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Mark Scheme (Results)
June 2010

GCE

GCE Chemistry (6CH02/01)

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Summer 2010

Publications Code US023632

Section A (multiple choice)

Question Number	Correct Answer	Mark
1(a)	D	**1**

Question Number	Correct Answer	Mark
1(b)	A	**1**

Question Number	Correct Answer	Mark
1(c)	B	**1**

Question Number	Correct Answer	Mark
2	D	**1**

Question Number	Correct Answer	Mark
3	C	**1**

Question Number	Correct Answer	Mark
4	C	**1**

Question Number	Correct Answer	Mark
5	B	**1**

Question Number	Correct Answer	Mark
6	D	**1**

Question Number	Correct Answer	Mark
7	D	**1**

Question Number	Correct Answer	Mark
8	B	**1**

Question Number	Correct Answer	Mark
9	C	**1**

Question Number	Correct Answer	Mark
10	A	**1**

Question Number	Correct Answer	Mark
11	A	**1**

Question Number	Correct Answer	Mark
12	A	**1**

Question Number	Correct Answer	Mark
13	D	**1**

Question Number	Correct Answer	Mark
14	D	**1**

Question Number	Correct Answer	Mark
15	B	**1**

Question Number	Correct Answer	Mark
16	A	**1**

Question Number	Correct Answer	Mark
17	A	**1**

Question Number	Correct Answer	Mark
18	B	**1**

Section B

Question Number	Acceptable Answers	Reject	Mark
19 (a)	**Mark independently** **From:** colourless **(1)** **To:** pink / (pale) red **(1)** If colour change wrong way round **max (1)**	**From:** clear **To:** magenta / purple / cerise	**2**

Question Number	Acceptable Answers	Reject	Mark
19 (b)	(Titres 2, 3 and 4) are concordant / within 0.2 (cm^3) / within 0.1 (cm^3) / consistent **OR** Titre 1 is rough / trial / a rangefinder / too far out / overshot *ALLOW* Titre 1 is an outlier / is anomalous	**Just** "very similar" / within 0.05 / within 0.5 Titre 1 "very different" **Just** "not accurate" "Titration 1 is a control experiment"	**1**

Question Number	Acceptable Answers	Reject	Mark
19 (c)	28.00 (cm^3) / 28.0 (cm^3) / 28 (cm^3)	28.14 (cm^3) / 28.1 (cm^3) / 28.13 (cm^3)	**1**

IN (d)(i) to (d)(v), IGNORE UNITS EVEN IF INCORRECT AND
ALLOW ANSWER IN EACH CASE WHETHER BY TE OR MARK SCHEME ANSWER, REGARDLESS OF ANY WORKING SHOWN

Question Number	Acceptable Answers	Reject	Mark
19 (d)(i)	$\frac{0.100 \times 28.00}{1000}$ = **0.0028 / 2.8 x 10^{-3}** (mol) *ALLOW* TE from (c) *IGNORE* sf except one sf		**1**

Question Number	Acceptable Answers	Reject	Mark
19 (d)(ii)	**0.0028 / 2.8 x 10^{-3}** (mol) OR **Same answer** to (d)(i) if TE applied *IGNORE* sf except one sf		**1**

Question Number	Acceptable Answers	Reject	Mark
19 (d)(iii)	$\frac{0.0028}{0.025}$ = **0.112** (mol dm^{-3}) OR **Answer** to $\frac{\text{(d)(ii)}}{0.025}$ if TE applied from (d)(ii) *IGNORE* sf except one sf		**1**

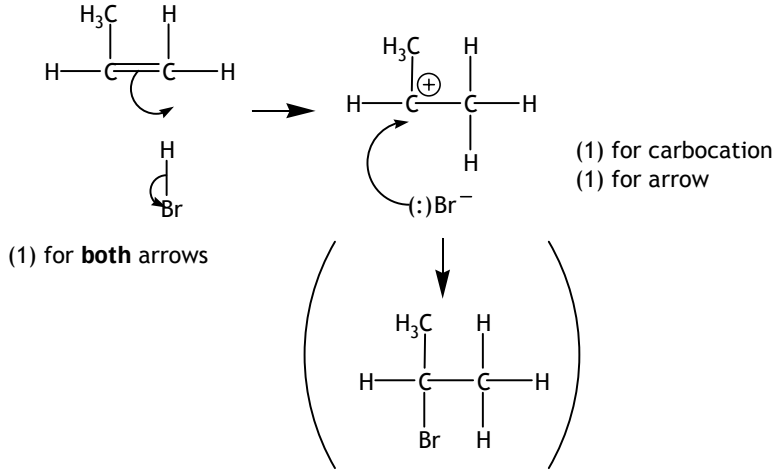
Question Number	Acceptable Answers	Reject	Mark
19 (d)(iv)	10 x 0.112 = **1.12** (mol dm^{-3}) OR **Answer** to (d)(iii) x 10 if TE applied from (d)(iii) *IGNORE* sf except one sf		**1**

