

Some Review PSC-4011 : Electricity

1. A) Aluminum
 B) Copper
 C) Germanium
 D) Nichrome
 E) Plastic
 F) Porcelain
 G) Silicon
 H) Silver



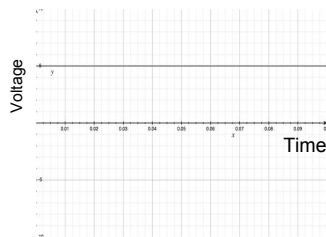
Of the above materials, name all those that could be used in each of the following applications. Give reasons for your answer.

- a) Kitchen stove heating elements: nichrome; resistive conductor
- b) Lightening conductors: Al, Cu; conductors
- c) Insulators for high-tension transmission lines: plastic, porcelain; insulators
- d) Casings for electrical appliances with two-pronged plugs: plastic, porcelain, insulators
- e) Diodes and transistors: Ge, Si ; Semiconductors

2. For each of the statements below, indicate whether it is referring to alternating current (AC) or direct current (DC):

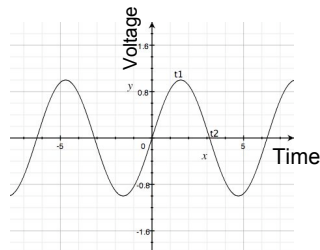
 hydro batteries 

a) The voltage of this type of current varies over time as follows:



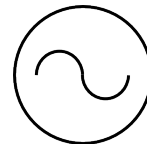
Ans: DC

b) The voltage of this type of current varies over time as follows:



Ans: AC

- c) Its frequency is 60 hertz in the Hydro-Quebec system. Ans: AC
- d) It is used to operate ipods and certain toys. Ans: DC
- e) It is used to operate household appliances. Ans: AC
- f) The root mean square value of its intensity is used when calculations are involved. Ans: AC
average I
- g) Its current always travels in the same direction. Ans: DC
- h) Its current changes direction on a regular basis. Ans: AC
- i) The following symbol is used to represent this type of current:

Ans: AC

3. The following events occurred during the history of the development of knowledge about electricity, magnetism, and electromagnetism.

Place all of these events in chronological order.

The man goes everywhere on foot.

- 5) A) Oersted discovered that current can be used to deflect a compass needle.
- 4) B) Electrical current was first used to separate water molecules into hydrogen and oxygen gases (process of electrolysis).
- 3) C) Gilbert performed experiments to show that many different substances can be electrified.
- 6) D) Faraday observed that magnets can create electric currents.
- 2) E) Maricourt identified the north and south poles of a magnet.
- 1) F) Thales discovered that amber and silk will attract each other after they have been rubbed together.

Answer: F, E, C, B, A, D

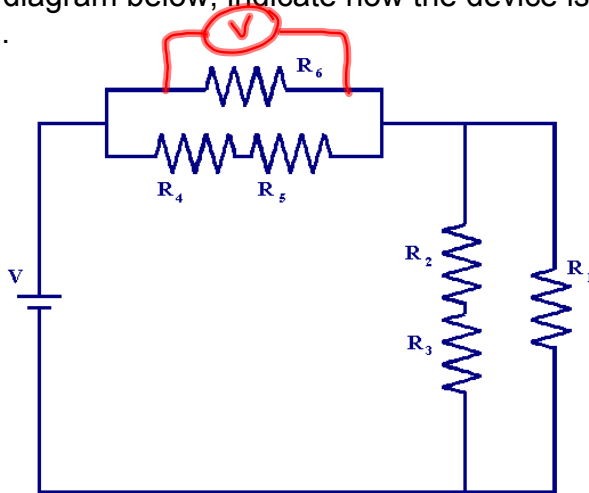
4. You want to measure the potential difference across the terminals of R_6 below.

a) What device will you use?

① **voltmeter**

b) On the diagram below, indicate how the device is connected, using the appropriate symbol.

