| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1(a)(i)** | $C_4H_8O_2$ | capital letters; numbers must be subscripts<br>ignore structural formulae such as $CH_3COOCH_2CH_3$ i.e. must have just $C_4$, $H_8$ and $O_2$ in any order. | **(1)** |

| Question Number | Answer | Mark |
|---|---|---|
| **1(a)(ii)** | ethanol + ethanoic acid → ethyl ethanoate + water (2)<br>LHS= 1 mark [allow acetic acid]; RHS= 1 mark [allow ethyl acetate]<br>Allow = for arrow.<br>Fully correct formula equation = 2 (part mark not possible with formulae) | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1(a)(iii)** | no vapour/ little vapour (given off) / it is not a gas / it is a solid (not vapour)<br>OR<br>small amount/ concentration in sweets | allow gas for vapour<br>allow ethyl ethanoate is in a liquid state | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1(b)(i)** | **D** soap | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **1(b)(ii)** | A description linking<br>• filter / decant off water (1)<br>• (then) wash/rinse (1)<br>Can only score second mark if first marking point awarded | ignore anything before filtering that would not contaminate soap but do not allow to evaporate water/ heat BEFORE filtering<br>ignore anything after washing, including drying | **(2)** |

| Question Number | Answer | Mark |
|---|---|---|
| **1(c)** | **C** unsaturated molecules in the liquid oil become saturated | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(a)(i)** | A description including two of the following<br>• dissolve the sugar/aqueous solution (1)<br>• **warm**/ 25-40°C (1)<br>• in absence of air / no oxygen/ anaerobic / attach airlock (1)<br>• pH neutral / slightly acidic /4-7<br>• **sterile** conditions<br>ignore any mention of pressure | ignore incorrect answers<br>ignore heat / hot<br>allow any temperature or range within 25-40 allowed<br>ignore clean etc<br>ignore 'optimum' {temp/pressure/pH} | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(a)(ii)** | **B** fractional distillation | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(a)(iii)** | $C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$ (2)<br>correct formulae (<u>with no others</u>) (1)<br>balancing <u>the three</u> formulae (1)<br>ignore state symbols | allow $C_2H_6O$/ $CH_3CH_2OH$ for $C_2H_5OH$<br>reject CO2 / $CO^2$<br>allow multiples | **(2)** |

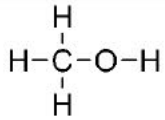
| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(b)(i)** | Any two of<br>• (reacts with) steam (1)<br>• catalyst/phosphoric acid (1)<br>• **<u>high temperature</u>** / 200°C - 450$^0$C (1)<br>• **<u>high</u>** pressure/ 50-100 atm (1) | allow reacts with water<br><u>ignore incorrect catalyst</u><br>ignore hot / heat | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **2(b)(ii)** | An explanation linking any three of<br>LAND: country needs land for: farming / food / crops / homes /not enough land to grow sugar crop for fermentation (1)<br><br>OIL SUPPLY: (reliable supply of) crude oil for **ethene** (1)<br><br>SPEED: fermentation slow/batch; hydration continuous/ fast (1)<br><br>PURITY: hydration makes {pure(r) ethanol / high concentration} (1)<br><br>ATOM ECONOMY: higher atom economy for ethene process (1) | ignore incorrect responses<br>ignore land needed for growing yeast<br><br>ignore cheaper/ easier<br><br>ignore yield | **(3)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(a)** | add yeast, temperature of 35°C | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(b)** | $C_2H_4$ (1) + $H_2O$ (1) → $C_2H_5OH$<br><br>award one mark max if incorrectly balanced | allow correct molecular formula $C_2H_6O$<br>allow $H_4C_2$<br>correct multiples<br>ignore state symbols | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(c)(i)** | A description linking any two from<br><br>• same **general** formula (1)<br>• same functional group (1)<br>• (consecutive) compounds differ by $CH_2$ (1)<br>• gradual variation in physical properties (1)<br><br>• {similar / same} chemical {properties / reactions} (1) | <br><br>allow $C_nH_{2n+1}OH$ (2)<br>allow $C_nH_{2n}$ or any correct general formula (2)<br><br>ignore same properties/physical properties<br><br>allow a correct trend, e.g. bp increases with number of carbon atoms (1) | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(c)(ii)** |  | allow –OH<br>allow correct dot and cross diagram | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(d)(i)** | oxidation | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **3(d)(ii)** | A description including any two from<br>• effervescence/fizzing/bubbling (1)<br>• solid disappears (1)<br>• colourless solution (1) | ignore incorrectly named gases<br>ignore gas given off/evolved<br>allow magnesium floats on surface of acid<br>allow solid dissolves (1)<br>ignore solution <u>turns</u> colourless<br>ignore clear | **(2)** |

