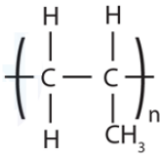
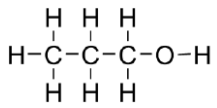
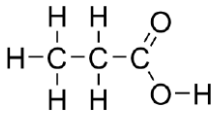
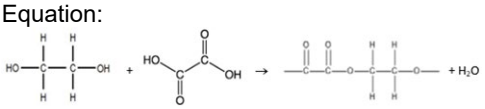
Mark scheme – Organic Chemistry (H)

Question			Answer/Indicative content	Marks	Guidance
1			**D ✓**	1 (AO1.1)	
			Total	**1**	
2			**B ✓**	1 (AO2.2)	
			Total	**1**	
3			**B ✓**	1 (AO1.1)	
			Total	**1**	
4			**A ✓**	1 (AO1.1)	
			Total	**1**	
5			**B ✓**	1 (AO1.1)	
			Total	**1**	
6			**D ✓**	1 (AO2.1)	
			Total	**1**	
7			**C ✓**	1(AO 1.1)	**Examiner's Comments** Candidates found this question challenging but there was no pattern of incorrect responses.
			Total	**1**	
8			**A ✓**	1(AO 1.1)	**Examiner's Comments** **Misconception** B and D were both common misconceptions in this question.
			Total	**1**	
9			**C ✓**	1(AO 1.1)	

			Total	**1**	
10			**C** ✓	1(AO 1.1)	**Examiner's Comments** **Misconception** A and B were both common misconceptions in this question.
			Total	**1**	
11	a	i	**A** and **D** ✓	1 (AO2.1)	**Both required for the mark**
		ii	**Any two from:** Have the same general formula / both have the formula C_nH_{2n+2} ✓ Idea that they differ from each other by CH_2 ✓ Both hydrocarbons with only single bonds / both saturated hydrocarbons ✓	2 (AO1.1)	**ALLOW** have similar chemical properties **ALLOW** show trends in physical properties **ALLOW** both hydrocarbons with no double bonds **ALLOW A** and **D** have the same functional group or no functional group / **B** and **C** have different functional groups (from **A** and **D**) **ALLOW** both (**A** and **D**) are alkanes / **C** is an alkene and **B** is a carboxylic acid
	b	i	 Correct structure ✓ Brackets and 'n' ✓	2 (AO2.1)	**ALLOW** structure of $-CH_3$ group shown **ALLOW** round or square brackets **Second marking point is dependent on correct structure**
		ii	**Any one from:** Idea that in addition polymerisation monomers react together to form one large molecule / polymer whereas in condensation polymerisation one large molecule and a smaller molecule is formed ✓ A monomer (molecule) for addition polymerisation has one functional group	1 (AO1.1)	**ALLOW** condensation polymerisation produces water (whereas addition polymerisation does not) **ALLOW** idea that addition polymerisation makes one product (whereas condensation polymerisation makes two products) / ORA **ALLOW** addition polymerisation requires (a monomer) with a C=C, but condensation

			whereas a monomer (molecule) for condensation polymerisation requires two different functional groups ✓ Addition polymerisation requires a catalyst (whereas condensation polymerisation can happen without a catalyst) / ORA ✓ Addition polymerisation requires high temperature (whereas condensation polymerisation can happen at room temperature) / ORA ✓ Addition polymerisation requires high pressure (whereas condensation polymerisation can happen at atmospheric pressure) / ORA ✓		polymerisation requires a -NH2 group and a-COOH group
	c		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Describes tests, the results, and identifies each of the three samples **AND** Includes correct balanced symbol equations for the reactions which occur. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Describes tests, the results, and identifies each of the three samples **OR** Describes a test and the result, to identify one of the three samples and attempts to identify the other two **AND** Includes a balanced symbol equation for the reaction which occurs. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Describes a test and the result, to identify	6 (AO3 × 1.2) (AO3 × 2.2)	**AO1 Knowledge and understanding of alkanes, alkenes and acids** • Alkanes do not react with bromine water • Alkenes react with bromine water / bromine water is decolourised • Acids react with carbonates to give off carbon dioxide / fizzing observed **AO2 Application and knowledge of tests and results** • Add sodium carbonate (or any suitable carbonate) • Ethanoic acid effervesces • Pentane and pentene do not effervesce • ALLOW other suitable reactions, eg addition of a metal; ethanoic acid effervesces • ALLOW use of universal indicator to identify ethanoic acid • Add bromine water to separate samples of pentane and pentene and shake • With pentene bromine water changes from orange to colourless / bromine water is decolourised • With pentane and ethanoic acid bromine water stays orange **AO2.1 Application of knowledge and understanding to produce balanced**

