



Science Department

Year 12 Chemistry ATAR

Organic Synthesis

Name: ANSWERS

Instructions to Students:

1. 50 minutes permitted
2. Attempt all questions
3. Write in the spaces provided
4. Show all working when required
5. All answers to be in blue or black pen, diagrams in pencil.

Multiple Choice	Short Answer	TOTAL
/20	/40	/60

Final Percentage

Multiple choice

1. Which of the following is not a property of most polymers?
 - a. Water-soluble
 - b. Low-density
 - c. Non-conductive
 - d. Acid-resistant

2. Which of the following is the best definition of a polymer?
 - a. A very long molecule
 - b. A giant lattice of carbon atoms in a repeating pattern
 - c. A very long covalent molecule constructed from a repeating unit
 - d. A very long molecule with no pattern to its structure

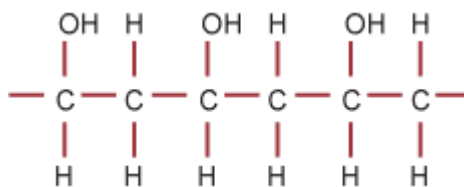
3. When addition polymers form
 - a. A double bond remains in the monomer
 - b. Delocalised electrons move along the long polymer chains
 - c. The monomers are bonded to each other by dispersion forces
 - d. A double bond in the monomer supplies the electrons for the bond between monomers

4. The bonding present in polyethene is
 - a. Covalent in the polymer chain, with dispersion forces between the neighbouring chains
 - b. Due to dipoles present in the monomers
 - c. Covalent in the polymer chain, and covalent in the crosslinks between chains
 - d. Covalent throughout because a polymer is a covalent network lattice

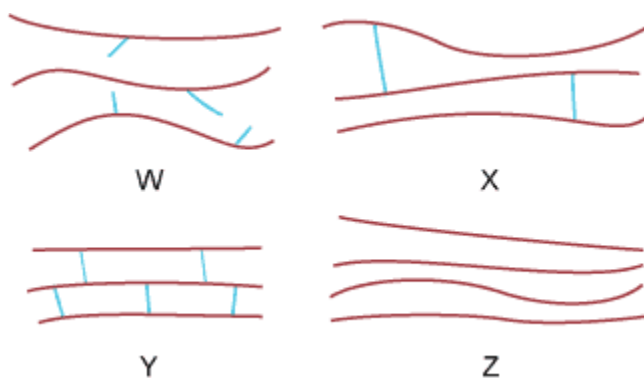
5. The melting point of a polymer does not increase with
 - a. Increased number of branches in the polymer chain
 - b. The presence of polar side groups on the polymer chain
 - c. Close alignment of the polymer chains
 - d. Increased length of the polymer chain

6. Compared to HDPE, LDPE has
 - a. Less polar monomers leading to a lower melting point
 - b. A series of crosslinks leading to a higher melting point
 - c. Much shorter molecules with weaker covalent bonds
 - d. More branches between the chains, leading to a lower melting point

7. The monomer used to form the polymer below is

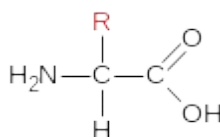


- $\text{CHOHCH}_2\text{CHOHCH}_2$
 - $\text{CH}_3\text{CH}_2\text{OH}$
 - CHOHCHOH
 - CH_2CHOH
8. Which of the following is not a common use of polyethene?
- Milk containers
 - Non-stick coating for frypans
 - Black garden tubing
 - Plastic garbage bags
9. Which of the following is not generally a difference between an addition polymer and a condensation polymer?
- During condensation polymerisation two products form, while in addition polymerisation only one product forms
 - They use different types of starting monomers
 - Condensation polymers may occur naturally, addition polymers are synthetic
 - They both use monomers with a carbon-carbon double bond
10. The structures of four polymers are modelled below. Which model best represents a polymer suitable for use as a saucepan handle?



