Question	Answer	Marks	Guidance
1 a	contains carbon and hydrogen (1) only / aw (1)	2	**allow** (formula) has only (1) C and H (1) the only is **not** an independent mark and must be linked to the carbon and hydrogen **not** contains carbon and hydrogen **molecules** = 0 marks for the question **not** contains a **mixture** of carbon and hydrogen = 0 marks for the question **not** an **element** containing carbon and hydrogen = 0 marks for the question **not** hydro atoms
b	**all** (carbon-carbon) bonds are single bonds / contains **only** single bonds (1)	1	**allow** does not contain a double bond (1) **ignore** has maximum number of bonds **ignore** has the maximum number of hydrogen atoms
c	idea that hydocarbons have different boiling points (1) **and any two from:** larger molecules or longer chains have higher boiling points / ora (1) larger molecules or longer chains have stronger intermolecular forces / ora (1) idea that stronger intermolecular forces results in higher boiling point / ora (1)	3	**allow** hexadecane for larg**er** molecules or hexane for small**er** molecules throughout the question **ignore** melting points **allow** molecules with higher mass have higher boiling points / ora (1) **allow** larger molecules or longer chains have more intermolecular forces / ora (1) **allow** idea that stronger intermolecular forces results in more energy needed (to boil) / ora (1)

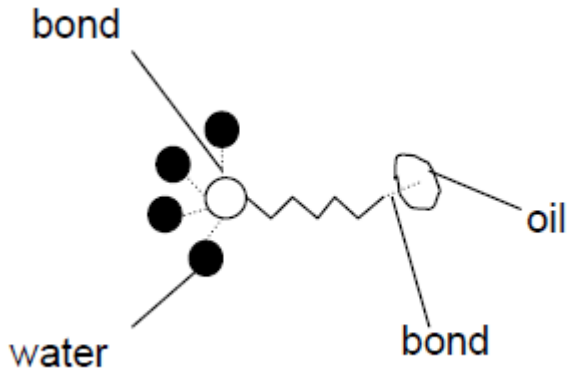
Question	Answer	Marks	Guidance
d	$2C_6H_{14}$ + **19**O_2 → **12**CO_2 + **14**H_2O right hand side correct (1) left hand side correct (1)	2	
e	hexane + oxygen → carbon + water **or** hexane + oxygen → carbon monoxide + water **or** hexane + oxygen → carbon + carbon monoxide + water (1)	1	**allow** correct formula instead of names C_6H_{14}, O_2, C, H_2O and CO **allow** mix of names and correct formulae symbol equation, if given, does not need to be balanced **ignore** soot **not** '+ carbon dioxide' in products **not** '+ energy'
	Total	**9**	

Question	Answer	Marks	Guidance
2 a	nine (1)	1	**more than one tick scores 0**
b	**Level 3** **Explains why the polymer has a low melting point in terms of intermolecular forces** **AND** **gives two suitable properties, with reasons, for the polymer** Quality of communication does not impede communication of science at this level. (5 - 6 marks) **Level 2** **Explains why the polymer has a low melting point in terms of intermolecular forces** **OR** **gives two suitable properties, with reasons, for the polymer** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **Level 1** **Attempts to explain why the polymer has a low melting point in terms of intermolecular forces** **OR** **gives one suitable property, with a reason, for the polymer** **OR** **gives two suitable properties** Quality of communication impedes communication of the science at this level. (1 – 2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A* Indicative scientific points at level 3 must include: • weak intermolecular forces between polymer molecules • does not need much energy to overcome or break the intermolecular forces **do not allow** break covalent bonds **Suitable properties may include**: • insoluble in water or waterproof so drink does not leak out • unreactive so it doesn't react with the contents or doesn't break down • flexible or bendy so can be made into different shapes • non-biodegradable so it will not decompose while still in use • non-toxic so drink does not get contaminated • low density or lightweight so that the bottle isn't heavy (to carry or transport) • strong so it contains the pressure or doesn't break when dropped **ignore** rigid / can be recycled / transparent **Use the L1, L2, L3 annotations in Scoris. Do not use ticks.**
	Total	**7**	

Question	Answer	Marks	Guidance
3 a	$2H_2 + O_2 \rightarrow 2H_2O$ correct formulae (1) balancing (1) balancing mark is conditional on correct formulae	2	**allow** any correct multiple e.g. $4H_2 + 2O_2 \rightarrow 4H_2O$ (2) **allow** = or ⇌for arrow **not** 'and' or & for + **allow** one mark for correct balanced equation with minor errors in case, subscript and superscript e.g. $2h_2 + O^2 \rightarrow 2H_2o$ (1)
b	horizontal line on the LHS is above the horizontal line on RHS (1) reactants i.e. hydrogen and oxygen and products i.e. water correctly labelled (1) $(2)H_2 + O_2$ $(2)H_2O$	2	**ignore** any labelling on the lines **ignore** any lines linking the reactants and products **ignore** transition states or free atoms in the middle of the diagram – focus on reactants and products only **this mark is independent of the first marking point** **allow** words instead of formulae / reactant and product **allow** H—H and O–O
c	provides water that astronauts can use / light / lightweight / low density / compact / no moving parts (1)	1	**allow** idea that makes a usable product i.e. water (for astronauts) / can be used as drinking water **ignore** efficient / reliable