②



c) Is this device connected in series or in parallel with R_6 ? Explain your answer.

parallel

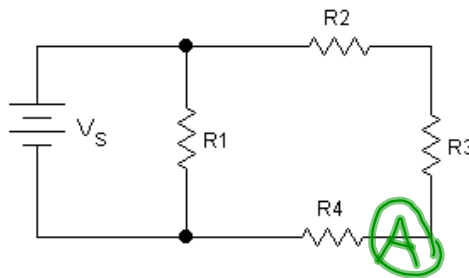
The electrons do not pass through the voltmeter in order for the voltmeter to measure potential difference.

5. You want to measure the intensity of the current flowing through resistor R_4 in the circuit below.

a) What device will you use?

ammeter

b) On the diagram below, indicate how the device is connected, using the appropriate symbol.



c) Is this measuring device connected in series or in parallel with resistor R_4 ? Explain your answer.

Series

Current must flow through ammeter in order for it to measure intensity

6. **WILL the car start? $Q = It$**
 A motorcycle battery has 12 A·h of charge. When the bike is not in use the battery discharges at a rate of 0.04 A every hour. If the bike sits unused for 12 days (24 hours per day), will the owner be able to start the bike? Start-up requires 460 A of current for 3 seconds.

$$\rightarrow 12 \times 24 = 288h$$



$$Q_{\text{initial}} = 12 \text{ A}\cdot\text{h}$$

$$Q_{\text{used}} = It = (0.04 \text{ A})(288 \text{ h})$$

$$Q_{\text{left}} = 12 \text{ Ah} - 11.52 \text{ Ah} = 0.48 \text{ Ah}$$

$$3 \text{ s} \div 3600$$

$$= 0.000833 \text{ h}$$

$$Q_{\text{needed}} = It$$

1 start-up

$$= (460 \text{ A})(0.000833 \text{ h})$$

$$= 0.383 \text{ A}\cdot\text{h}$$

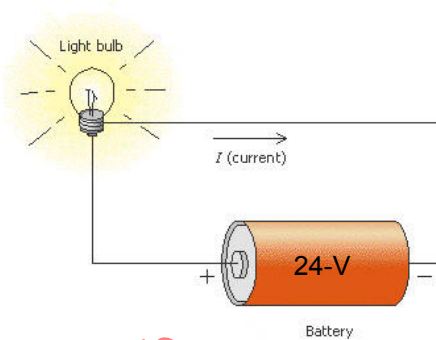
Yes, the bike will start. We need 0.383 A·h to start, and we have 0.48 A·h of charge.

More than enough!

Before

After

7. If the 24-V battery in the circuit below is replaced with a 15-V battery, then how will this affect the current intensity supplied to the bulb? Explain using the appropriate formula.



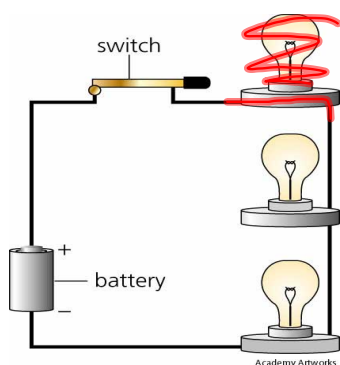
$$\frac{A}{B} = \frac{15 \div 3}{24 \div 3} = \frac{5}{8}$$

$$I = \frac{V}{R} \quad \textcircled{1}$$

$$V \downarrow \frac{5}{8} \times$$

$$\therefore I \downarrow \frac{5}{8} \times \quad \textcircled{1}$$

8. If one of the light bulbs is removed from the circuit below, then how will the current intensity in the circuit be affected? Explain using the appropriate formula.



$$R \downarrow \frac{1}{3} \times$$

$$I = \frac{V}{R} \text{ (1)}$$

$$I \uparrow 3 \times \text{ (1)}$$

Thickness of wire.

9. Household circuits typically carry 10 - 30 A of current. Industrial circuits can carry in the order of 200 000 A. Which of the wire gauges shown below would be most suitable for an industrial circuit? Explain your reasoning by referring to any relevant equations.