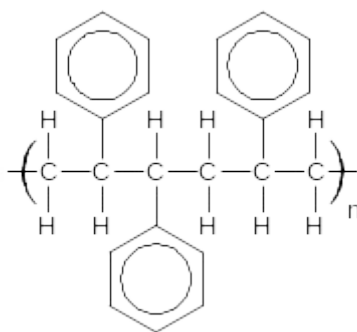
- W
- X
- Y
- Z

11. Fats and oils belong to a group of compounds known as triglycerides. The primary characteristic of oils is that they are
- long chain saturated fatty acids attached to a glycerol backbone
 - long chain unsaturated fatty acids with cis-bonds attached to a glycerol backbone
 - short chain saturated fatty acids attached to a glycerol backbone
 - long chain unsaturated fatty acids with trans-bonds attached to a glycerol backbone
12. Protein structure is organised into a number of different levels based on different interactions between atoms in the molecule. The level of structure dependent on the N-H group on the amino acid residue is known as:



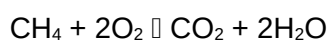
- Primary
 - Secondary
 - Tertiary
 - Quaternary
13. In the micelle that is created when soap dissolves in water:
- The hydrophobic heads repel each other to form a sphere.
 - The hydrophilic parts of the molecule are attracted to each other.
 - The charged ionic portions of the molecule interact with water.
 - The hydrophobic portions of the molecule bond with dipole-dipole forces.
14. Which of the following is not a principle of green chemistry?
- Less hazardous chemical syntheses.
 - Design for degradation.
 - Cheaper chemistry for cost-saving.
 - Inherently safer chemistry for accident prevention.
15. What is a potential issue with base-catalysed biodiesel production?
- Saponification can occur.
 - It can be a more costly process.
 - The process takes longer.
 - The process needs non-renewable feedstock.
16. By what name is the polymerisation that creates the polyester called terylene known as?
- Polyesterification
 - Addition
 - Condensation
 - Multiplication

17. What monomer is used to make the polymer that is shown below:



- a. Ethylbenzene
- b. Polystyrene
- c. Benzyl ether
- d. Styrene

18. What is the atom economy of the following reaction if carbon dioxide is the desired product?



- a. 100%
- b. 72%
- c. 55%
- d. 50%

19. In acidic solution, an amino acid will assume the following form:

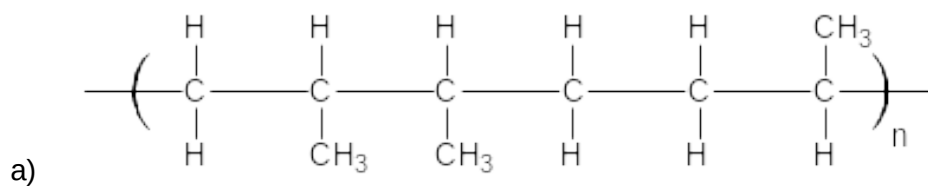
- a. Molecular form
- b. Zwitterion
- c. Anionic form
- d. Cationic form

20. The crucial link between amino acids in a protein is known as a:

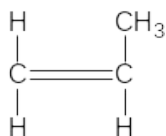
- a. Amine linkage
- b. Peptide linkage
- c. Protein join
- d. Carbonyl linkage

Short Answer

1. Give the structure of the monomers used to form the following polymers. You must also list any **by-products** formed in the reaction and you must state the **type of polymerization**. Finally, provide a possible **use** of the polymer.



