

## 6CH02/01

### Section A

Question Number	Correct Answer	Reject	Mark
1	C		1

Question Number	Correct Answer	Reject	Mark
2	B		1

Question Number	Correct Answer	Reject	Mark
3	A		1

Question Number	Correct Answer	Reject	Mark
4	D		1

Question Number	Correct Answer	Reject	Mark
5	C		1

Question Number	Correct Answer	Reject	Mark
6	A		1

Question Number	Correct Answer	Reject	Mark
7	B		1

Question Number	Correct Answer	Reject	Mark
8	D		1

Question Number	Correct Answer	Reject	Mark
9	B		1

Question Number	Correct Answer	Reject	Mark
10 (a)	A		1

Question Number	Correct Answer	Reject	Mark
10 (b)	C		1

Question Number	Correct Answer	Reject	Mark
11	D		1

Question Number	Correct Answer	Reject	Mark
12	C		1

Question Number	Correct Answer	Reject	Mark
13	B		1

Question Number	Correct Answer	Reject	Mark
14	D		1

Question Number	Correct Answer	Reject	Mark
15	C		1

Question Number	Correct Answer	Reject	Mark
16	A		1

Question Number	Correct Answer	Reject	Mark
17	C		1

Question Number	Correct Answer	Reject	Mark
18	A		1

Question Number	Correct Answer	Reject	Mark
19	B		1

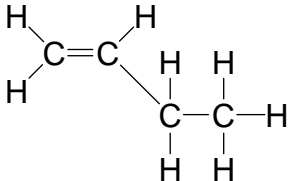
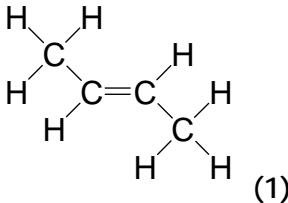
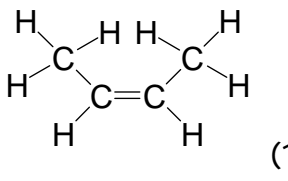
## Section B

Question Number	Correct Answer	Reject	Mark
20 (a)(i)	<p><b>Reaction 1 - (nucleophilic) substitution (1)</b></p> <p><b>Reaction 2 - elimination (1)</b></p>		2

Question Number	Correct Answer	Reject	Mark
20 (a)(ii) QWC	<p><b>Reaction 1 - Water can behave as a nucleophile /water can donate a lone pair (from oxygen)/water has a lone pair/water forms an <math>\text{OH}^-</math> ion (1)</b></p> <p>And attack (positive) carbon (originally attached to Cl)/bonds to the carbon/bonds to the carbocation (1)</p> <p><b>Reaction 2 - behaves as a base (1)</b></p> <p>and accepts a hydrogen ion/proton / donates <math>e^-</math> pair to H/removes a proton/removes a hydrogen ion/removes a <math>\text{H}^+</math> (1)</p> <p>In each case a correctly drawn mechanism could get (2)</p>	Removes a H atom	4

Question Number	Correct Answer	Reject	Mark
20 (b)(i)	<p>Heterolytic (fission)</p> <p><b>Notes</b> Accept phonetic/incorrect spelling as long as the word is recognisable</p>		1

Question Number	Correct Answer	Reject	Mark
20 (b)(ii)	<p>Butyl group less electron releasing/butyl group has less of a (positive) inductive effect (1)</p> <p>so less stable (positive charge on) carbocation (1)</p> <p><b>OR</b></p> <p>1- chlorobutane is a primary halogenoalkane/the carbon only has 1 other C attached (1)</p> <p>So forms a less stable carbocation (1)</p> <p><b>OR</b></p> <p>Primary carbocation is less stable than a tertiary carbocation (2)</p> <p><b>OR</b></p> <p>Water/<sup>-</sup>OH can attack C on 1° chloroalkane more easily (so no need to form cation) OWTTE / 1° chloroalkane reacts via SN2 mechanism/C-O bond forms before C-Cl breaks (1)</p> <p>As the carbon attacked is not surrounded by bulky groups OWTTE (1)</p>	Negative inductive effect	2

