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**

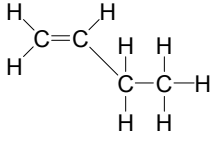
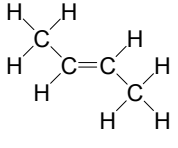
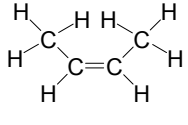
Section B

Question Number	Correct Answer	Reject	Mark
20 (a)(i)	**Reaction 1** – (nucleophilic) substitution **(1)** **Reaction 2** – elimination **(1)**		**2**

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

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

Question Number	Correct Answer	Reject	Mark
20 (b)(ii)	Butyl group less electron releasing/butyl group has less of a (positive) inductive effect **(1)** so less stable (positive charge on) carbocation **(1)** **OR** 1- chlorobutane is a primary halogenoalkane/the carbon only has 1 other C attached **(1)** So forms a less stable carbocation **(1)** **OR** Primary carbocation is less stable than a tertiary carbocation **(2)** **OR** Water/$^{-}$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)** As the carbon attacked is not surrounded by bulky groups OWTTE **(1)**	Negative inductive effect	**2**

Question Number	Correct Answer	Reject	Mark
20 (c)	Hydrogen (ion) can be eliminated from C on either side (of C attached to Cl)/double bond can form between 1st and 2nd or 2nd and 3rd carbon OWTTE **(1)** **OR** 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)** allow descriptions in terms of cis and trans  **(1)**  **(1)**  **(1)** Methyl and ethyl groups do not need to be fully displayed Structural formulae/skeletal formulae For all 3 **(2)** For 2 **(1)** For 1 **(0)** For an incorrect haloalkane structure that can form 3 isomers including cis/trans **(2 max)** (eg 2-chloropentane)		**4**

Question Number	Correct Answer	Reject	Mark
20 (d)	(Slower) as C−F bond is stronger (than C-Cl)/fluorine bonds more strongly/fluorine holds the carbon more strongly **OR** Slower as $\mathbf{F^-}$ is a poorer leaving group (than Cl^-) **(1)** Use sodium hydroxide /NaOH/ potassium hydroxide /KOH/ hydroxide ions **(1)** As OH^- is a stronger nucleophile / OH^- has a full negative charge/ more strongly attracted to $C^{\delta+}$ /OH^- has more lone pairs (than water)/ OH^- is more negative than water **(1)**	 Alkali Hydroxide	**3**

Question Number	Correct Answer	Reject	Mark
21 (a)(i)	Hydrogen bonding Hydrogen bond(s) H bonding H bond(s) **Notes** Accept phonetic/incorrect spelling as long as the word is recognisable	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 Any correct answer in conjunction with an incorrect response, eg hydrogen dipole-dipole bond.	**1**

Question Number	Correct Answer	Reject	Mark
21 (a)(ii)	(Fluorine atom) is more electronegative **(1)** Because it has less shielding / (bonding) electrons closer to the nucleus/ smaller /has less shells (so greater pull from nucleus on bonding electrons) **(1)** so HF has a (greater) dipole moment/$H^{\delta+}$ on HF (greater than on HBr)/HF is (more) polar **(1)**		**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)	**Water:** Hydrogen bonds with the (oxygen of the) carbonyl group/H bonds to the oxygen **(1)** **Octane:** 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)	$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ Allow correct multiples		**1**

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

Question Number	Correct Answer	Reject	Mark
22 (b)(i)	orange	Yellow Any colour in conjunction with orange	**1**

Question Number	Correct Answer	Reject	Mark
22 (b)(ii)	$(18.0/1000 \times 0.100) = 1.8 \times 10^{-3}$ $/0.0018/2 \times 10^{-3}/0.002$ *IGNORE* 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)** [If candidate fails to divide by 1000 in both (b)(ii) and b(iii) penalise only once] Moles HCl reacted = 3.2×10^{-3} (can get first mark here if 5×10^{-3} not shown above) So moles CaO = 1.6×10^{-3} **(1)** *IGNORE* sf Allow TE from b **(ii)**		**2**