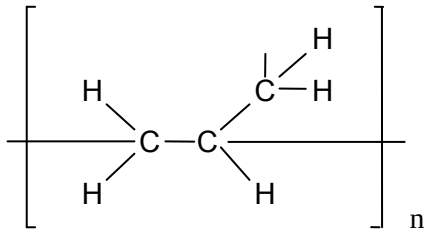
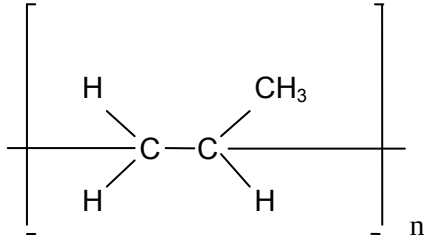
Question	Answer	Marks	Guidance
d	idea that fuel cells contain poisonous catalysts (which need to be disposed of) (1) (idea of pollution) from the **burning** of fossil fuels associated with fuel cell production or manufacture of raw materials (1)	2	**allow** catalyst could be pollutants (when disposed of) / contain harmful catalysts **ignore** dangerous catalysts **allow** makes waste when they are thrown away **allow** mining for some of the materials used in a fuel cell (will cause pollution)
	Total	**7**	

Question	Answer	Marks	Guidance
4 a	formula **C** (1) because it contains (a) carbon to carbon double bond(s) (1)	2	 **allow** contains C=C (double bonds) (1) must be clear it is a carbon-carbon double bond and not a carbon-oxygen double bond **ignore** carbon double bond / double carbon bond
b	**any two from:** saponification involves reacting (a fat or oil) with sodium hydroxide (1) soap is made (1) glycerol is made (1) it is a hydrolysis reaction (1)	2	 **allow** caustic soda / potassium hydroxide instead of sodium hydroxide **allow** propane-1,2,3-triol instead of glycerol **allow** marks to be awarded from a word equation even if equation is incorrect e.g. fat or oil + sodium hydroxide → soap + glycerol (2) **allow** correct products from **A**, **B** or **C** if specified e.g. saponification of **A** gives methanol and soap **ignore** reference to enzymes

Question	Answer	Marks	Guidance
c	**any two from:** hydrophobic tail (1) (hydrophobic end) attracted to fat or oil / bonds to fat or oil / intermolecular attraction with fat or oil (1) (hydrophilic) head attracted to water / intermolecular attraction with water (1) idea that **tail** lifts off grease (1) idea that detergent molecules surround grease **and** so prevent it returning to clothes (1)	2	**marks may be awarded from a labelled diagram** **allow** stain = oil or fat in the context of the question **allow** hydrophobic end or hydrophobic head (1) **allow** attached to / sticks to / binds to dissolved in or goes into **not** sufficient **allow** hydrophilic end bonds with water / attached to water / sticks to water / binds to water (1) dissolved in or goes into **not** sufficient 
	Total	**6**	

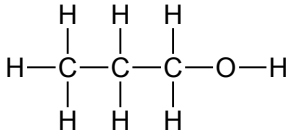
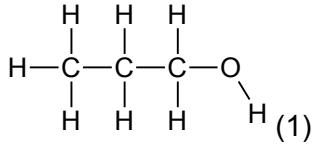
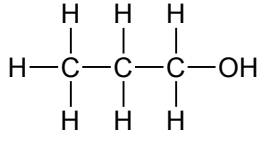
Question	Answer	Marks	Guidance
5 a	C_2H_6 / H_6C_2 (1)	1	the numbers must clearly be subscripts **not** C^2H^6 / C2H6
b	**B** contains carbon and hydrogen (1) only / AW (1) **C** contains oxygen / has oxygen in the formula / does not contain only carbon and hydrogen (1)	3	**allow** (formula) has only (1) H and C (1) the only is **not** an independent mark and must be linked to the carbon and hydrogen **not** contains carbon and hydrogen molecules / contains a mixture of carbon and hydrogen **not** hydro atoms but **ignore** for the third marking point **allow C** has three elements / **C** has three different atoms (1) **not C** contains oxygen molecules
c	**A** and **F** (1)	1	**both needed**
	Total	**5**	