Wire A



Wire B



Industrial wires

$$I = \frac{V}{R}$$

For $\uparrow I$ need $\downarrow R$

$$R = \frac{\rho L}{A}$$

... for $\downarrow R$ need $\uparrow A$

\therefore industrial circuits must use thick wires

10. a) Jim (below) bought a new electric snowblower in the hopes of saving himself some money by not having to pay a snow-removal company. The distance from the outlet (outside Jim's front door) to the end of his driveway is 64 feet. At the hardware store, Jim has the choice of buying a 50-foot, 100-foot, or 200-foot extension cord. Which should Jim buy? Explain using any relevant equations.



$$R = \frac{\rho L}{A}$$

Want $L \downarrow$ as possible
so $R \downarrow$ as possible.

- b) Should the extension cord that Jim buys have two prongs or three prongs? Explain.

Since it has
metal casing.

3rd prong acts
as a ground.

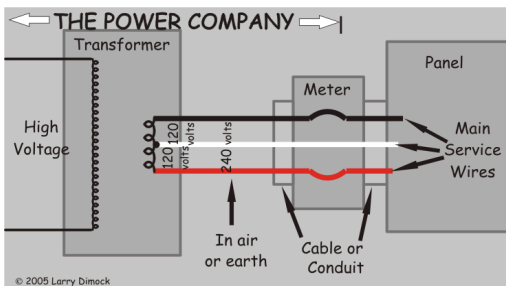
11. An oven operates at 240 V and draws 17 A of current.
a) What is the power dissipated by the oven?



$$P = VI \text{ ①}$$

$$= (240V)(17A)$$

$$P = 4080W$$



- b) Which of the three transformer wires (red, black, and/or white) are connected to the oven?

red, black & white

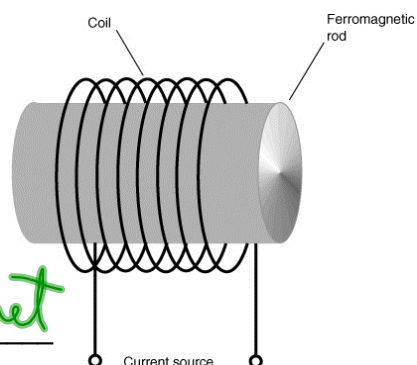
12. Identify the following:



a) transformer



b) tungsten filament



c) electromagnet

13.



$$P = I^2 R$$



The power lines above are carrying electricity to a city which is 150 km away. These power lines are carrying a very high tension (700 000 V). Explain, using appropriate formulas, why the electricity is carried at such a high tension for long distances.

$$P = VI$$

↑ constant ↑ ↓

$$P = \frac{I^2 R}{1}$$

power loss via Joule Effect

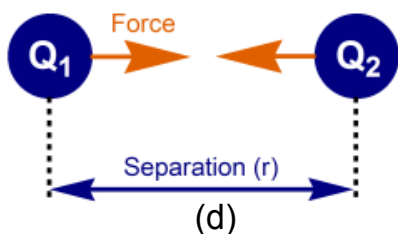
By ↑ V, ∴ ↓ I> by ↓ I ↓ power loss via Joule Effect

14. Explain the following:

- electrons jump from hair to comb
- Now hair is +, comb is -.
- Opposites attract