Question Number	Correct Answer	Reject	Mark
22 (b)(iv)	Mass CaO = (1.6 x 10^{-3} x 56.1) = 0.0898 g **(1)** % purity = 0.0898/0.121 x100 = 74.2% **(1)** OR Allow % calculated in terms of moles e.g moles of CaO should be 0.121 x 56.1 = 0.0021568 (mol) **(1)** % purity = 0.0016/0.0021568 = 74.2% **(1)** **Accept** = (1.6 x 10^{-3} x 56) = 0.0896 g **(1)** % purity = 0.0896/0.121 x100 = 74.0% **(1)** Allow TE of incorrect moles of CaO from (b)(iii) Allow TE from incorrect mass of CaO if answer is ≤100% 0.09 g and 74.4% is 1 out of 2 (rounding too soon)	Any % purity without 3 sf for second mark	**2**

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

Question Number	Correct Answer	Reject	Mark
22 (c)(ii)	Barium/Ba/Ba^{2+}		**1**

Question Number	Correct Answer	Reject	Mark
23 (a)	H bond between appropriate O and H atom **(1)** Angle of 180° between molecules **(1)** 2nd 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)** 2nd mark in each pair dependent on 1st mark 1st mark can be obtained by circling correct point on diagram or by description Circle for 3rd 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 x 2)/20.10 x 100 = 0.05/0.04975 (%) *IGNORE* sf		**1**

Question Number	Correct Answer	Reject	Mark
23 (d)	Suitable drying agent e.g anhydrous magnesium sulfate/anhydrous sodium sulfate/calcium oxide **(1)** **Accept** 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 PCl_5 /phosphorous(v)chloride/ phosphorous pentachloride (1) Misty fumes (of HCl) seen/steamy fumes/fumes that form white smoke with NH_3/fumes that turn blue litmus red **(1)** **OR** Add Na (to dried ethanol) **(1)** Bubbles (of H_2) seen/fizzing/effervescence **(1)** **OR** Add acidified (sodium) dichromate((VI))/$Cr_2O_7^{2-}$ and H^+ **(1)** Blue/green colour observed **(1)** **OR** Add acidified (potassium) manganate((VII))/MnO_4^- & H^+ **(1)** Loss of (purple) colour/colour fades/decolourises **(1)** 2nd mark dependent on sensible attempt at test reagent	PCl_3 White smoke on its own White fumes on its own	**2**

Question Number	Correct Answer	Reject	Mark
23 (f)(i) QWC	A fuel (derived from a plant) that takes in as much CO_2 (as it forms/grows) **(1)** as is released during its production /combustion/when used **(1)** **OR** A fuel (such as hydrogen) that produces no CO_2 when burnt **(1)** Nor in its production/processing **(1)**		**2**

Question Number	Correct Answer	Reject	Mark
23 (f)(ii) QWC	**2 specific reasons** e.g • energy used to heat/distil (ethanol water mixture after fermentation) may require burning a fuel/energy • energy required to manufacture fertilisers (to grow plants for biofuels in good yield) • energy required to manufacture inseticides (to grow plants for biofuels in good yield) • energy required to transport fuel to the power plant • biofuels less effective at absorbing CO_2 than (rain)forests/trees **(2)** **2 well reasoned effects on society** e.g • use of food crops to produce biofuels reduces food supply • (use of land) for biofuels reduces biodiversity • use of land to grow biofuels leads to reduced food supply • leads to deforestation/leads to habitat loss • new jobs created to grow crops on new farmland • increased price of car/car service due to engine modifications • less CO_2 so less global warming • less SO_2 so less acid rain • less SO_2 so less respiratory illnesses e.g asthma **(2)** **Choice of most sustainable biofuel with appropriate reasoning** e.g • elephant grass as it requires little/no energy to process before it is burnt • elephant grass grows very quickly • elephant grass is a high yield crop • Any of the fuels can be burnt using existing technology **(1)**		**5**

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