Chapter 11 – Static Electricity – Answers to Homework Questions

11.1 What is Static Electricity?

2. Static electricity is an imbalance of charge on an object or in other words, it's when an object has a positive or negative charge on it.

3. a) Protons and neutrons are difficult to add/remove from an atom

b) Electrons are easier to add/remove from an atom

c) Electrons can move between objects. If there is an excess of electrons, the object is charged negatively. IF electrons leave an object and there is a deficit of electrons, then the object is charged positively.

4. Fig. 13 shows a neutral object because there is equal # of positive and negative charges.
Fig. 14 shows a negatively charged object because there is more negative charges than positive charges.

5. For this object to be neutral, 2 more electrons must be added to it. (remember, protons can't move!)

6. To make this object positively charged, electrons (-ve) would have to leave. To make this object negatively charged, electrons would have to be added to it.

7. a) Opposites attract so +ve and –ve objects would attract.
Same charges repel, so –ve and –ve objects would repel.

8. a) Because opposite charges attract, the negative paint would be attracted to the positively charged object.

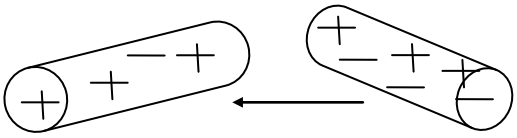
b) Electrostatic paint sprayers are beneficial because they reduce the amount of wasted paint and ensures that the object is evenly painted...even on the back side of the object.

11.2 Charging by Contact

1 a) Glass & silk: silk will gain electrons and become –ve charged while glass will become +ve charged
Ebonite & fur: ebonite will become –ve and fur will become +ve
Human hair & rubber balloon: balloon will become –ve and hair will become +ve
Amber & cotton: amber will become –ve and cotton will become +ve

2 Some objects become charged when rubbed together because different materials have greater or lesser tendancy to gain electrons. Those that gain electrons become –ve and those that lose electrons become +ve. This is called 'charging by friction'.
Draw a diagram similar to Fig. 2 in text (comb and hair)

3 Charging by conduction occurs when 2 differently charged objects touch. The electrons move to try to balance the charges.



+ve object

Neutral object

In this case, electrons would move from right object to left. 1 electron would move. This means the left and the right object would both be charged +ve.

4 Charge by friction

- 2 objects required
- Objects are rubbed together
- 2 objects are charged differently (+ and -)

Charge by contact (conduction)

- 2 objects required
- Objects need to just touch
- 2 objects become the same charge

5 a) Electrons move between the 2 objects (always electrons!)

b) Electrons move from X to Y. They move from an area of highly –ve to an area of less -ve

6 When a +ve charged object is grounded, electrons from the ground move to the object to neutralize it.

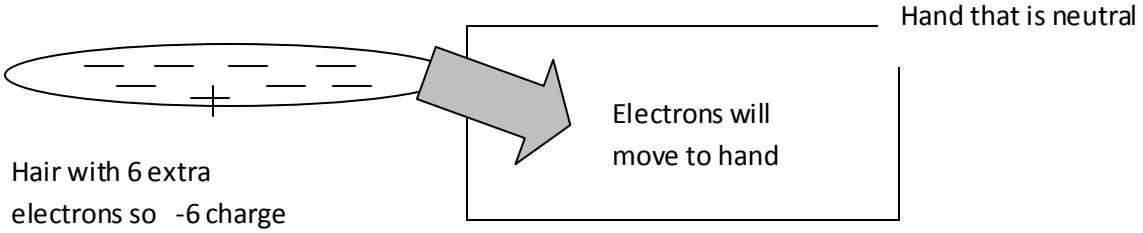
11.4 Conductors and Insulators

1. A conductor is a material that allows electrons to easily move through it. ie: copper and aluminum (many metals actually). Humans are not bad conductors either (unfortunately)
   An insulator is a material that doesn't allow electrons to move easily through it. ie: wool, plastic
2. Salt water conducts electricity better than pure water. This is because salt water has ions in it which are charged particles. Charged particles allow the flow of electrons. Pure water does not contain ions and is not a good conductor. The water in your home has dissolvesd ions in it and so is a fair conductor of electricity. One should be careful with electricity around water in the home for this reason.
3. If I held an insulator and touched a conductor with electricity running through it, I would NOT get a shock. The insulator would prevent the electricity from passing through to me.
4. I could touch a 'live wire' (current running through it) with the insulator and the conductor. If I used the conductive material, I would get an shock. If I used the insulating material, I would NOT get a shock. (like Brainiac video) This can be dangerous! So instead, I could put both these materials separately into a simple circuit of electricity (like pHet simulation). The conducting material would allow electricity to flow and a lightbulb in circuit would stay on. An insulator would not allow electricity to flow and light bulb would go off.
6. Electricians use screwdrivers with rubber handles to protect themselves. Rubber is an insulator and just in case they touch a live wire with electricity running through it, the rubber should protect them from receiving a large shock!

11.8 Electric Discharge

1 If you are working with electric equipment, you should make sure it is off! Also, you should use tools with insulating handles to protect yourself. You could also wear shoes with insulating soles so electricity cannot pass through you to 'ground'.

2 a)



The movement of electrons from hair to hand will neutralize or 'ground' the hair.

3 You might wish to talk about charged up yourself by walking across the carpet in your socks and then 'discharging' yourself by touching a friend. This gives your friend a 'shock'. Really, you just discharged on the friend or grounded yourself on your friend!

4 Lighting can cause forest fires. This affects the economy in that money must be spent to put out the fire. Lightning can also damage hydro electric wires and again, money must be spent to repair the damage.

5. The bottom of the cloud is often –ve charged while the top is +ve charged. The bottom of the cloud could discharge to the top of a cloud. This creates the lightning we see in the sky!