**Student Instructions Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Introduction to Polymer Chemistry #\_\_\_\_\_\_**

In this laboratory, you will break down the polymer starch into its monomer glucose, precipitate a latex polymer, and synthesize nylon. Be sure to wear goggles at all times during this lab!

**Materials needed at each station:**

Goggles, 4 test tubes, test tube rack (get the ones the test tube won’t fall through while carrying), stirring rod (rinse well between experiments), disposable cup (plastic), wire, hot plate; 250-400 ml beaker, test tube holder, beaker tongs, hot ‘mitt’, Benedict’s solution, Apron (optional)

**Materials (stock solutions) in plastic tub or on counter (do NOT bring the stock solutions to your station!):** Ethanol, Glucose solution, Starch solution, latex, wax pencil

**Materials in hood (obtain them there AND GIVE EACH OTHER SPACE!): 6M HCl; Hexandiamine; Sebacoyl chloride solutions**

**Experiment 1: Starch Polymer**

1. Obtain three test tubes. Label one tube “Glucose”, a second tube “Starch Control”, and the third tube “Starch + Acid”. Use wax pencil to label
2. Pour or pipette 2-3 mL (about 1-2 cm deep in your test tube) of glucose solution and the same volume of starch solution into the corresponding test tubes. You can use disposable graduated pipets or graduated cylinder. DO NOT CROSS CONTAMINATE SOLUTIONS!
3. Triple the volume of the “Glucose” and “Starch Control” tubes with Benedict’s solution (~ 6 ml) and place the two tubes into a boiling water bath for five to six minutes. Make sure the test tubes are pointed away from you! (\**You can put tubes in water before it starts boiling*)
4. After five to six minutes of boiling, observe the two tubes.

Do you see a change in either tube?

 Which tube(s) changed? Describe.

For which solution(s) is Benedict’s solution a positive test?

1. Now get the test tube labeled “Starch + Acid” and add 2-3 mL of starch. Go to the hood and add ~ 10 drops (1 ml) of hydrochloric acid.
2. Place the tube into a boiling water bath for 15 minutes. Go on to the next section (Exp 2) during the 15 minute boiling period.
3. After 15 minutes, retrieve the solution, triple its volume with Benedict’s solution (~ 6 ml), and place it back into the water bath for five minutes.
4. Now observe the solution.

Describe any changes after the treatment with hydrochloric acid and Benedict’s.

Explain why this happened.

What is the monomer that makes up the starch polymer?

\*\*Additional Questions:

9- Show the reaction mechanism for secondary or tertiary alcohol’s reaction with HX. Be sure to show the carbocation intermediate. (\*If we haven’t done this in class yet, fill this in later)

10- How does the above mechanism pertain to this lab? EXPLAIN.

**Experiment 2: Precipitation of Latex**

1. Obtain one of the disposable cups and pour ~ 10 mL latex into it.
2. Pour 10 mL 95% ethanol into the latex and mix well with a stirring rod or wooden stick.

What happens to the latex? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Wash the product thoroughly with tap water. Observe its elasticity**. Describe.**

**Experiment 3: Synthesis of Nylon 6, 10**

1. Obtain another test tube and the chemicals sebacoyl chloride and hexanediamine from the hood. Be careful! These chemicals are very volatile.
2. Pour about 2 mL (1 cm) hexanediamine into the test tube.
3. **Carefully** pour the same amount of sebacoyl chloride down the side of the test tube **on top** of the hexanediamine. **Caution: Do not mix!**
4. What do you see at the interface of the two layers?
5. Get a piece of wire and bend one end to form a hook. Lower the hook into the bottom layer of chemicals and lift it. A strand of nylon will be pulled behind the hook. Carefully, see how far you can stretch it.
6. Wash off the strands of nylon with water. Lay them on absorbent paper towels to dry.
7. Observe the elasticity of the nylon strands after they have dried. **Describe.**

8- Here is the reaction that occurred. Generally speaking, **what does the bracket and the x indicate**?

H₂N(CH₂)₆NH₂ + ClCO(CH₂)₈COCl → [-NH(CH₂)₆NHCO(CH₂)₈CO-]x

Hexanediamine Sebacoyl Chloride Nylon 6, 10