15. Consider the two charges below.



$$F = k \frac{Q_1 Q_2}{d^2} \textcircled{1}$$

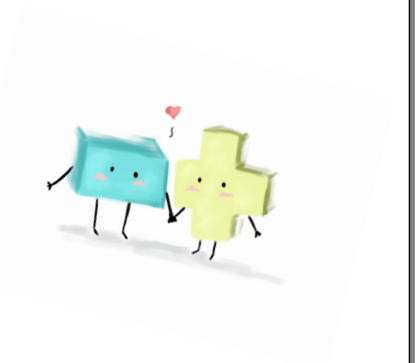
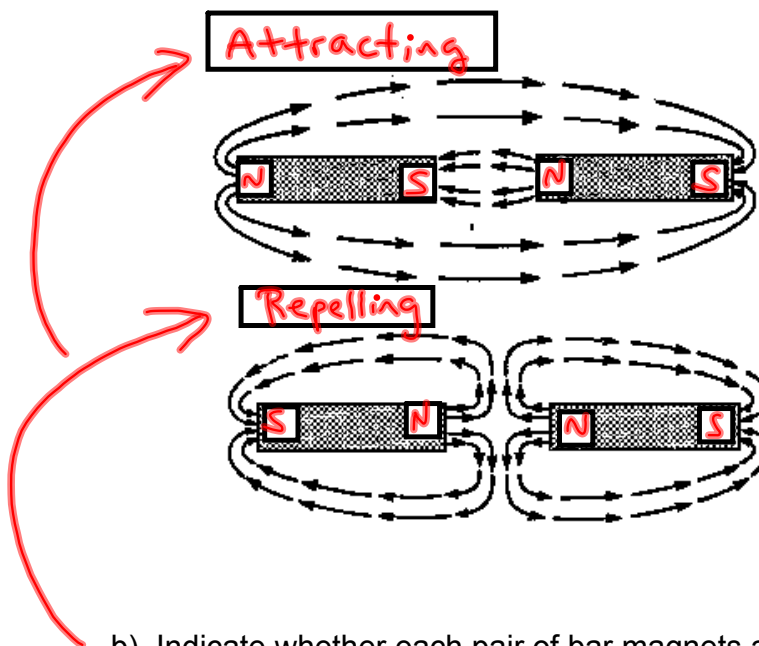
a) If one of the charges is tripled then how will the force between the charges be affected?

$$Q_1 \uparrow 3X ; \therefore F \uparrow 3X$$

b) If the distance between the charges is increased from 6cm to 12cm then how will the force between the charges be affected?

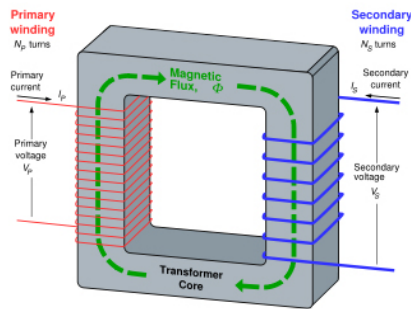
$$d \uparrow 2X \therefore F \downarrow \frac{1}{4} X$$

16. a) Label the poles on the bar magnets below.



b) Indicate whether each pair of bar magnets are attracting or repelling each other.

17.
 $P = VI$
 $\uparrow \downarrow$



$P = VI$
 $\downarrow \uparrow$

a) Is this a step-up or step-down transformer? How do you know?

Less coils in the secondary.

b) Is the current intensity at the input of the transformer greater than, less than, or equal to the current intensity at the output of the transformer.

Less than.

c) Is the potential difference at the input of the transformer greater than, less than, or equal to the potential difference at the output of the transformer?

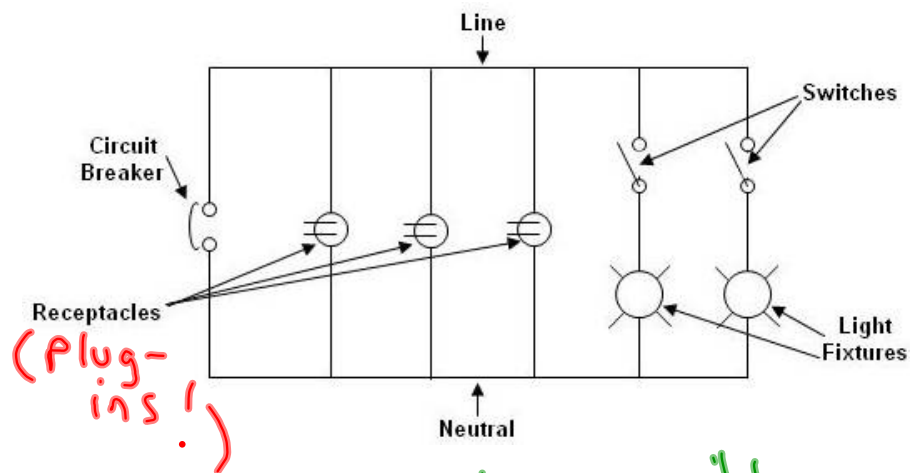
greater than

d) Give an example of where such a transformer might be found.

e.g. transformer outside house

OR transformer in ipod adapter.