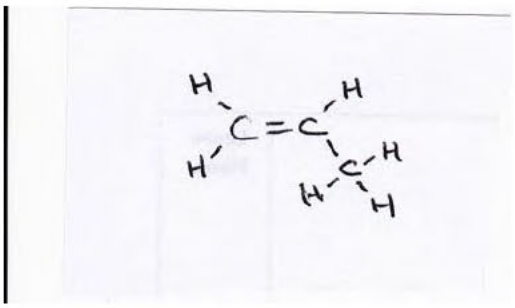
| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4(a)** | $C_2H_4 + H_2O \rightarrow C_2H_5OH$<br><br>$C_2H_4$ as **reactant** (1)<br><br>rest of equation correct conditional on $C_2H_4$ as a reactant (1) | do not allow H2O / $H^2O$ /lower case h/HOH<br><br><br>allow $C_2H_6O$ for ethanol<br>ignore state symbols | <br><br><br><br>**(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4(b)** | A description including any two from<br><br>• dissolve sugar in water /sugar solution (1)<br><br>• (add) yeast (1)<br><br>• warm / any temperature or range within 15 to 40°C (1)<br><br>• anaerobic / {no/little} {air/oxygen} c enter the apparatus (1) | <br><br>allow glucose solution<br>ignore carbohydrate<br><br><br>allow room temperature<br>ignore heat unless specified temperature<br>ignore optimum temperature<br><br>do not allow just 'sealed container'<br>ignore fractional distillation | <br><br><br><br><br><br><br><br>**(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4(c)** | An explanation linking<br><br>Marking point 1 – sugar- one from<br>• sugar obtained from {plants /crops/specific crop} (1)<br>• (plenty of) land available to grow {plants /crops/specific crop} (for fermentation)(1)<br><br>Marking point 2 - ethene<br>• ethene obtained from {crude oil / fractional distillation /cracking} (1)<br><br>Marking point 3 – cost/energy – one from<br>• cannot afford to buy crude oil (1)<br>• crude oil is too expensive (1)<br>• more expensive to {use/buy/produce} ethene (1)<br>• cheaper to use fermentation (1) | ignore answers that just repeat the information in the question<br><br>ignore vague answers such as carbon neutral/environmentally friendly<br><br>for marking point 1 **OR** 2, allow plants renewable/{crude oil/ethene} non-renewable (1)<br><br>allow {little/no} {heat/energy} required for fermentation (1)<br>allow {high temperature /high pressure} required for hydration of ethene (1) | **(3)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **4(d)** | An explanation including any two from<br><br>• formulae differ by $CH_2$<br><br>• same general formula<br><br>• all have {OH/hydroxyl group} | general formula is $C_nH_{2n+1}OH$ (2)<br><br>allow increase by {$CH_2$/1 carbon **and** 2 hydrogens}<br><br>do not allow incorrect general formula<br><br>allow have similar **chemical** {reactions /properties}/same functional group/OH from an incorrect general formula<br><br>ignore 'hydroxide'/all end in (an)ol /all alcohols<br><br>ignore physical properties<br><br>maximum (1) if hydroxide ions /carboxyl group | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(a)(i)** | D $C_4H_{10}$ | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(a)(ii)** | <br>**one** C=C in a molecule with three consecutive carbon atoms (1)<br><br>rest of structure correct, ignore bond angles, conditional on first marking point(1) | allow $-CH_3$<br><br>do not allow two C=C in a molecule<br><br>allow (1) for completely correct dot and cross diagram | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(b)** | C oxidised | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(c)(i)** | A description including two from<br><br>• effervescence / fizzing / bubbles of gas (1)<br><br>• solid {disappears/clears} /(colourless)solution formed (1) | ignore {cloudy/white ppt} /'gas formed'/colour change /name of gas / changes to a liquid<br><br>(solid/sodium carbonate/it) dissolves (1) | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **5(c)(ii)** | $CH_3COOC_2H_5$/$CH_3COOCH_2CH_3$ / $CH_3CO_2C_2H_5$ / $CH_3CO_2CH_2CH_3$ / $C_2H_5O_2CCH_3$ / $CH_3CH_2OOCCH_3$ (1)<br><br>$H_2O$ (1) | allow displayed formulae/ $C_4H_8O_2$ do not allow formulae ending in –COOH/-COO or any formula that does not show an ester<br><br>do not allow H2O / $H^2O$ /lower case h/HOH<br><br>maximum (1) if additional incorrect balancing ignore state symbols | **(2)** |