Question Number	Correct Answer	Reject	Mark
20 (c)	<p>Hydrogen (ion) can be eliminated from C on either side (of C attached to Cl)/double bond can form between 1<sup>st</sup> and 2<sup>nd</sup> or 2<sup>nd</sup> and 3<sup>rd</sup> carbon OWTTE (1)</p> <p><b>OR</b></p> <p>double bond can't rotate (so methyl group and hydrogens can be fixed in position) to form E and Z isomers / geometric isomers/cis and trans/stereoisomers/or named in diagrams OWTTE (1)</p> <p>allow descriptions in terms of cis and trans</p> <div style="text-align: center;">  <p>(1)</p> </div> <div style="text-align: center;">  <p>(1)</p> </div> <div style="text-align: center;">  <p>(1)</p> </div> <p>Methyl and ethyl groups do not need to be fully displayed</p> <p>Structural formulae/skeletal formulae  For all 3 (2)  For 2 (1)  For 1 (0)</p> <p>For an incorrect haloalkane structure that can form 3 isomers including cis/trans (2 max) (eg 2-chloropentane)</p>		4

Question Number	Correct Answer	Reject	Mark
20 (d)	<p>(Slower) as C-F bond is stronger (than C-Cl)/fluorine bonds more strongly/fluorine holds the carbon more strongly</p> <p><b>OR</b></p> <p>Slower as F<sup>-</sup> is a poorer leaving group (than Cl<sup>-</sup>) (1)</p> <p>Use sodium hydroxide /NaOH/ potassium hydroxide /KOH/ hydroxide ions (1)</p> <p>As OH<sup>-</sup> is a stronger nucleophile / OH<sup>-</sup> has a full negative charge/ more strongly attracted to C<sup>δ+</sup> /OH<sup>-</sup> has more lone pairs (than water)/ OH<sup>-</sup> is more negative than water (1)</p>	Alkali Hydroxide	3

Question Number	Correct Answer	Reject	Mark
21 (a)(i)	<p>Hydrogen bonding Hydrogen bond(s) H bonding H bond(s)</p> <p><b>Notes</b> Accept phonetic/incorrect spelling as long as the word is recognisable</p>	<p>Not "hydrogen" on its own Dipole-dipole bond Permanent dipole-dipole bond Covalent bond van der Waals' (forces) Temporary dipole-dipole Induced dipole-dipole London forces</p> <p>Any correct answer in conjunction with an incorrect response, eg hydrogen dipole-dipole bond.</p>	1

Question Number	Correct Answer	Reject	Mark
21 (a)(ii)	<p>(Fluorine atom) is more electronegative (1)</p> <p>Because it has less shielding / (bonding) electrons closer to the nucleus/ smaller /has less shells (so greater pull from nucleus on bonding electrons) (1)</p> <p>so HF has a (greater) dipole moment/H<sup>δ+</sup> on HF (greater than on HBr)/HF is (more) polar (1)</p>		3

Question Number	Correct Answer	Reject	Mark
21 (a)(iii)	Between 150 - 180 (K) Accept a range within the range e.g. '150-170'	°C	1

Question Number	Correct Answer	Reject	Mark
21 (b)(i)	Because propanone has both polar and non polar characteristics/can form both London forces and H bonds/can form London forces and dipole-dipole forces OWTTE (1)  London forces can be described as Van der Waals VDW Temporary dipole-dipole Instantaneous dipole-induced dipole		1

Question Number	Correct Answer	Reject	Mark
21 (b)(ii)	<b>Water:</b> Hydrogen bonds with the (oxygen of the) carbonyl group/H bonds to the oxygen (1)  <b>Octane:</b> London forces with methyl groups/carbon chain/CH groups/H atoms (1)  Both forces given allow (1)	Carbon atoms	2

Question Number	Correct Answer	Reject	Mark
22 (a)(i)	Use of heat (1) To break down (a reactant)/one reactant into more than one product (1)		2

Question Number	Correct Answer	Reject	Mark
22 (a)(ii)	$\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ Allow correct multiples		1

