

| Question number | | Answer | Notes | Marks | | | | | | |
|-----------------|--|---|-------|-------------------|--------|--|---------|--|--|---|
| 1 | (a) | B (a pressure of 65 atm) | | 1 | | | | | | |
| | (b) | <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>Displayed formula</th> </tr> </thead> <tbody> <tr> <td>ethene</td> <td> $\begin{array}{c} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C} = \text{C} & \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array}$ </td> </tr> <tr> <td>ethanol</td> <td> $\begin{array}{c} \text{H} & \text{H} \\ & \\ \text{H}-\text{C} & -\text{C}-\text{O}-\text{H} \\ & \\ \text{H} & \text{H} \end{array}$ </td> </tr> </tbody> </table> | | Displayed formula | ethene | $ \begin{array}{c} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C} = \text{C} & \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array} $ | ethanol | $ \begin{array}{c} \text{H} & \text{H} \\ & \\ \text{H}-\text{C} & -\text{C}-\text{O}-\text{H} \\ & \\ \text{H} & \text{H} \end{array} $ | <p>All atoms and bonds must be shown</p> <p>Ignore bond angles</p> | 2 |
| | Displayed formula | | | | | | | | | |
| ethene | $ \begin{array}{c} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C} = \text{C} & \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array} $ | | | | | | | | | |
| ethanol | $ \begin{array}{c} \text{H} & \text{H} \\ & \\ \text{H}-\text{C} & -\text{C}-\text{O}-\text{H} \\ & \\ \text{H} & \text{H} \end{array} $ | | | | | | | | | |

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|-----------------|-----|--|--|-------|
| 1 | (c) | <p>M1 (saturated because) there are only single bonds / all the bonds are single</p> <p>M2 (not a hydrocarbon) because it contains oxygen/another element</p> | <p>Accept no double bonds / no multiple bonds</p> <p>Accept contains an OH group / an alcohol group</p> <p>Accept does not contain only hydrogen and carbon</p> | 2 |
| | (d) | <p>Any three of the following:</p> <p>M1 correct statement about connection between crude oil and ethene, eg: crude oil is converted /fractionally distilled /cracked to obtain ethene</p> <p>M2 correct statement about connection between sugar cane or glucose and ethanol, eg: sugar/glucose is converted into ethanol / sugar/glucose fermented to make ethanol</p> <p>M3 correct statement about effect of crude oil being less available, eg: less ethene available /ethene more expensive / ethene production (more) difficult OR process 1 used less / less favoured / (more) expensive</p> | <p>Ignore references to time taken to obtain ethene or ethanol</p> <p>Ignore references to purity of ethene or ethanol</p> <p>Ignore references to global warming / finite and renewable resources</p> | 3 |

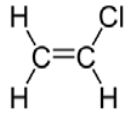
| | | | | | |
|--|--|--|---|-----------------------------|----------|
| | | | M4 correct statement about effect of climate change, eg: more sugar can be fermented / more ethanol can be produced / ethanol cheaper / ethanol production easier/easy OR process 2 used more / more favoured / less expensive | | |
| | | | | | |
| | | | | Total for Question 1 | 8 |

| Question number | Answer | Accept | Reject | Marks |
|-----------------|--|--|---|-------|
| 2(a)(i) | fermentation | | | 1 |
| (ii) | (to provide the) catalyst/enzyme/zymase | to increase the rate of the reaction | | 1 |
| (b)(i) | M1 (test) – flame test | suitable description of flame test | | 2 |
| | M2 (observation) – brick red / orange-red | red | | |
| (ii) | copper(II) ions: | accept other suitable alkalis | | 5 |
| | M1 (test) – (aqueous) sodium hydroxide / NaOH | suitable alternatives to precipitate | all other colours | |
| | M2 (observation) – blue precipitate ignore shades of blue | | | |
| | M2 dep on M1 or near miss of formula, eg Na(OH) ₂ | | | |
| | sulfate ions: | (dilute) nitric acid / HNO ₃ | | |
| | M1 (test) – (dilute) hydrochloric acid / HCl | (aqueous) barium nitrate / Ba(NO ₃) ₂ | Reject sulfuric acid for M1 only | |
| | M2 (test) - (aqueous) barium chloride / BaCl ₂ | | | |
| | M3 (observation) – white precipitate | | | |
| | M3 dep on M2 or near miss | | | |

| Question number | Answer | Accept | Reject | Marks |
|-----------------|---|--|---------------------------|-------|
| 2 (c) | <p>M1 (pressure) – 60-70 atm</p> <p>M2 (catalyst) – phosphoric acid / H_3PO_4 ignore references to concentration</p> | <p>any pressure or range within this range</p> <p>phosphoric(V) acid</p> | any other oxidation state | 2 |
| (d) | <p>M1 (Σ bonds broken) 348 + 412 + 360 (= 1120)</p> <p>M2 (Σ bonds made) 612 + 463 (= 1075)</p> <p>M3 M1 – M2 / Σ bonds broken – Σ bonds made</p> <p>M4 (+)45 (kJ/mol)</p> <p>Correct answer with no working scores 4</p> <p>– 5 (kJ/mol) scores 3</p> | <p>3231</p> <p>3186</p> | | 4 |

