand for Victoria at 6 pm? \_\_\_\_\_
19. Calculate the percentage increase in power demand from 4 am to 6 pm? \_\_\_\_\_
20. In other words, power demand increased by \_\_\_\_\_% from 4 am to 6 pm.
21. What was the percentage increase in power demand from 2 pm to 6 pm? \_\_\_\_\_

Part A  
Part B

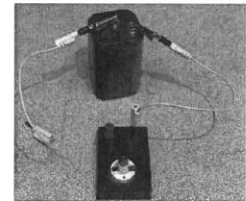
1. There are four things required to make use of electricity: \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
2. Draw a simple diagram of a circuit where a battery is connected to a light globe.

3. Describe why the light globe in the circuit shown on the right is not on.

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Part C

4. Draw a circuit diagram (using circuit symbols) of a circuit that has a switch which switches on one light globe.

Part D

#### LIGHT GLOBES IN SERIES

5. (a) Draw a circuit diagram of a circuit where a battery powers two light globes that are connected in series.  
(b) Draw a second circuit diagram that includes a switch so that the two light globes connected in series can be turned on and off.

6. If one light globe in the circuits above suddenly blows, why will the other one also go out?

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7. How does the amount of light emitted by the two globes in the circuit above compare to the amount of light that would be emitted if just one of the globes was connected to the battery?

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#### LIGHT GLOBES IN PARALLEL

8. (a) Draw a circuit diagram of a circuit where a battery powers two light globes that are connected in parallel.  
(b) Draw a second circuit diagram that includes a switch so that the two light globes connected in parallel can be turned on and off.

9. If one light globe in the circuits in Q8 suddenly blows, how will the other one be affected? Explain.

\_\_\_\_\_

10. How does the amount of light emitted by the two globes in the circuit in Q8 compare to the amount of light that would be emitted if just one of the globes was connected to the battery?

\_\_\_\_\_

11. Draw a circuit diagram of a circuit where one switch switches on one light globe and the other switch switches on another light globe.

**CRITICAL-THINKING EXERCISES**

12. Describe the operation of the circuits on the right. (You can refer to each component as switch A, light globe C etc). Eg. When switch A is pressed... (The circuits are not necessarily well constructed!)

(a) \_\_\_\_\_

\_\_\_\_\_

(b) \_\_\_\_\_

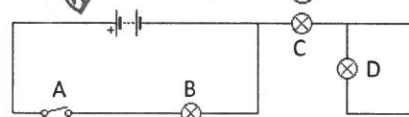
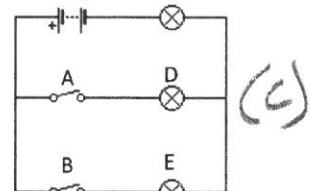
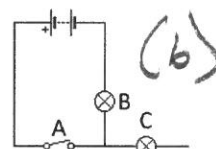
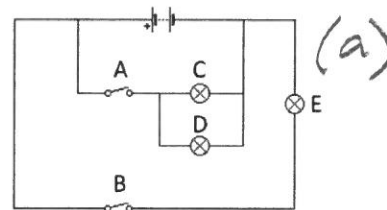
\_\_\_\_\_

(c) \_\_\_\_\_

\_\_\_\_\_

(d) \_\_\_\_\_

\_\_\_\_\_



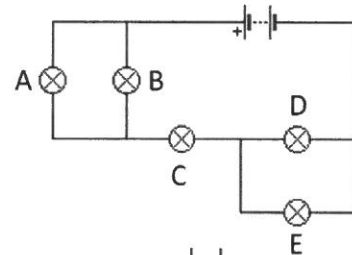
13. Which globes in the circuit on the right will remain lit in the following circumstances? (There may be none)

(a) Globe B blows (or is removed). \_\_\_\_\_

(b) Globe C blows. \_\_\_\_\_

(c) Globes B and D blow. \_\_\_\_\_

(d) Globes A and B blow. \_\_\_\_\_



14. Points A-E are points in the circuit where switches can be placed.

Where would you place a single switch so that

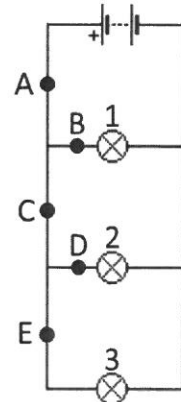
(a) all light globes can be turned on and off at the same time? \_\_\_\_\_

(b) light globe 2 can be turned off and on while the others stay on? \_\_\_\_\_

(c) light globes 2 and 3 can be turned on and off at the same time (while light globe 1 remains on)? \_\_\_\_\_

15. If you had two switches, where would you place them so that light globe 1 can be switched on and off with one switch and light globes 2 and 3 can be switched on and off with the other?