			one of the three samples. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*		**symbol equations** $2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + CO_2 + H_2O$ $C_5H_{10} + Br_2 \rightarrow C_5H_{10}Br_2$
			Total	**11**	
12	a	i	4 / four ✓	1(AO 1.1)	**Examiner's Comments** Two and three were common errors in this question.
		ii	Amino acids ✓	1(AO 1.1)	**Examiner's Comments** Most candidates knew that the monomers in proteins are amino acids.
	b	i	Carboxylic acids ✓	1(AO 1.1)	**IGNORE** carboxyl group **Examiner's Comments** Alkanes, amines and esters were common errors in this question.
		ii	Alcohol **X**  ✓ Compound **Y**  ✓	2(AO 2.1)	**ALL** covalent bonds must be shown in both displayed formulae **BUT** **ALLOW** 1 mark if both displayed formulae are correct, but show '-OH' without covalent bond **Examiner's Comments** More candidates were able to correctly draw the structure of alcohol X than compound Y. Many candidates did not gain the mark for the displayed formula of the alcohol because they lacked the O-H bond. The question stated '**show all the covalent bonds**'. Lower ability candidates did not recall the carboxylic acid functional group, -COOH. Often the diagrams had two C-O bonds drawn (the oxygens had no other bonds). Other diagrams included C=OH or more than one C=O within the structure.
	c		Type of polymerisation – condensation (polymerisation) ✓ Correct choice of ethane-1,2-diol and	4(AO1 × 1.1) (AO1 ×	

			ethanedioic acid ✓ Equation:  Correct ester (link) formed ✓ Water molecule eliminated ✓	3.1a) (AO2 × 2.1)	**ALLOW** mark for correct choice of monomers from correct reactant structures in an equation **ALLOW** mark for 'water' from an equation, even if incorrect **Examiner's Comments** Good responses to this question described the reaction of ethanedioic acid with ethane-1,2-diol in a condensation polymerisation reaction to form an ester and water. Many candidates gained 3 marks, but the fourth mark for drawing the correct ester link was less frequently given. Choosing ethene as one of the monomers was a common error.
	d		Idea of swapping the position of boiling tube **X** and the boiling tube of limewater ✓ Idea that any liquid that condenses in boiling tube **X** must have come from the burning methane or not from the limewater ✓	2(AO 3.3b)	**ALLOW** idea that water condenses before the limewater is reached **ALLOW** idea of carrying out 2 experiments, one to test for carbon dioxide and one to test for water **for 2 marks** **Examiner's Comments** Higher ability candidates suggested swapping the position of boiling tube X and the boiling tube of limewater to make sure that any liquid that condenses in boiling tube X must have come from the burning methane and not from the limewater. Lower ability candidates misunderstood the question and focused on testing the condensed liquid to prove that it was water. Another common misconception was to suggest that the experiment needed to be a closed system to prevent water vapour / oxygen/carbon dioxide from the air affecting the results.

			Total	**11**	
13			(Condensation) polymer ✓	1(AO 1.1)	**ALLOW** polyamide / polypeptide **DO NOT ALLOW** addition polymer **DO NOT ALLOW** chain **Examiner's Comments** Many candidates correctly stated that Kevlar® is a polymer or polyamide. Polyester, alcohol and alkene were common incorrect responses. **Misconception** **Addition** polymer was a common misconception
			Total	**1**	
14			C	1	
			Total	**1**	
15			D	1	
			Total	**1**	
16			B	1	
			Total	**1**	
17			C	1	
			Total	**1**	
18			C	1	
			Total	**1**	
19	a		Fractions have different boiling points (1) Idea that larger molecules have stronger intermolecular forces (1)	2	Answer must be **comparative** **ALLOW ORA**
	b		Has a carbon-carbon double bond (1)	1	**ALLOW** has C=C **ALLOW** answer indicated on the displayed formula Has a double bond is not sufficient
			Total	**3**	