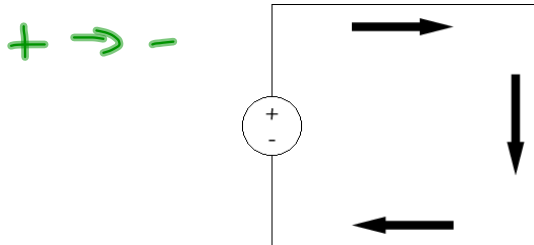
18. Consider the household circuit below. If you were to plug in your hairdryer to one of the receptacles, would electricity be able to flow into the hairdryer? Explain.



Yes, because it's a parallel circuit.

19. Indicate whether each of the statements below is true or false.

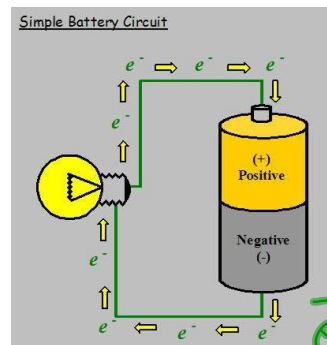
a) The diagram below is showing the direction of conventional current:



Ans: True

b) The diagram to the right shows the direction that electrons flow in a circuit:

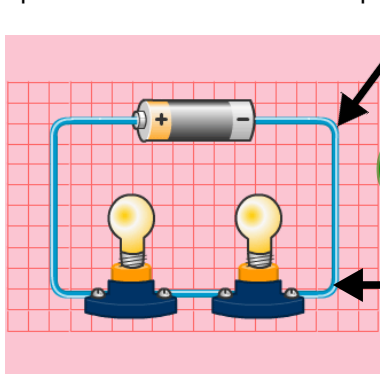
Ans: True



actual current

$- \rightarrow +$

- c) The voltage between the two points indicated by the arrows below is equal to one-half the \mathcal{E} of the power supply.



Ans: False

- d) In the picture to the right the switch in an electrical circuit is being opened.

Ans: False



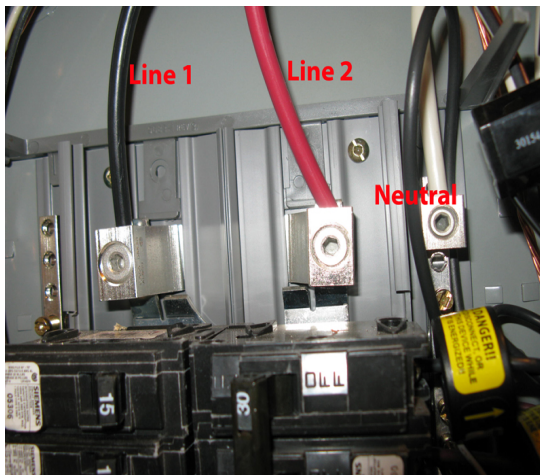
- e) If the \mathcal{E} powering an air conditioner is increased, the current intensity flowing through the resistor will also increase.

Ans: True

$$\mathcal{E} = IR$$

↑ ↑

- f) The wires below (black, red and white) are entering the distribution panel of a home. There is only one combination of these wires that can carry 120 V to a circuit.

