**Proteins**

Enzymes are protein molecules which are biological catalysts. The action of an enzyme is highly dependent on shape, which in turn is dependent on the primary, secondary and tertiary structure of the protein. Using an enzyme in industrial synthesis can have economic benefits, but care must be taken to ensure that pH and temperature do not result in the denaturation of enzymes.

* Explain what is meant by ‘primary’, ‘secondary’ and ‘tertiary structure’ including examples where appropriate.
* Explain how pH and temperature can lead to denaturation of enzymes, and why this would be disadvantageous in chemical synthesis

Primary structure:

1. Order of amino acids
2. Example of primary structure

Secondary structure:

1. Alpha-helix and beta-pleated sheets
2. Due to H bonding between carbonyl (C=O) and amine (N-H) groups from polypeptide chain
3. Diagram for alpha-helix
4. Diagram for beta-pleated sheet

Tertiary structure:

1. Due to interactions between side-chains from different amino acids
2. Hydrogen bonding (+ example)
3. Disulfide bridge (+ example)
4. Dispersion force (+ example)
5. Ionic bond (+ example)

Denature

1. Change shape of protein
2. Stops ability to work as a catalyst
3. pH affects ionic bonds
4. temperature affects dispersion forces

**Soaps and Detergents**

Discuss the chemistry of soaps and detergents, including their structure, manufacture, ability to act as a emulsifier and effectiveness in hard water.

1. Example of soap structure
2. Reaction of soap (words)
3. Reaction of soap (equation)
4. Example of detergent structure
5. Reaction of detergent (words)
6. Reaction of detergent (equation)
7. Polar head dissolves in water
8. …through hydrogen bonding/ion dipole forces
9. Non-polar tail dissolves in grease
10. …through dispersion forces
11. Appropriate image
12. Hard water contains Ca2+, Mg2+
13. Soaps form soap scum
14. Equation for soap scum
15. Detergent do not form a precipitate

**Polymer Option #1**

Using examples, describe ‘addition polymers’ and ‘condensation polymers’ (including polyesters and polyamides).

Your answer should include:

* an explanation of the term ‘polymer’
* the structure and name of an example of type of polymer (including polyesters and polyamides)
* structures of starting materials for each example of a polymer type
* polymerisation reactions

1. Polymer is large molecule made from combination of many small molecules (monomers)

**Addition polymers**

1. Description of how they are formed (e.g. alkene monomers do addition)
2. Name of an addition polymer
3. Structure of addition polymer
4. Monomer for addition polymer
5. Reaction for addition polymer

**Condensation polymers**

1. Formed from condensation reaction between COOH and –OH or –COOH and –NH2.
2. Name of a polyester
3. Structure of polyester
4. Monomer for polyester
5. Reaction for addition polymer
6. Name of a polyamide
7. Structure of polyamide
8. Monomer for polyamide
9. Reaction for addition polyamide

**Polymer Option #2**

The uses of polymers are directly related to their properties. These properties are determined by structure, which can in turn be influenced by:

1. Changing operating conditions during synthesis (i.e. temperature and pressure)
2. Changing the types of monomers (i.e. producing different types of polymers)

Discuss the production, structure, properties and uses of low density polyethene (LDPE), high density polyethene (HDPE) and another (non-polyethene) polymer of your choice. As part of your answer you should demonstrate the link between structure, properties and uses for each polymer.

1. Polyethene reaction and structure
2. HDPE = linear chains vs LDPE branched chains
3. HDPE conditions (low temp, atmospheric pressure)
4. HDPE strong dispersion forces
5. HDPE properties *(at least 2)* (e.g. rigid, opaque, impervious to water)
6. HDPE uses *(at least 2)*
7. LDPE conditions (high temp, high pressure)
8. LDPE weak dispersion forces
9. LDPE properties *(at least 2)* (e.g. flexible, opaque)
10. LDPE uses
11. Other polymer – structure
12. Other polymer – reaction
13. Other polymer – properties *(at least 2)*
14. Other polymer – uses *(at least 2)*
15. Other polymer – Link between structure and properties

**Production of Ethanol**

Most of the world’s ethanol is produced from one of the following two methods: the hydrolysis of ethene or fermentation.

Compare these two methods for producing ethanol, including:

* the source of feedstock for each process
* the reaction conditions used
* the catalyst used in each reaction
* the environmental effects of using each type of ethanol as a fuel source

**Hydrolysis of ethene**

1. Hydrolysis equation
2. Source: ethene from catalytic cracking of fossil fuels
3. Temperature: 300 °C
4. reasons (high 🡪 rate, low 🡪 yield)
5. Pressure: 60-70 kPa
6. reasons (high favours rate + yield, too high = polymerisation)
7. Catalyst: H+

**Fermentation**

1. Fermentation equation
2. Source: plant materials
3. Uses enzymes from yeast
4. Temperature: 37 °C
5. (optimum temperature for enzyme)
6. Pressure: 1 atmosphere

**Environmental effects**

1. Fermentation is carbon neutral. (And brief description of what carbon neutral refers to)
2. Burning ethanol from hydration adds new carbon dioxide to atmosphere. (and brief elaboration re: climate change / greenhouse effect / ocean acidification)

**Amino acids**

“Amino acids are an important category of organic molecules. Discuss the chemistry of amino acids, including:

* The chemical structure of amino acids, including alpha- amino acids
* The effect of pH on the structure of amino acids
* How this structure is linked to the physical properties of amino acids ( i.e. melting point and solubility)
* How amino acids are able to form long polypeptide chains”

1. General structure of amino acid
2. Explanation of what is meant by **alpha**-amino acid
3. Forms zwitterions in neutral solution
4. Forms positive ions in acidic solution
5. Forms negative ions in basic solution
6. Ionic bonding between zwitterions
7. Higher melting and boiling point than other organic substances
8. ------ due to ionic bonding being stronger than intermolecular forces
9. Soluble in water
10. ------ due to formation of strong ion-dipole forces between +/- ion charges and water molecules
11. Insoluble in non-polar solvents
12. ------- due to dispersion forces between solute and solvent being weaker than ionic bonding in solid
13. Undergoes condensation reactions with other amino acids
14. -------- which links the chains via an amide/ peptide group
15. Equation for condensation reaction