Chemistry Bridging Work

Welcome to A – Level Chemistry at Kings Langley School. We look forward to welcoming you to the course in September, when we will provide further information about the structure of the course.

In preparation for September, we would like you to complete some work which will give you:

- an opportunity to revisit some of the topics covered at GCSE
- a taste of some of the content of the A-level course
- an introduction to some of the topics covered
- an indication of the academic demand of the course.

Focus of Bridging work

To be successful on this course, you must be able to work independently. Content will be covered in class, but the majority of the learning, revision and practice takes place outside of lessons. Part of managing the transition between GCSE and A-level is ensuring you are fully aware of the expectations for independent work. One aspect of working independently is being able to manage your time to ensure you complete all the work to a high standard.

The knowledge and skills required for this Bridging work is mostly at GCSE level, but you will need to apply your knowledge and skills to unfamiliar contexts, as well as use your research and problem-solving skills.

Please complete this task on lined paper.

TASK

1. Watch this video as an introduction to polymers: **https://www.youtube.com/watch?v=rHxxLYzJ8Sw**

2. Read the information about the discovery of poly(ethene) below and work through the questions.

Polymers

Poly(ethene) was discovered by accident. The chemical company ICI was carrying out research into new dyes in the 1930s when two chemists Eric Fawcett and Reginald Gibson accidently synthesised this new polymer. They were studying the reaction between ethene and benzaldehyde under a pressure of 2000atm; they hoped to make a ketone. The reaction was left to run over the weekend and when some ethene was lost due to leakage they added more ethene. When the reaction vessel was opened, a white waxy solid was found and on analysis it was shown to have the empirical formula CH_2. They called it polyethylene as ethylene was the traditional name for ethene. The synthesis was repeated several times, sometimes successfully and sometimes with explosions. Because of the risky nature of the synthesis, development was stopped in 1933 but by 1935 engineers had constructed a reactor vessel that could withstand high pressure and work recommenced in December 1935. Controlling the pressure allowed

the chemists to control the molar mass of the polymer and after one month the researchers had produced enough material to show that it could be moulded and was an electrical insulator. The first poly(ethene) products appeared in shops in 1948. Today we commonly use two types of poly(ethene) as described below.

High-density poly(ethene), HDPE
Made at atmospheric pressure
Ziegler-Natta catalyst, Titanium (IV) chloride + triethylaluminium
Molecules have little branching
Density: 0.95-0.97 $g.cm^{-3}$
Harder and stiffer than LDPE, less easily softened on heating

Low-density poly(ethene), LDPE
Made at high pressure (15 atm)
Branched molecules
Density: 0.91-0.94 $g.cm^{-3}$
More flexible than HDPE, withstands bad weather well

Polymers are made up of thousands of repeating monomers. The monomer that joins together to form Poly(ethene) is ethene.

a. What is the molecular formula for ethene?

b. What is the Mr of ethene?

c. Draw the displayed formula for ethene

d. Draw a dot and cross diagram to show the covalent bonding in ethene

3. Ethene is an alkene. What is the general formula for an alkene?

4. Ethene is produced in a process called cracking. Large hydrocarbons such as octane are cracked to form smaller alkanes and alkenes.

a. What is a hydrocarbon?

b. How many carbons does octane contain?

c. What is the natural source of octane?

d. Which process is used to separate out octane from other hydrocarbons in this source?

5. Since polyethene was discovered, scientists have been able to manufacture many more synthetic polymers. Copy the table below. For each of the synthetic polymers below, draw a diagram to show the monomer that makes up the polymer and state a use of that polymer.

Polymer name	Diagram of Monomer	Use
Poly(chloroethene)		
Poly(propene)		
Poly(styrene)		
Poly(tetrafluoroethene)		

6. When polymers form from alkenes, the double bond between the carbon atoms of one monomer breaks, and a new bond forms between two monomers

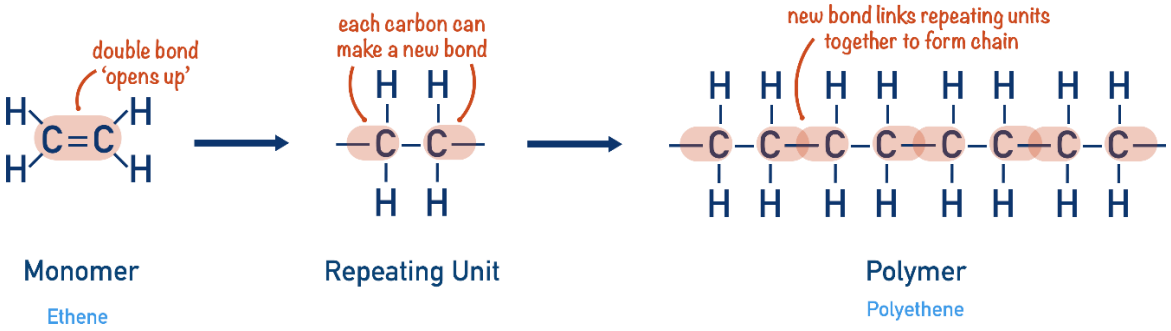

Figure 1

7. Use the information at the top of page 2 to answer the questions below:
    a. What property of LDPE makes it suitable for food packaging?
    b. With reference to the **structure and bonding** in LDPE and HDPE, explain why HDPE has a higher melting point. (Hint: You will need to research the effect of branching on melting point)

8. Choose one of the synthetic polymers from the table above. Using **Figure 1** above to help you, draw a diagram to show the monomer, repeating unit and polymer consisting of a chain of three monomers.

9. Poly(aniline) is a compound that has been of interest since the 1980s because of its electrical conductivity and mechanical properties. Poly(aniline) is one of the most studied conducting polymers. To synthesise poly(aniline), the monomer aniline is first reacted with Hydrochloric acid to produce anilium chloride. HCl is regenerated at the end of the reaction. Anilium chloride is then oxidised so that polymerisation can take place. Ammonium persulfate is used as the oxidising agent.

    a. Explain how the information above shows that the HCl acts as a catalyst.

b. What is the purpose of the oxidising agent?

c. The second part of the equation is shown below.

$4C_6H_5NH_3Cl + 5(NH_4)2S_2O_8 \rightarrow 5C_{24}H_{20}N_4Cl_2 + 2HCl + 5H_2SO_4 + 5(NH_4)_2SO_4$

Anilium chloride + Ammonium persulfate → Poly(aniline)

The M_r of poly(aniline) in this equation is 435.36 but in reality, it would be much larger. The molar ratios however will be the same no matter how large the molecule is. This is the simplest balanced chemical equation. If you had 0.5g anilium chloride, theoretically, what mass of poly(aniline) would be produced in this reaction?

d. The actual mass of poly(aniline) produced was 0.202g. What is the percentage yield of this reaction?

10. HCl(aq) is used as a catalyst in this reaction. HCl(aq) is a strong acid.
    a. Give a definition of a strong acid

    b. Give the ions found in HCl(aq)

    c. Explain the charges on the ions found in HCl

    d. The pH of the acid is related to the concentration of hydrogen ions in the solution.

        i. State the equation used to determine the concentration of H^+ given the pH

        ii. What is the concentration of H^+ if the pH of the solution is 3.6?