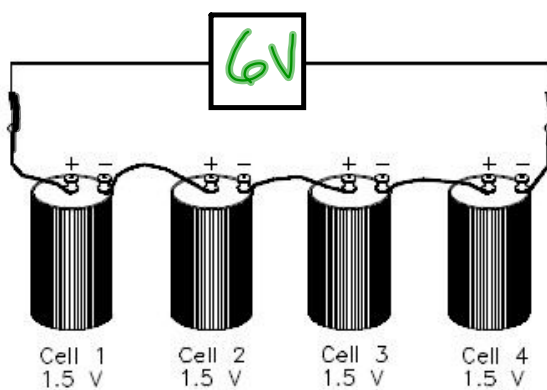


Ans: False

Red + white → 120V
OR
Black + white → 120V

20. Indicate the amount of the electromotive force being supplied to the component represented by the square below:

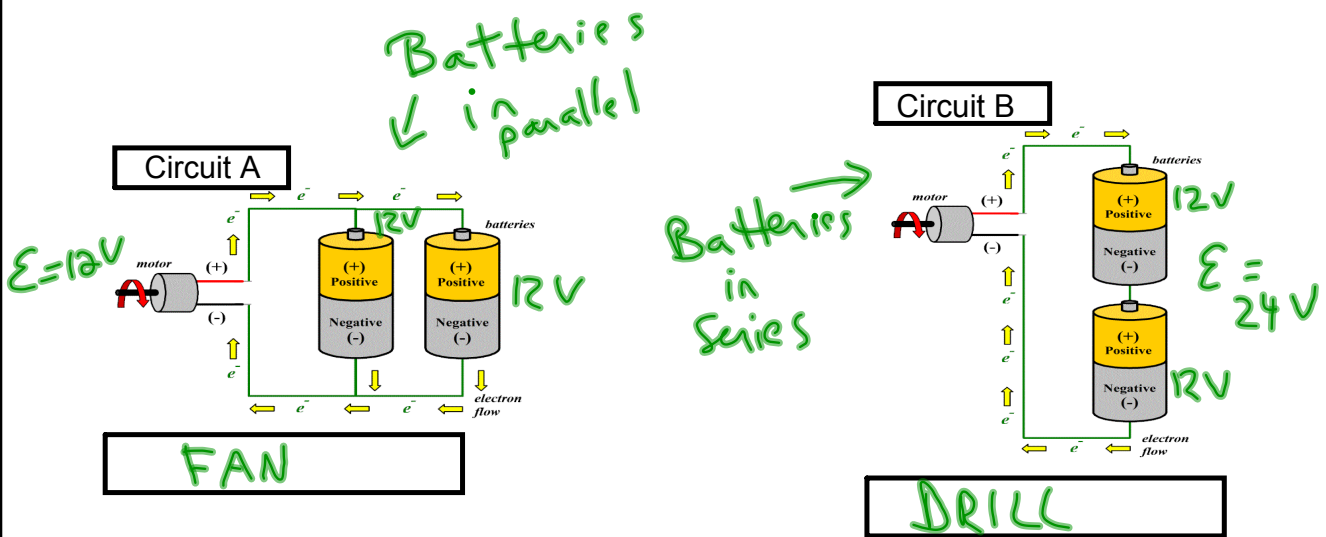
Batteries
connected
in
series



Explain your answer:

Batteries in series :
 $\mathcal{E} = V_1 + V_2 + V_3 + V_4$

21. The batteries below are each 12 V batteries. One of the circuits below is supplying 24 V to a drill. The other circuit is supplying 12 V to fan. Place either the word "DRILL" or "FAN" in the box under each circuit drawing. Then, explain how you reached your decisions.

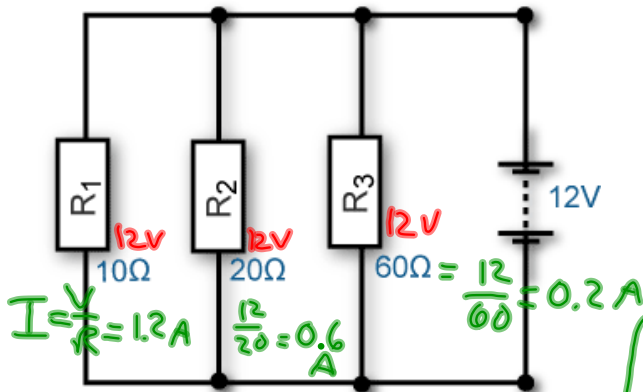


Explanation: A: In parallel... $\mathcal{E} = 12V$

B: In series... $\mathcal{E} = 24V$

22. In the circuit diagram below, determine the value of I_T , the current supplied by the power supply. All formulas and calculations must be shown.

(4)

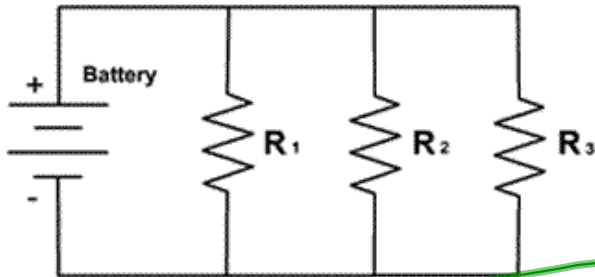
 $I_T ?$ 

$$I_T = I_1 + I_2 + I_3$$

$$= 1.2A + 0.6A + 0.2A$$

$$I_T = 2A$$

23. In the circuit diagram below, determine the value of \mathcal{E} , the electromotive force. All formulas and calculations must be shown.