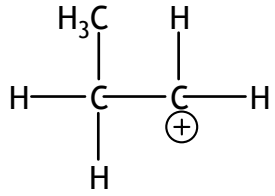
Question Number	Acceptable Answers	Reject	Mark
19 (d)(v)	1.12 x 60 = **67.2** (g dm^{-3}) OR **Answer** to (d)(iv) x 60 if TE applied from (d)(iv) *IGNORE* sf except one sf	67.1	**1**

Question Number	Acceptable Answers	Reject	Mark
19 (e)	*NOTE*: answer must refer to making up the diluted solution and not the titration *NOTE:* the Reason mark must be correctly linked to the Improvement **Improvement:** Use a pipette / burette to measure acid (solution) **(1)** **Reason:** Pipette / burette more accurate (than a measuring cylinder) **(1)** *ALLOW* "more precise" **OR** **Improvement:** Shake / invert **the volumetric flask** (thoroughly) **(1)** **Reason:** To ensure a uniform concentration **(1)** **OR** **Improvement:** Rinse out measuring cylinder (and transfer washings to the volumetric flask) **(1)** **Reason:** To ensure **all** the acid is transferred (to the volumetric flask) **(1)** **OR** **Improvement:** Use a (teat) pipette to make up to the mark (in volumetric flask) **(1)** **Reason:** To ensure volume of solution accurately measured **(1)**	Use of volumetric flask for **initial** measurement of volume of vinegar solution "more reliable" swirl (the flask) to ensure "fully dissolved" **just** "rinse out apparatus" Any suggested improvements relating to the titration part of this experiment	**2**

Question Number	Acceptable Answers	Reject	Mark
19 (f)(i)	**Z *I*** between 27.85 and 28.05 (cm^3) *ALLOW* 27.95 ±0.10 (cm^3)		**1**

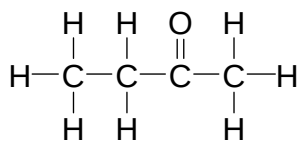
Question Number	Acceptable Answers	Reject	Mark
19 (f)(ii)	Any **one** of the following / a statement equivalent to: • overshoots/misses end-point • water left in burette / pipette • air lock below tap in burette / air in pipette • burette not vertical • alkali not at stated concentration • leaking tap • not reading meniscus at eye-level • funnel left in top of burette • not reading level against a white background • not reading meniscus correctly • washing pipette between titres • washing the flask with the solution that will go in it • not swirling flask / mixture *IGNORE* "errors in calculation"	"water left in conical flask" **just** "measurements may be inaccurate" "there could be uncertainty with other equipment" "contamination of the vinegar"	**1**

Question Number	Acceptable Answers	Mark
20 (a)(i)	 (1) for carbocation (1) for arrow (1) for **both** arrows **1st mark:** • top arrow must start from the double bond / close to the double bond and **not** from either of the C atoms of the C=C bond • top arrow can end on, or close to, the H in HBr • lower arrow must start from the bond and **not** the H atom in HBr *REJECT* **full** charges on the HBr **2nd mark:** the carbocation must have a full + and **not** δ+ **3rd mark:** • the bromide ion must have a full ⁻ and **not** δ⁻ • the lone pair need not be shown on the Br^- • arrow from bromide ion can start anywhere on the Br^- or from the minus sign or the lone pair (if shown) on Br^- and can go to the C or the + sign on the intermediate 3rd mark available even if an incorrect intermediate has been drawn	**3**

Question Number	Acceptable Answers	Reject	Mark
20(a)(ii)	 OR $CH_3\,CH_2\,CH_2^+$		**1**

Question Number	Acceptable Answers	Reject	Mark
20(b)(i)	B /$CH_3CH_2CH(OH)CH_3$ /butan-2-ol **(1)** Because the C atom bearing the OH is attached to two other C atoms / C with OH group attached to one H (atom) **(1)** *ALLOW* Because the C atom bearing the OH is attached to two alkyl groups **These marks are stand alone**	**Just** "OH is on the second C atom" / "OH is in the chain, not on the end" OR "OH attached to two **methyl** / two **CH_3** groups" OH^- (instead of –OH)	**2**