Monomers



By-product (if any)

None

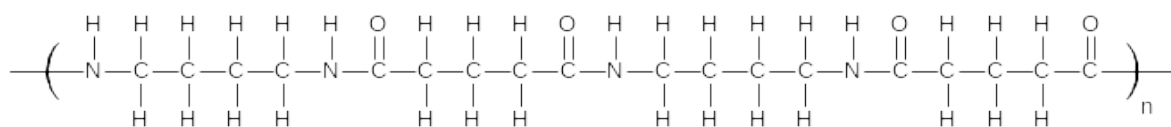
Polymerisation type

Addition

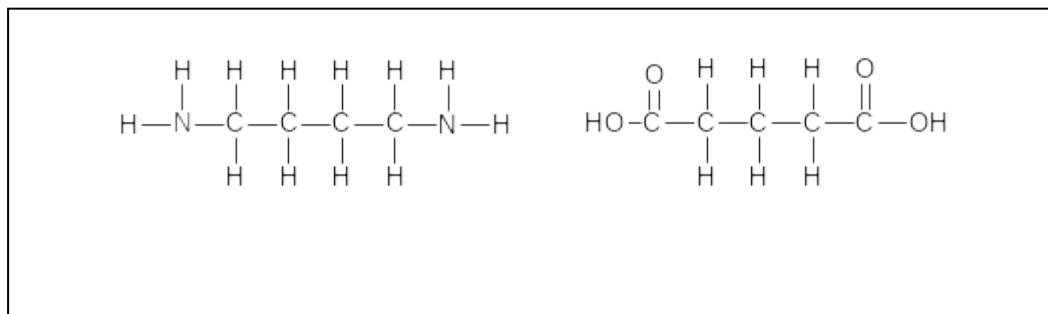
Use

Any of - thin films, packing material, rope and carpet. Toys, chairs, furniture and car parts.

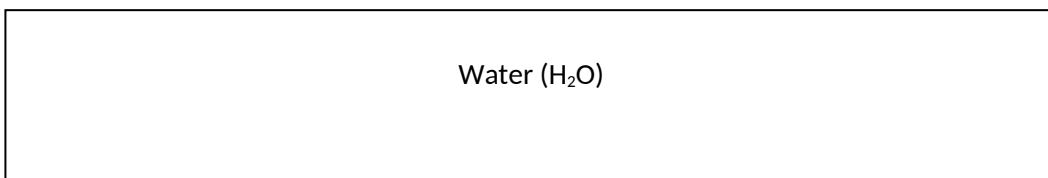
b)



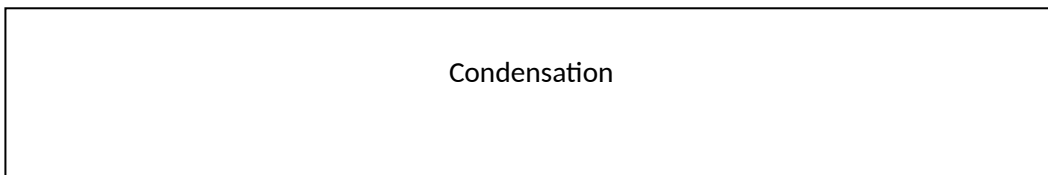
Monomers



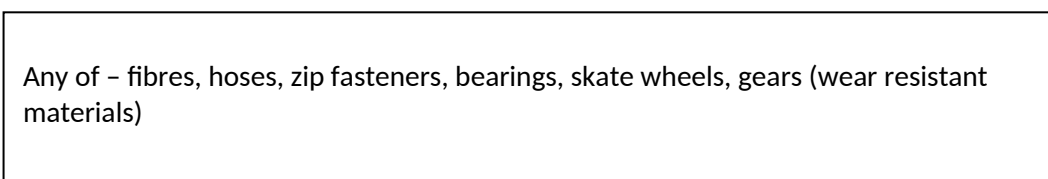
By-product (if any)



Polymerisation type



Use

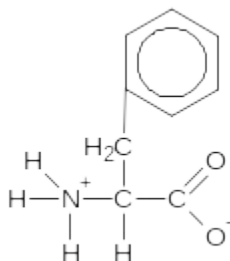


[9 marks]

3. Phenylalanine is one of the naturally occurring amino acid involved in creating DNA and brain signaling molecules such as dopamine. It is found in soybeans, cheese, nuts, seeds, beef, lamb, chicken, pork, fish, eggs, dairy, beans, and whole grains.