\_\_\_\_\_



Part A

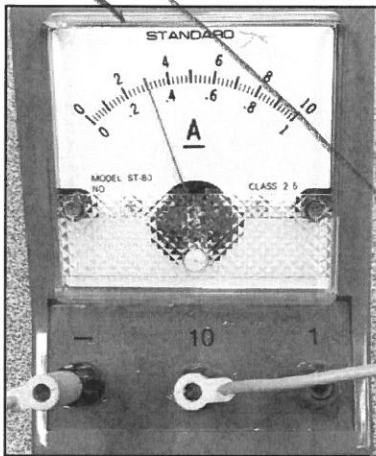
- At the simplest level, what is electric current? \_\_\_\_\_
- Things that electric current can flow through are called \_\_\_\_\_, while things that electric current can't flow through are called \_\_\_\_\_.
- Electric current is measured using a device called an \_\_\_\_\_. Electric current is (officially) measured in \_\_\_\_\_ (but this unit is often simplified to \_\_\_\_\_). The symbol for the unit is \_\_\_\_\_.

Part B

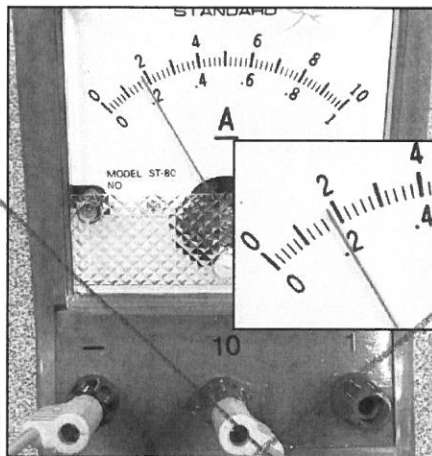
- Draw a circuit diagram showing how to place an ammeter in a circuit so that it can measure the current flowing in a single light globe.

- If you measure that the current in a certain part of an electrical circuit is 1 amp, it means that \_\_\_\_\_ electrons are flowing past that point per second.

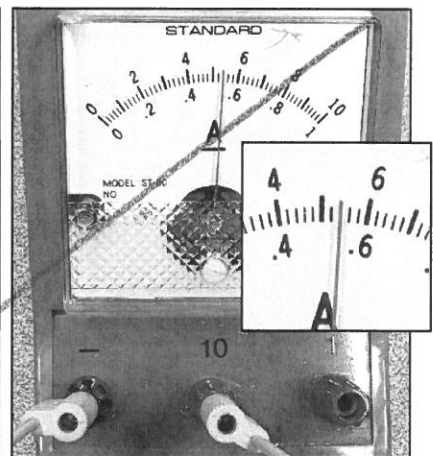
- A school ammeter is connected to various circuits. Noting that the 10 A scale is being used, what current is passing through the circuits?



