Question 30 (8 marks)

(a) Compare the process of polymerisation of ethylene and glucose. Include relevant chemical equations in your answer. **3**

Addition polymerisation is used to produce polyethylene from ethylene. In addition polymerisation, bonds are rearranged in the monomer to form the polymer with no loss of species. For example in ethylene, the double bond breaks and a chain is formed with multiple units ⇒ $n(CH_2=CH_2) \rightarrow (CH_2-CH_2)_n$.
In the polymerisation of glucose, condensation polymerisation is used. A reaction occurs between the two functional groups of the glucose monomer and two monomers join, resulting in the loss of a small molecule (water). This process can continue to create a large macromolecule, with the condensation process repeating each time.

Question 30 continues on page 22

$$n(C_6H_{12}O_6) \longrightarrow n(C_6H_{10}O_4) + (n-1)H_2O$$

Question 30 (continued)

(b) Explain the relationship between the structures and properties of THREE different polymers from ethylene and glucose, and their uses. **5**

Ethylene can be used as a monomer to produce high density polyethylene (HDPE). HDPE consists of densly packed linear chains of polyethylene without side branching. This results in a strong rigid plastic due to the large amount of dispesion forces. As a result it has found applications in garbage bins, childrens toys and hard bottles as it is also relatively unreactive. Polystyrene is also derived from ethylene and a benzene ring. Polystyrene is a hard plastic with strong dispesion forces due to the rigid structure provided by the benzene ring. If a foaming agent is used, polystyrene foam is lightweight and a good insulator, hence it is used in disposable coffee cups and the insides of surfboards.

End of Question 30

Rayon is a polymer derived from cellulose which in turn contains glucose. Rayon has a strong structure and can be manufactured into thread that can then be ~~used~~ woven into fabric. The strength is due to the rigidity of the polymer structure through its high molecular weight and dispesion forces.