Question Number	Correct Answer	Reject	Mark
22 (a)(iii)	<p>Group 2 carbonates are more (thermally) stable as you go down the group (1)</p> <p>as the cations get bigger/charge density gets less/cation has more shells (1)</p> <p>So have less of a polarising effect/distortion on the carbonate (ion)/less of a weakening effect on C-O (1)</p> <p>2nd and 3rd marks cq on first</p>	<p>Metal gets bigger/element gets bigger</p> <p>Carbonate molecule</p>	3

Question Number	Correct Answer	Reject	Mark
22 (b)(i)	orange	<p>Yellow</p> <p>Any colour in conjunction with orange</p>	1

Question Number	Correct Answer	Reject	Mark
22 (b)(ii)	$(18.0/1000 \times 0.100) = 1.8 \times 10^{-3}$ $/0.0018/2 \times 10^{-3}/0.002$ <i>IGNORE</i> sf and units even if incorrect		1

Question Number	Correct Answer	Reject	Mark
22 (b)(iii)	$(50/1000 \times 0.100) = 5 \times 10^{-3}$ (1) <p>[If candidate fails to divide by 1000 in both (b)(ii) and b(iii) penalise only once]</p> <p>Moles HCl reacted = <math>3.2 \times 10^{-3}</math> (can get first mark here if <math>5 \times 10^{-3}</math> not shown above)            So moles CaO = <math>1.6 \times 10^{-3}</math> (1)</p> <p><i>IGNORE</i> sf</p> <p>Allow TE from b (ii)</p>		2



Question Number	Correct Answer	Reject	Mark
22 (b)(iv)	<p>Mass CaO = <math>(1.6 \times 10^{-3} \times 56.1)</math> = 0.0898 g (1)</p> <p>% purity = <math>0.0898/0.121 \times 100 = 74.2\%</math> (1)</p> <p>OR</p> <p>Allow % calculated in terms of moles e.g moles of CaO should be <math>0.121 \times 56.1 = 0.0021568</math> (mol) (1)</p> <p>% purity = <math>0.0016/0.0021568 = 74.2\%</math> (1)</p> <p><b>Accept</b> = <math>(1.6 \times 10^{-3} \times 56)</math> = 0.0896 g (1)</p> <p>% purity = <math>0.0896/0.121 \times 100 = 74.0\%</math> (1)</p> <p>Allow TE of incorrect moles of CaO from (b)(iii)</p> <p>Allow TE from incorrect mass of CaO if answer is <math>\leq 100\%</math></p> <p>0.09 g and 74.4% is 1 out of 2 (rounding too soon)</p>	Any % purity without 3 sf for second mark	2

Question Number	Correct Answer	Reject	Mark
22 (c)(i)	<p>(Clean) nichrome/platinum wire/ceramic rod/silica/nickel/chrome rod (1)</p> <p>(In conc.) HCl/HCl(aq)/dilute HCl (1)</p> <p>Heat/place in (blue Bunsen) flame (1)</p>	<p>Metal loop/inoculating loop/glass rod/silver/spatula</p> <p>Place in yellow Bunsen flame/burn</p>	3

Question Number	Correct Answer	Reject	Mark
22 (c)(ii)	Barium/Ba/Ba <sup>2+</sup>		1

Question Number	Correct Answer	Reject	Mark
23 (a)	H bond between appropriate O and H atom (1) Angle of 180° between molecules (1)  2 <sup>nd</sup> mark is dependent on first Compounds other than ethanol showing correct H bond and angle (1 max)	O---H-O if not in a straight line	2

Question Number	Correct Answer	Reject	Mark
23 (b)	Incorrect water flow through condenser (1) so takes longer to collect product / lower amount of product collected / inner tube in condenser could crack / backflow of water due to gravity/air bubbles/inefficient cooling/condenser does not fill up with water (1)  Thermometer bulb too high (1) so incorrect boiling point reading/product collected at incorrect temp OWTTE (1)  Sealed apparatus (1) so risk of explosion/pressure build up (1)  2 <sup>nd</sup> mark in each pair dependent on 1 <sup>st</sup> mark 1 <sup>st</sup> mark can be obtained by circling correct point on diagram or by description  Circle for 3 <sup>rd</sup> error must cover joint to collection flask and/or delivery adaptor  If the whole apparatus is circled to indicate sealed 2 marks could be awarded if the problem of the pressure build up is explained  Circling the whole apparatus with no or incorrect explanation = 0 marks		6