Current = \_\_\_\_\_

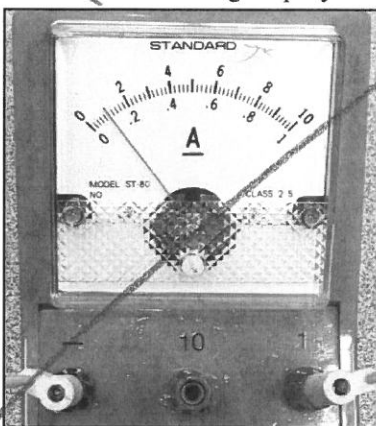


Current = \_\_\_\_\_

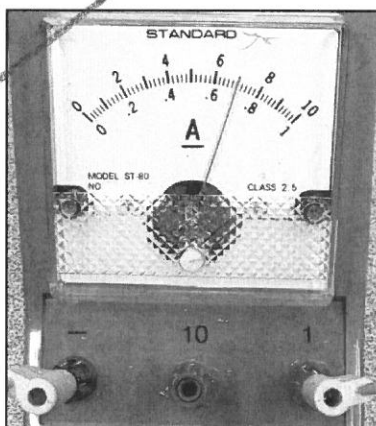


Current = \_\_\_\_\_

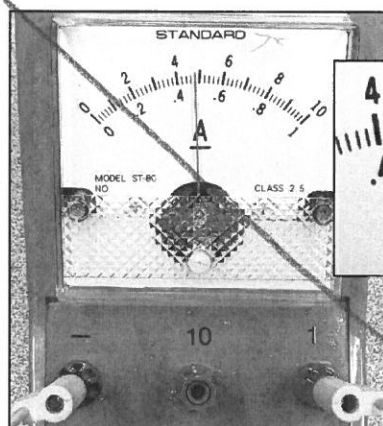
- For this ammeter, currents of less than 1 Amp are best measured using the 1 Amp terminal. What current is being displayed in each circuit?



Current = \_\_\_\_\_



Current = \_\_\_\_\_



Current = \_\_\_\_\_

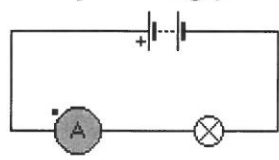
- A car headlight running off a car battery draws about \_\_\_\_\_ A.
- List two household appliances that draw large currents. \_\_\_\_\_
- List two household appliances that draw small currents. \_\_\_\_\_

11. 1 Amp = \_\_\_\_\_ milliamps; 1 mA = \_\_\_\_\_ A  
 2 A = \_\_\_\_\_ mA; 0.2 A = \_\_\_\_\_ mA  
 300 mA = \_\_\_\_\_ A; 450 mA = \_\_\_\_\_ A; 20 mA = \_\_\_\_\_ A

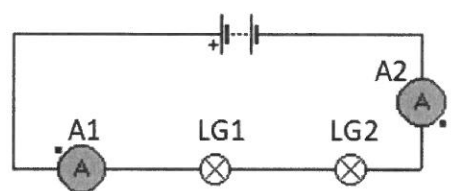
12. In the USA and Canada, mains electricity is supplied at a voltage of \_\_\_\_\_, while in Australia, Europe, and most of the rest of the world, mains voltage is \_\_\_\_\_.

13. The higher the power of an electrical device, the \_\_\_\_\_ the current that it draws (for an equal voltage).

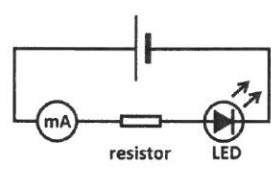
Part C



14. A student sets up the circuit on the left. If the ammeter reads 0.5 Amps, what is the current  
 (a) in the light globe? \_\_\_\_\_  
 (b) coming out of the battery? \_\_\_\_\_

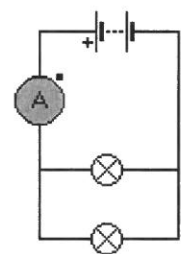


15. The student wires up another circuit shown on the left. The current in Ammeter 1 is 0.3 Amps. What is the current  
 (a) in Light Globe 1? \_\_\_\_\_  
 (b) in Light Globe 2? \_\_\_\_\_  
 (c) in Ammeter 2? \_\_\_\_\_  
 (d) coming out of the battery? \_\_\_\_\_  
 (e) going back into the battery? \_\_\_\_\_



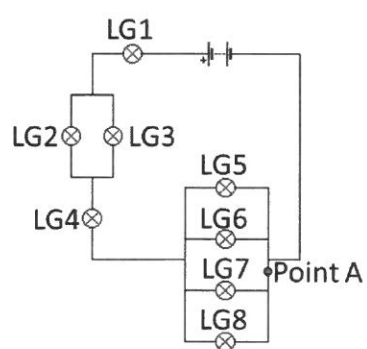
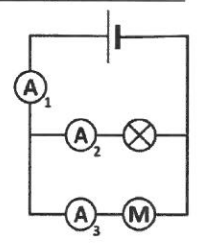
16. A milliammeter, an LED, and a resistor are connected to a 9 Volt battery. The current in the milliammeter is 12 mA. What is the current in  
 (a) the resistor? \_\_\_\_\_  
 (b) the LED? \_\_\_\_\_

17. What general rule applies to electric current when components are connected in series?  
 \_\_\_\_\_  
 \_\_\_\_\_



18. Two identical headlights are connected to a car battery in parallel. The ammeter reads 7 Amps. What is the current in each light globe? \_\_\_\_\_