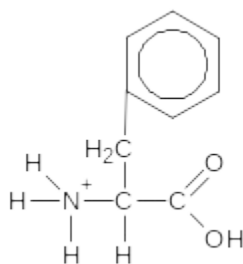
(a) Using your data sheet, draw a full structural diagram of the zwitterion form of phenylalanine.

[1 mark]



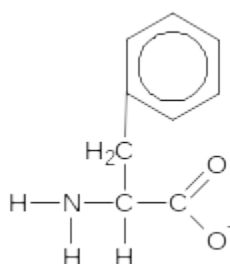
(b) Draw the structure of phenylalanine in acidic solution.

[1 mark]



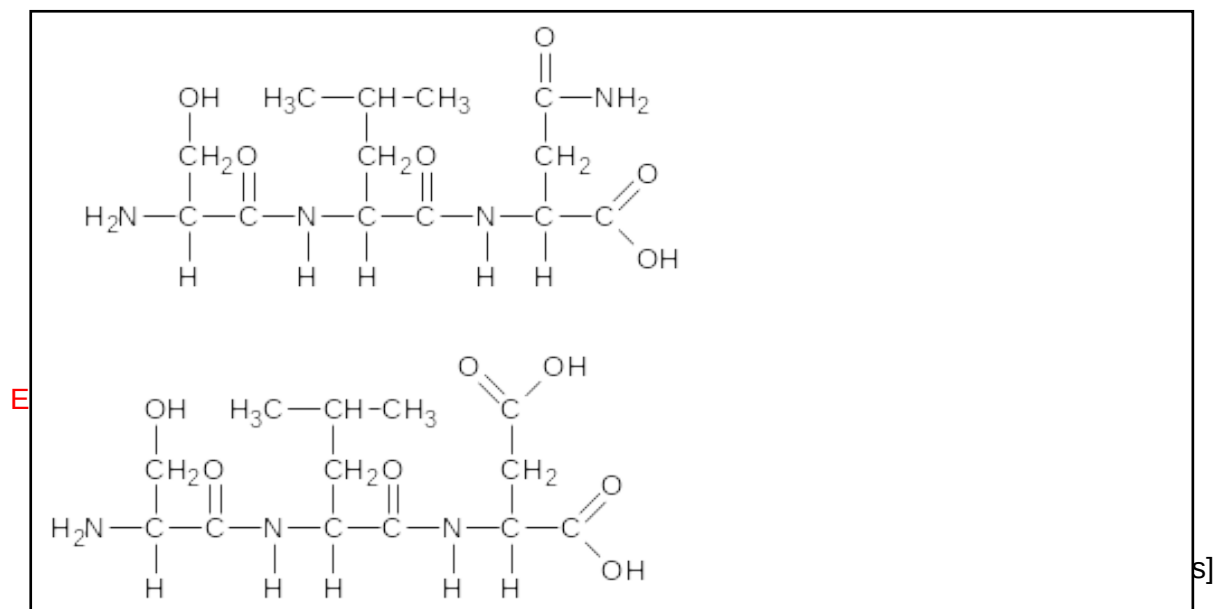
(c) Draw the structure of phenylalanine in basic solution.

[1 mark]



4. Peptides are formed when amino acids are combined.

(a) Using the amino acids, serine (Ser), leucine (Leu) and Asparagine (Asp) draw the primary structure of the tripeptide that could be formed.



(b) The most important level of organisation in a protein is the **tertiary structure** – the 3D shape. The overall tertiary shape may be long and narrow (fibrous proteins) or a roughly globular shape (such as enzymes). There are five types of **interactions** in determining the tertiary structure.

Name and describe **three (3)** of the interactions that will determine the tertiary structure of a protein.