Question Number	Acceptable Answers	Reject	Mark
20(b)(ii)	C /$(CH_3)_3COH$ /(2-)methylpropan-2-ol **(1)** Because it is a **tertiary** (alcohol)/no C-H bonds to break **(1)** *ACCEPT* a description of a tertiary alcohol **These marks are stand alone**	"tertiary **structure"** / "tertiary **carbon"** / "tertiary **carbocation"**	**2**

Question Number	Acceptable Answers	Reject	Mark
20(b)(iii)	**BOTH** B / $CH_3CH_2CH(OH)CH_3$ / butan-2-ol **AND**  **BOTH required for the one mark**	Structural / skeletal formula	**1**

Question Number	Acceptable Answers	Reject	Mark
20(b)(iv)	A / $CH_3CH_2CH_2CH_2OH$ / butan-1-ol **and** D / $CH_3CH(CH_3)CH_2OH$ / (2-)methylpropan-1-ol **BOTH needed for one mark**		**1**

Question Number	Acceptable Answers	Reject	Mark
20(b)(v)	Steamy fumes / misty fumes / white mist	White **smoke**	**1**

Question Number	Acceptable Answers	Reject	Mark
20(b)(vi)	(C_4H_9OH + PCl_5 →) **C_4H_9Cl + $POCl_3$ + HCl** **(1)** for HCl **(1)** for rest of the equation correct *NOTE:* Equation must be completely correct for the second mark. *ACCEPT* "PCl_3O" instead of $POCl_3$		**2**

Question Number	Acceptable Answers	Reject	Mark
21(a)(i)	**Mark the two points independently, subject to the constraint in Reject column** **Effect:** (Equilibrium) shifts to the right **(1)** *ALLOW:* "favours forward reaction" / "increase the amount of product" / "increase the yield (of product)" **Reason:** Exothermic (in forward direction) **(1)** *NOTE:* **Just** "(equilibrium) shifts in the exothermic direction" scores **(1)**	**"Equilibrium shifts to left" will score (0) for (a)(i)**	**2**

Question Number	Acceptable Answers	Reject	Mark
21(a)(ii)	**First mark:** Activation energy for the reaction is too high / (if cooled) molecules would not have enough energy to react / few(er) molecules have the required E_a/more molecules have energy ≥ E_a at higher temperatures **OR** not (technologically) feasible to cool the gases before they enter the converter/costly to cool the gases **(1)** **Second mark:** (cooling the gases would make) the rate (too) slow /rate is faster if the temperature is high (so the gases are not cooled) **(1)**	Cooling the gases decreases the yield (of products) /an incorrect Le Chatelier argument	**2**

Question Number	Acceptable Answers	Reject	Mark
21(a)(iii)	**Mark the two points independently, subject to the constraint in Reject column** **Effect:** (Equilibrium) shifts to the right *ALLOW:* "favours forward reaction" / "increase the amount of product" / "increase the yield of product" **(1)** **Reason:** Shifts / moves in the direction of fewer (moles of gas) molecules *ALLOW* "shifts in direction of fewer moles (of gas molecules)" **(1)** *IGNORE* effect on the rate	**"Equilibrium shifts to left" will score (0) for (a)(iii)** "…. fewer **atoms**"	**2**

Question Number	Acceptable Answers	Reject	Mark
21(b)(i)	**(In NO):** +2 / 2+ **(1)** (**In NO_3^-):** +5 / 5+ **(1)** *NOTE:* **(In NO):** Just "2" **AND** (**In NO_3^-):** Just "5" scores **(1)**		**2**

Question Number	Acceptable Answers	Reject	Mark
21(b)(ii)	NO_3^- + **4**H^+ + **3**e^- → NO + **2**H_2O *ACCEPT* multiples		**1**

Question Number	Acceptable Answers	Reject	Mark
21(b)(iii)	$Ag \rightarrow Ag^+ + e^{(-)}$ / $Ag - e^{(-)} \rightarrow Ag^+$ *ACCEPT* multiples *IGNORE* state symbols, even if incorrect	"$Ag + e^- \rightarrow Ag^+$"	**1**

Question Number	Acceptable Answers	Reject	Mark
21(b)(iv)	$3Ag + NO_3^- + 4H^+ \rightarrow 3Ag^+ + NO + 2H_2O$ **(2)** **(1)** for multiplication of the silver half-equation by three or cq multiple from (b)(ii) **(1)** for rest of equation correct *NOTE:* Equation must be completely correct for the second mark. *IGNORE* state symbols, even if incorrect	if any e^- are left in the final equation, second mark cannot be scored	**2**