19. An electric motor and a light globe are connected in parallel and ammeters are placed in the circuit to measure the current. If Ammeter 1 reads 2.8 amps and Ammeter 2 reads 1.5 Amps, what will Ammeter 3 read? \_\_\_\_\_. What therefore is the current in the motor? \_\_\_\_\_



20. If  $I_{LG1} = 60 \text{ mA}$  and all the light globes are identical,  $I_{LG3} =$  \_\_\_\_\_,  $I_{LG4} =$  \_\_\_\_\_, and  $I_{LG6} =$  \_\_\_\_\_.  
 21.  $I_{\text{Point A}} =$  \_\_\_\_\_.

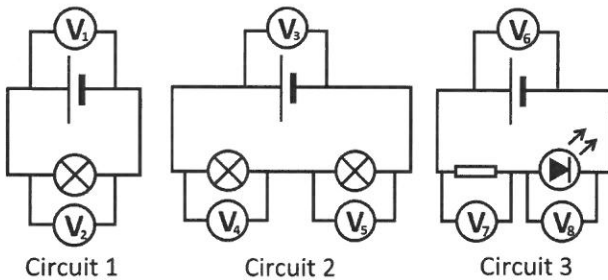
# Shedding Light on Electricity Episode 4: Voltage, Current, and Resistance

Name: \_\_\_\_\_

- Part A**
1. In Australian homes, the voltage of the power supply is about \_\_\_\_\_ Volts.
  2. For a given voltage, if one electrical device requires more power than another, it will draw more/less current.

- Part B**
3. Substances that electric current (or, in other words, electrons) can flow through easily are called \_\_\_\_\_. Examples include \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
  4. Substances that electric current can't flow through easily are called \_\_\_\_\_. Examples include \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
  5. If two light-globe filaments are connected to the same voltage, the filament that resists the flow of current more (and therefore has a higher "resistance") will allow more/less current to flow than the filament with a lower resistance. A filament with a lower resistance will allow more/less current to flow.

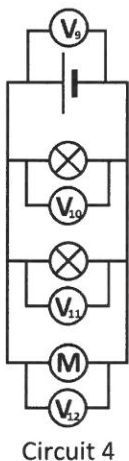
- Part C**
6. What typically happens to the electrical current in a circuit if the voltage of the power supply is increased? \_\_\_\_\_
  7. Voltage is always measured between two points in a circuit. What is it a measure of? \_\_\_\_\_
  8. The voltage between the two terminals of AAA (and, in fact AA) batteries is \_\_\_\_\_.



9. If voltmeter  $V_1$  in Circuit 1 reads 6 volts, what does voltmeter  $V_2$  read? \_\_\_\_\_

10. If voltmeter  $V_3$  in Circuit 2 reads 12 volts and the two light globes were identical, what do voltmeters  $V_4$  and  $V_5$  read?  
 voltmeter  $V_4$ : \_\_\_\_\_, voltmeter  $V_5$ : \_\_\_\_\_

11. If voltmeter  $V_6$  in Circuit 3, reads 9 V (which means that the battery is a 9 V battery) and voltmeter  $V_7$  reads 7 V, what would voltmeter  $V_8$  read? \_\_\_\_\_



12. If two light globes and a motor were connected in parallel to a 12-volt car battery (Circuit 4), what would the voltmeters read?  
 $V_9$ : \_\_\_\_\_,  $V_{10}$ : \_\_\_\_\_,  $V_{11}$ : \_\_\_\_\_,  $V_{12}$ : \_\_\_\_\_

13. In general, when electrical devices are connected in parallel to a power source, what can be said about the voltage across each one compared to the voltage of the power source? \_\_\_\_\_

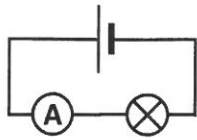
14. Given that the voltage supplied to houses in Australia is 240 V, what is the voltage across all our lights and power sockets (which are all connected in parallel)? \_\_\_\_\_

- Part D**
15. Briefly describe what electrical resistance means. \_\_\_\_\_



16. Resistance is measured in \_\_\_\_\_ and this unit has the symbol \_\_\_\_\_.

17. Write down the three variations of the formula that links voltage, current, and resistance.



18. A car taillight is connected to a 12.6 Volt car battery and it draws a current of 2 amps. What is the resistance of the light globe?