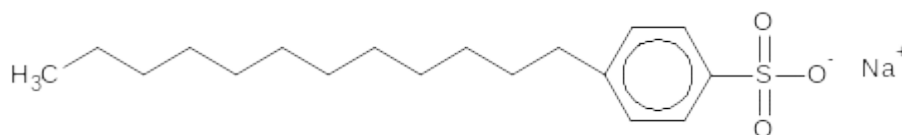
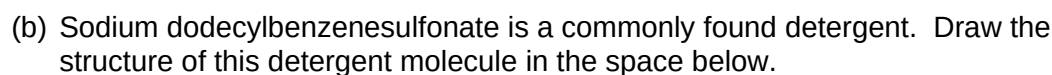
Any three of the following –

1. **Dispersion forces** between non-polar side chains on the amino acids such as phenylalanine and valine. These non-polar groups have many electrons, and the larger the group, the greater the dispersive forces.
2. **Hydrogen bonding** between polar side groups such as –C=O and –OH or –NH on amino acids such as serine and asparagine, as well as hydrogen bonding between peptide groups. Bonding occurs between the N-H and O-H hydrogen bond donor sites at C=O acceptor sites.
3. **Ionic attraction** between ionisable side chains such as –COO[–] in aspartic acid and –NH₃⁺ in lysine. (Needs to explain ionisation/ion formation)
4. **Dipole-dipole** attraction between polar side groups such as serine and threonine. (Explain how this arises)
5. **Covalent bonding** formed when the –SH groups on the side chain of cysteine are oxidised to form –S–S– (disulfide) **covalent** links (a form of cross-linking between

[9 marks]

(a) Sodium Stearate $\text{NaCH}_3(\text{CH}_2)_{16}\text{COO}$ is a common type of soap taught in Year 12 Chemistry. In the space below, write the full equation for the formation of this product from a suitable triglyceride. (Use structural formula)

[3 marks]



[2 marks]

(c) Detergents are not known to be as “green” as soaps are. Provide two reasons (with an explanation) why according to the principles of green chemistry detergents are not considered “green”.

Detergents are not green as they are made from **fossil fuels** – this means they come from **non-renewable feedstock**, a principle of green chemistry.

Detergents are possibly not **biodegradable**, **design for degradation** is another principle of green chemistry.

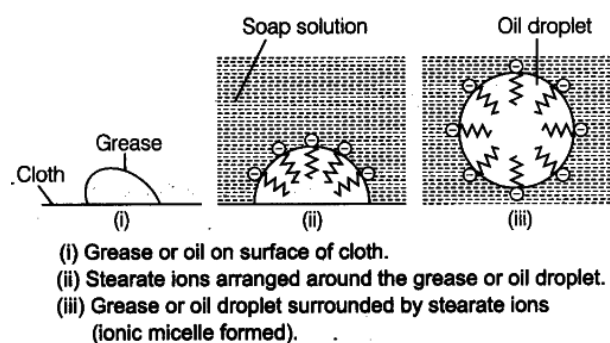
[4 marks]

- (d) Explain in three of four sentences how a soap is able to dissolve in water and the process of “cleaning” grime from a dirty t-shirt this soap once it is dissolved. Diagrams may be used.

Soap anions are able to dissolve in H_2O and form micelles. The hydrophobic tails of each anion dissolve in each other pushing the hydrophilic heads outwards, which allows ion-dipole interaction with H_2O . (1)

If there is grime on the t-shirt, then the soap micelles will collide with the grease. The micelle opens and tails of the anions dissolve in the grease. (1)

The grease becomes coated in anionic heads, which interact with H_2O , allowing the grease to become water soluble and washed away from the fabric. (1)



[3 marks]

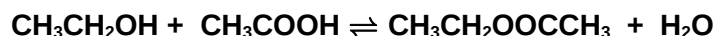
6. The process of chemical synthesis may involve a sequence of reactions.
- (a) Use equations to show how ethyl ethanoate can be produced from ethene through the successive processes of hydrolysis and esterification.

[4 marks]

Hydration of ethene



Esterification with ethanoic acid



- (b) Write the overall equation for the process of synthesising ethyl ethanoate from ethene.

[1 mark]



End of Test