$$R_1 = 10 \Omega$$

$$R_2 = 15 \Omega$$

$$R_3 = 20 \Omega$$

$$I_t = 13.3 \text{ A}$$

$$\mathcal{E} = ?$$

$$\mathcal{E} = I_t R_{eq}$$

$$\mathcal{E} = (13.3 \text{ A}) (4.61 \Omega)$$

$$\mathcal{E} = 61.3 \text{ V}$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

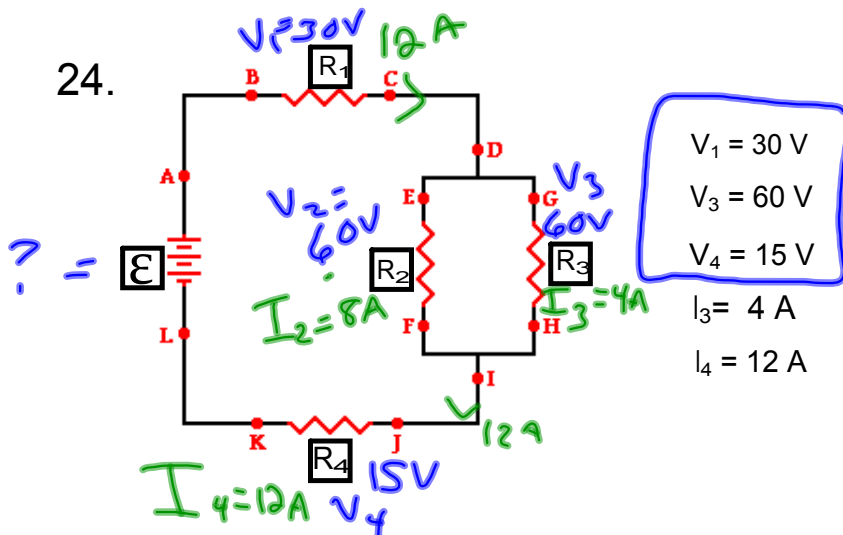
$$\frac{1}{R_{eq}} = \frac{1}{10} + \frac{1}{15} + \frac{1}{20}$$

$$\frac{1}{R_{eq}} = 0.1 + 0.067 + 0.05$$

$$\frac{1}{R_{eq}} = 0.217$$

$$R_{eq} = \frac{1}{0.217}$$

$$R_{eq} = 4.61 \Omega$$



Without calculating, based only on your understanding of voltage and current laws, find the values below. Explain your answers.

- a) $V_2 = 60V$ because: $V_2 = V_3$ since they're in parallel
- b) $I_1 = 12A$ because: $I_1 = I_4$
- c) $I_2 = 8A$ because: $I_2 + I_3 = 12A$
- d) $\mathcal{E} = 105V$ because: $\mathcal{E} = 30V + 60V + 15V$

25. For each of the battery types below, identify one advantage and one disadvantage. Also, cite one type of technological device for which each would be recommended to use.



advantage: last longer
between uses

disadvantage: more waste
in landfill

device used in: smoke detector



advantage: reusable; don't
end up in landfill

disadvantage: discharge quickly
when not in use

device used in: X-box controller

26. Explain why the plastic wrap sticks to the bowl!



Wrap is charged in factory.
There are little "pockets" of + and -
charge so wrap will "stick" to itself.

27. The following statements are related to electric motors and generators:
For each sentence, fill in the missing word (from the words below).
Some words will be used more than once.

1. The rotor is the mobile part of an electric motor.
2. The stator is the stationary part of an electric generator.
3. A motor converts electrical energy into mechanical rotational energy.
3. In a generator the mechanical rotation of a conducting coil in a magnetic field produces an electromotive force in the coil.
4. The power of a generator can be increased by adding turns to the electromagnet coil.
5. The power of an electric motor can be increased by increasing the voltage of the power supply.
6. A motor uses electricity.
7. A generator produces electricity.

generator rotor voltage
 motor stator