Question Number	Correct Answer	Reject	Mark
23 (c)	$(0.005 \times 2) / 20.10 \times 100 = 0.05 / 0.04975 (\%)$ <i>IGNORE</i> sf		1

Question Number	Correct Answer	Reject	Mark
23 (d)	Suitable drying agent e.g anhydrous magnesium sulfate/anhydrous sodium sulfate/calcium oxide (1) <b>Accept</b> anhydrous calcium chloride silica (gel)  Add to ethanol (leave) and then filter/Add to ethanol (leave) and then decant (1) Mark independently	Concentrated sulfuric acid OR Sodium and potassium hydroxide Anhydrous copper sulfate Anhydrous cobalt chloride	2

Question Number	Correct Answer	Reject	Mark
23 (e)	Add $\text{PCl}_5$ /phosphorous(v)chloride/ phosphorous pentachloride (1) Misty fumes (of HCl) seen/steamy fumes/fumes that form white smoke with $\text{NH}_3$ /fumes that turn blue litmus red (1)  <b>OR</b>  Add Na (to dried ethanol) (1) Bubbles (of $\text{H}_2$ ) seen/fizzing/effervescence (1)  <b>OR</b>  Add acidified (sodium) dichromate((VI))/ $\text{Cr}_2\text{O}_7^{2-}$ and $\text{H}^+$ (1)  Blue/green colour observed (1)  <b>OR</b>  Add acidified (potassium) manganate((VII))/ $\text{MnO}_4^-$ & $\text{H}^+$ (1)  Loss of (purple) colour/colour fades/decolourises (1)  2 <sup>nd</sup> mark dependent on sensible attempt at test reagent	$\text{PCl}_3$  White smoke on its own White fumes on its own	2

Question Number	Correct Answer	Reject	Mark
23 (f)(i) QWC	<p>A fuel (derived from a plant) that takes in as much CO<sub>2</sub> (as it forms/grows) (1) as is released during its production /combustion/when used (1)</p> <p><b>OR</b></p> <p>A fuel (such as hydrogen) that produces no CO<sub>2</sub> when burnt (1) Nor in its production/processing (1)</p>		2

Question Number	Correct Answer	Reject	Mark
23 (f)(ii) QWC	<p><b>2 specific reasons</b> e.g</p> <ul style="list-style-type: none"> <li>• energy used to heat/distil (ethanol water mixture after fermentation) may require burning a fuel/energy</li> <li>• energy required to manufacture fertilisers (to grow plants for biofuels in good yield)</li> <li>• energy required to manufacture insecticides (to grow plants for biofuels in good yield)</li> <li>• energy required to transport fuel to the power plant</li> <li>• biofuels less effective at absorbing CO<sub>2</sub> than (rain)forests/trees</li> </ul> <p style="text-align: right;">(2)</p> <p><b>2 well reasoned effects on society e.g</b></p> <ul style="list-style-type: none"> <li>• use of food crops to produce biofuels reduces food supply</li> <li>• (use of land) for biofuels reduces biodiversity</li> <li>• use of land to grow biofuels leads to reduced food supply</li> <li>• leads to deforestation/leads to habitat loss</li> <li>• new jobs created to grow crops on new farmland</li> <li>• increased price of car/car service due to engine modifications</li> <li>• less CO<sub>2</sub> so less global warming</li> <li>• less SO<sub>2</sub> so less acid rain</li> <li>• less SO<sub>2</sub> so less respiratory illnesses e.g asthma</li> </ul> <p style="text-align: right;">(2)</p> <p><b>Choice of most sustainable biofuel with appropriate reasoning</b> e.g</p> <ul style="list-style-type: none"> <li>• elephant grass as it requires little/no energy to process before it is burnt</li> <li>• elephant grass grows very quickly</li> <li>• elephant grass is a high yield crop</li> <li>• Any of the fuels can be burnt using existing technology</li> </ul> <p style="text-align: right;">(1)</p>		5