V = \_\_\_\_\_ I = \_\_\_\_\_ (write down the data in the question and then...)

(use the equation...) R =



19. A headlight with a resistance of  $4 \Omega$  is connected to a 12.6 V car battery. How much current will it draw?

R = \_\_\_\_\_ V = \_\_\_\_\_

I =

20. A 6 W LED light globe is designed to operate at a voltage of 240 V. If it draws 0.025 Amps, what is its resistance?

V = \_\_\_\_\_ I = \_\_\_\_\_

R =

21. A wire's resistance depends on four things:

- (a) \_\_\_\_\_
- (b) \_\_\_\_\_
- (c) \_\_\_\_\_
- (d) \_\_\_\_\_

22. All incandescent light globes (the light globes that generate light by getting really hot) have filaments that are made of tungsten steel. Why is tungsten steel used? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

23. How do manufacturers change the resistance of the different incandescent light globes?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

24. Draw a circuit diagram that includes a battery, a light globe, an ammeter and a voltmeter, so that the ammeter can measure the current flowing through the light globe and the voltmeter can measure the voltage across it.

25. Ammeters have a very \_\_\_\_\_ resistance.

26. Voltmeters have a very \_\_\_\_\_ resistance.

**Shedding Light on Electricity Episode 5: Electrical Safety** Name: \_\_\_\_\_

**Part A**

1. How much electric current passing across a person's chest is enough to kill the person?  
Approximately \_\_\_\_\_ A (\_\_\_\_\_ mA).
2. If a small light globe connected to a 6 V battery draws 0.29 Amps, why is it still safe to touch the terminals of the 6 V battery? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
3. What is the resistance of the light globe in Q2? ( $V = IR$ ) (This is a revision question from EP4.)
4. What effect does too much current have on muscles? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Part B**

5. The resistance of a wire is determined by four main factors:
  - (a) Length: a longer wire has a \_\_\_\_\_ resistance than a shorter wire.
  - (b) Thickness: a thicker wire has a \_\_\_\_\_ resistance than a thinner wire and will draw \_\_\_\_\_ current than a thinner wire when it is connected to a voltage source.
  - (c) \_\_\_\_\_: hotter wires usually have a higher resistance than colder wires.
  - (d) \_\_\_\_\_: All metals are excellent conductors but some conduct better than others.
6. Fill in the table below. ( $V = IR$ ,  $R = V/I$ ,  $I = V/R$ )

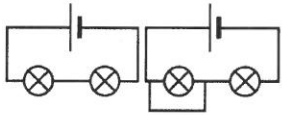
Light Globe Type	Power Output (Watts)	Voltage, V	Current, I	Resistance, R
Car headlight (incandescent)	60 Watts	12 V	5 A	
Household Incandescent	60 Watts	240 V	0.25 A	
Household LED	6 Watts	240 V		9,600 $\Omega$

(Please note: a 6 W LED globe produces about the same amount of light as a 60 W incandescent.)

7. Comment on the different design characteristics of the three light globes. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

8. What is nichrome and why is it used to make toaster filaments? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Part C



9. Two light globes are connected in series and then a wire is placed in parallel across one of the light globes. What happens and why? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

10. If a really low resistance wire is connected directly to a large voltage source, a large / small amount of current will flow and a large / small amount of heat will be generated. (circle the correct words and cross out the incorrect words.)

11. Laws specify that car battery terminals must be covered with plastic covers. Why?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Part D

12. What is a circuit breaker (and what does it do)? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

13. (a) If you connect a 2,400 Watt electric heater to a 240 V plug, it will draw about 10 A. How much current will be drawn (in total) if you connect a second heater to the same plug? \_\_\_\_\_  
(b) What is likely to happen if you connect a third heater to the same power outlet? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Part E

14. Under normal circumstances, the Earth wire does not carry any electric current. When does it carry an electric current and what happens when it does? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

15. Revision Question. In a simple circuit where a battery is connected to a light globe, how does the size of the electric current flowing out of the battery compare to the size of the electric current flowing into the battery? \_\_\_\_\_

16. What are Residual Current Devices (RCDs) and what do they do? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

*Called GFCI (Ground Fault Circuit Interrupter) in the U.S.*