Total 15 marks

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|-----------------|---|--|--|-------|
| 3 (a) | $C_{12}H_{22}O_{11} + H_2O \rightarrow 2C_6H_{12}O_6$ <p>Ignore yeast</p> | | lower case symbols and numbers not given as subscripts | 1 |
| (b) (i) | no more bubbles/fizzing/effervescence IGNORE when no more ethanol is formed/all the glucose has reacted/all the yeast has reacted/references to mass/references to temperature | no more gas/carbon dioxide given off | | 1 |
| (ii) | filtration/filtering IGNORE sieving | decant | evaporation/distillation | 1 |
| (c) (i) | (the elements of) water removed | H ₂ O removed 2 hydrogen (atoms) and 1 oxygen (atom) are removed | | 1 |
| (ii) | aluminium oxide/Al ₂ O ₃ | (concentrated) sulfuric acid (concentrated) phosphoric acid | dilute acid phosphorus/phosphorous | 1 |
| (iii) | chlorine (gas) / Cl ₂ If both name and formula given, both must be correct | correct name or formula as part of an equation | chloride / Cl ⁻ | 1 |
| (iv) | CH ₂ ClCH ₂ Cl → CH ₂ (=)CHCl + HCl | C ₂ H ₄ Cl ₂ for CH ₂ ClCH ₂ Cl and C ₂ H ₃ Cl for CH ₂ =CHCl | | 1 |

| Question Number | Answer | A | Reject | Marks |
|-----------------|---|---|--------------|-----------|
| (d) (i) |  <p>IGNORE bond angles and positions of H and Cl relative to each other</p> | | | 1 |
| (ii) | <p>Any three from:</p> <p>M1 - (one bond in the) double bond breaks</p> <p>M2 - small molecules/monomers/chloroethene molecules join together</p> <p>M3 - to form a (long) chain/macromolecule</p> <p>M4 - product/polymer contains only single bonds</p> | | | 3 |
| | | | Total | 11 |

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|-----------------|---|--------------------------------|-----------------|--|-------|
| 4 (a) | Statement | Fractional distillation | Cracking | 1 mark for each line correct | 5 |
| | Crude oil is heated | (✓) | | | |
| | A catalyst may be used | | ✓ | | |
| | Alkenes are formed | | ✓ | | |
| | Decomposition reactions occur | | ✓ | | |
| | Fuels are obtained | ✓ | ✓ | | |
| | Separation is the main purpose | ✓ | | | |
| (b) | C ₅ H ₁₂ | | | Accept H ₁₂ C ₅ | 1 |
| i | <pre> H H H H H—C—C—C—C—C— H H H H H H </pre> | | | | 1 |
| ii | C ₅ H ₁₂ | | | Accept H ₁₂ C ₅ | 1 |
| i | pentane | | | | 1 |
| iv | C _n H _{2n+2} | | | Accept x and other letters in place of n Accept answers like C _n H _{2n+ 2} Ignore 2(n+1) | 1 |
| v | | | | | |

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|-----------------|---|---|-------------|
| 4 (c) i | (products) 2 2 (oxygen 3) | M1 and M2 independent | 1 1 |
| ii | 4 electrons shared between 2 (carbon) atoms 4 electron pairs between 2C and 4H atoms | Ignore inner electrons even if wrong Ignore number of hydrogen atoms Accept all permutations of dots and crosses Ignore intersecting circles Accept H atoms at all angles At least one C or one H atom must be labeled if not Max 1 if more than 2 C Max 1 if wrong number of electrons in outer shell of any atom | 1 1 |
| (d) i | phosphoric acid / H_3PO_4 any value in range 250 – 350 °C | Ignore concentrated / dilute Accept value without unit Accept 523 – 623 K Marks independent | 1 1 |
| ii | 20 (mol) M1 × 24 480 (dm ³) | Accept 480 000 cm ³ If M1 incorrect but 480 is final answer, then only M3 can be awarded If no answer to amount of ethene, then 20 x 24 = 480 scores M2 and M3 | 1 1 1 |
| | | Total | 19 |