Exercises

Intermediate Chemistry Exercises

1. You mix together two chemicals and notice that the outside of the container feels like ice. What type of reaction is it?

2. You test a solution with litmus paper and find that there's no change in the color of the paper. Is it acidic or basic?

3. You need a source of oxygen for an experiment. How would you generate it? Would you use a catalyst?

4. Your fish tank is registering a pH of 6.8. Is your tank acidic or basic?

5. What type of reaction is a campfire? Nail rusting? Turning lead into gold?

6. You have two test tubes that both contain a clear gas. One is hydrogen, the other oxygen. Which one will ignite with a match? Why doesn't the other ignite?

7. You have two containers, one with lightweight helium and the other with heavier neon gas. What happens to the temperature of both when you squish the containers down to half their original size?

8. What is the difference between a highly corrosive acid and a strong acid?

9. How many protons are in a copper atom? How many electrons? Neutrons?

10. What's a 'mole'? Why bother using the 'mole' to measure stuff in chemistry?

11. What are the most dangerous chemicals in your set?

12. What are the most important lab skills to master in this unit?

13. You want to build a vehicle that runs only on sunlight and water (no batteries). Draw out the experiment you would use to get energy from water. What type of chemical reaction are you using?

Answers to Intermediate Chemistry Exercises

1. An endothermic reaction needs energy in order to happen. The energy comes from the molecular bonds itself as they break apart to form new bonds with the new chemicals in the solution.

2. Basic solutions do not change blue litmus paper. They can reverse a piece of litmus paper previously dipped in an acidic solution back to blue.

3. Leave a container of hydrogen peroxide out on the counter and stick a balloon over the neck of the bottle to capture the gas. To speed this reaction, add in a crushed lump of charcoal.

4. The fish tank is acidic. And this pH level is preferred by most fresh water fish.

5. A campfire is a combustion reaction.

   A nail rusting is a synthesis reaction: the iron (Fe) in a nail combines with oxygen (O_2) to form rust, also called iron oxide (Fe_2O_3). Here's the chemical equation for this reaction: $2Fe + O_2 \rightarrow Fe_2O_3$.

   Turning lead into gold is a nuclear reaction, not a chemical reaction, as it requires altering the nucleus of an atom using a linear accelerator.

6. The hydrogen ignites when a match is brought to it. The oxygen will not ignite, as oxygen is not a fuel source.

7. Both gases behave the same, no matter what atomic weight they have, so using the Ideal Gas Law, you can estimate that the temperature of both doubles when you squish the containers down to half their original size.

8. Here's the difference between acid strength and corrosiveness: strong acids are quick to donate protons. Corrosive substances are highly reactive (like the HF example). Even though HF is super-corrosive, it's not a strong acid because it does not completely dissociate (break apart into H^+ and Fl^-) in water.

9. Copper has the atomic number 29, which means it has 29 protons in the core and 29 electrons in the shells. The atomic weight of copper is 63.546, so rounding up gives an atomic weight of 64. Since electrons are so lightweight, they really don't add to the overall mass of the atom compared to the protons and neutrons. The number of protons

and neutrons need to add up to give the atomic weight of 64. So the number of neutrons in the nucleus is 64 – 29 = 35.

10. A mole is a unit of measurement, just like inches or meters. Since chemical reactions take place on such a small scale, the unit of the mole was invented to help keep track of the particles interacting with each other. One mole is the amount of a substance that has the same number of particles as found in 12 grams of carbon C-12. How many particles, you ask? 602,214,150,000,000,000,000,000 particles to be precise. Or in shorter notation: 6.022×10^{23} particles. This special number is called Avogadro's constant, and since "mole" is a lot easier to write than 6.022×10^{23}, chemists like to use it to help keep track of the particles in a chemical reaction. It's a handy way to convert between atoms and grams, or even molecules and grams.

11. The most dangerous chemicals in your set are:

    a. C1000 & C3000: Potassium Hexa-cyanoferrate(II) – do not release this back into the environment, as it is harmful to aquatic organisms, , so dispose of in container as directed. Do not inhale the dust, and avoid contact with skin and eyes.

    b. C1000 & C3000: Hexamethyl-eneteramine – flammable, do not inhale the dust and avoid contact with skin, always wear protective gloves when handling.

    c. C1000 & C3000: Copper Sulfate – wear protective gloves and glasses when handling, very poisonous to aquatic organisms, so dispose of in container as directed. Do not release into environment.

12. The most important lab skills to master in this unit are: don't eat anything in your chemistry lab, keep children and pets away from your lab, lock up your chemicals safely, learn how to store your chemicals safely, and don't create large quantities of anything explosive, corrosive, or toxic. Always wear safety equipment and do your experiments in a spot what has plenty of air for ventilation, water and a drain, and a phone.

13. Refer to the Electrolysis experiment to split the water molecule into oxygen and hydrogen. Use a solar cell to provide electricity for the electrochemical cell and capture the gases in individual tanks. When you combine the two gases, you will get water and electricity as an output. This is exactly how a fuel cell works.