Question	Answer	Marks	Guidance
6 a	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ correct reactants and products (1) balancing – dependent on correct reactants and products (1)	2	**allow** any correct multiple, including fractions **allow** = / ⇌ instead of → **not** and / & balancing mark is dependent on the correct formulae but **allow** 1 mark for a balanced equation with minor errors in subscripts / formulae e.g. CH4 + 2O2 → CO2 + 2H2o
b	(sea water because) **any two from:** removes more of the pollutant / removes 9% more of nitrogen dioxide / 99% of nitrogen dioxide removed (1) does not form a waste product (1) cheap(er) (1) readily available (near the coast) (1) **OR** (limestone because) idea of does not have to be pumped (a long way) from the sea (1) need less mass of material (1)	2	**No marks** for sea water or for limestone – the marks are for the explanation **allow** does not produce waste (1) **allow** only a small amount needed (1)
	Total	**4**	

Question	Answer	Marks	Guidance
7 a	correct atoms and bonds without the double bond (1) brackets and n (1)	2	**second marking point is dependent on the first** **allow** more than 1 repeat unit  **allow** round brackets **allow** 

Question	Answer	Marks	Guidance
7 b	**Level 3** **<u>Two</u> properties needed by the plastic are explained AND** **the flexibility of poly(propene) is explained in terms of the structure and bonding.** Quality of communication does not impede communication of science at this level. (5-6 marks) **Level 2** **The flexibility of poly(propene) is explained in terms of the structure and bonding** **OR** **<u>two</u> properties needed by the plastic are explained** **OR** **<u>one</u> property of the plastic is explained <u>and</u> an attempt to explain why poly(propene) is flexible.** Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **Level 1** **<u>One</u> property needed by the plastic is explained** **OR** **an attempt to explain why poly(propene) is flexible.** Quality of communication impedes communication of the science at this level. (1 – 2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to A*** **Indicative scientific points for level 3 may include:** • Poly(propene) molecules are attracted to one another by weak intermolecular forces or bonds that are easy to overcome • Poly(propene) molecules need very little energy to be separated • Poly(propene) molecules can slide over each other • Poly(propene) has atoms held together by strong covalent bonds **Indicative scientific points for all levels may include:** • Non-biodegradable so the plastic does not rot or decay • Insoluble in water or waterproof so that the sandwich box can be washed clean / so it will not dissolve / so moist foods can be stored • Non-toxic material so it will not contaminate the food or make the food dangerous to eat • Non-reactive or inert so will not react with chemicals in the food • Non-permeable so water doesn't reach the food **ignore** references to can be coloured / is strong / tough / durable / light or lightweight / hard / easily moulded / insulator / does not melt (in hot water) **Use the L1, L2, L3 annotations in Scoris; do not use ticks**
	Total	**8**	

Question	Answer	Marks	Guidance
8 **a**	72 (1)	1	unit **not** needed **ignore** any unit given
b	C_4H_6 / H_6C_4 (1)	1	**not** if superscripts used for the numbers
c	C_2H_2 **and** C_6H_6 (1)	1	**both** needed if no answer on answer line **allow** other ways of indicating the correct answer e.g. circling, ticking or underlining
d	Mole ratio C : H is 0.1 : 0.4 (1) Empirical formula is CH_4 / H_4C(1)	2	**LOOK AT THE ANSWER FIRST IF CH_4 / H_4C AWARD 2 MARKS** **allow** moles of C = 0.1 and moles of hydrogen = 0.4 **allow** moles of C = 1.2/12 and moles of hydrogen = 0.4/1 **allow** C_1H_4 **allow** full marks despite any working out for correct empirical formula
	Total	**5**	

Question	Answer	Marks	Guidance
9 a i	any value between 12 and 13 (cm^3) (1)	1	
ii	44°C (1) idea of highest point on the curve / where most carbon dioxide is made (1)	2	**allow** 42-45 (°C) (1) **second mark is dependent on the correct temperature** **allow** optimum temperature (1)
b	$C_6H_{12}O_6 \rightarrow 2CO_2 + 2C_2H_5OH$ formulae (1) balancing – dependent on correct formulae (1)	2	**allow** C_2H_6O as formula for ethanol **allow** any correct multiple e.g. $2C_6H_{12}O_6 \rightarrow 4CO_2 + 4C_2H_5OH$ **allow** = or ⇆ for arrow **not** 'and' or & for + **allow** one mark for correct balanced equation with minor errors of case, subscript or superscript e.g. $C^6H^{12}O^6 \rightarrow 2Co_2 + 2C_2H_5OH$
c i	C_3H_7OH / C_3H_8O (1)	1	
ii	 (1)	1	**allow**  (1) **allow**  (1) **allow** displayed formula for propan-2-ol
	Total	**7**	