SECTION C

Question Number	Acceptable Answers	Reject	Mark
22(a)(i)	2-bromo-2-chloro-1,1,1-trifluoroethane *ALLOW* 1-bromo-1-chloro-2,2,2-trifluoroethane *IGNORE* incorrect punctuation and incorrect order of the halogen atoms	**"**1-bromo-1-chloro-**2**-trifluoroethane"	**1**

Question Number	Acceptable Answers	Reject	Mark
22(a)(ii)	London (forces) / instantaneous dipole / induced dipole / dispersion / van der Waals' (forces) **(1)** permanent dipole (-permanent dipole) (forces) / dipole-dipole (forces) / dipole (forces) **(1)** *IGNORE* **any** references to hydrogen bonding		**2**

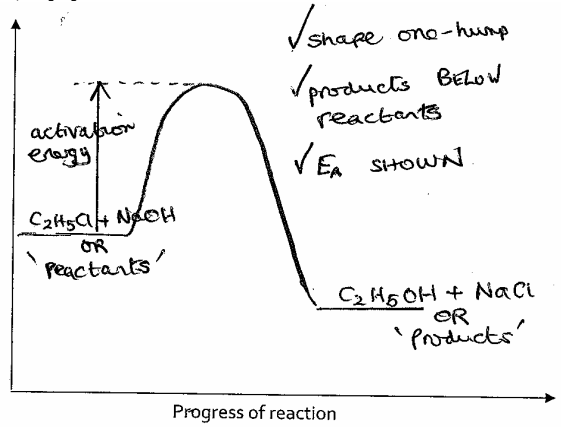
Question Number	Acceptable Answers	Reject	Mark
22(a)(iii)	Any **one** of the following / a statement equivalent to: **Ethanol** is **flammable** [Note: if any reference to **only** the halogenoalkane being flammable scores **(0)**] OR reference to greater control of heating (e.g. "to control the rate of reaction" / "to prevent the reaction being too vigorous" / "to prevent the reaction getting out of control") *ALLOW* "so that the reaction takes place slowly" OR "(reaction) mixture is flammable/it is flammable" OR "Bunsen flame too hot / too vigorous" OR "(Bunsen flame) would cause too much evaporation to occur" OR "(allows) constant heating"/ "even heating"	Compound **X** is flammable **Just** "to prevent an explosion" **Just** "to minimise the risk"	**1**

Question Number	Acceptable Answers	Reject	Mark
22(a)(iv)	Solvent (for both reactants) OR To dissolve (the reactants) OR To mix the reactants *ALLOW* "To enable the mixture to dissolve"	**Just** "mixing" "to acidify the silver nitrate"	**1**

Question Number	Acceptable Answers	Reject	Mark
22(a)(v)	Cream / **off-**white / **pale**-yellow **precipitate** *ALLOW* Cream / **off-**white / **pale**-yellow **solid** *IGNORE* incorrect identification of this precipitate *NOTE:* **both** colour **and** state (of the AgBr) needed	**Just** "Yellow" (precipitate/ solid) OR "**white** precipitate" OR "white-yellow precipitate" **(0)** if contradictory observation given, eg "cream precipitate and fizzing"	**1**

Question Number	Acceptable Answers	Reject	Mark
22(a)(vi)	Ag^{+}**(aq)** + Br^{-} **(aq)** → AgBr**(s)** Must include **state symbols** *ACCEPT* multiples	If NO_3^- left on either side	**1**

Question Number	Acceptable Answers	Reject	Mark
22(b)(i)	**Mark independently** **Name:** ethanol **(1)** *ALLOW* **"**ethan-1-ol**"** **Structural formula:** CH_3CH_2OH or C_2H_5OH **(1)** *Allow* displayed formula *ALLOW* brackets around the OH	 C_2H_6O	**2**

Question Number	Acceptable Answers	Reject	Mark
22(b)(ii)	**Mark independently** **1st mark:** Energy of products, **labelled**, **below** that of reactants, **labelled (1)** *Note* if the words 'reactants' and 'products' are written, ignore any formulae *Note* if the words 'reactants' and 'products' are not written, both formulae of the reactants and both formulae of the products must be given. (Na^+ ions can be omitted.) **2nd mark:** Shape of profile with one 'hump' **(1)** **3rd mark:** Activation energy / "E_a" correctly shown **with a single-headed arrow** to the peak (or close to it) **(1)**  	**Maxwell-Boltzmann curve scores (0) for (b)(ii)** **Double-headed** arrow showing E_a	**3**

Question Number	Acceptable Answers	Reject	Mark
22(c)(i)	Chlorofluorocarbon Accept ..flouro… spelling		**1**

Question Number	Acceptable Answers	Reject	Mark
22(c)(ii)	Any **one** of the following / a statement equivalent to: aerosol / propellant / spray cans OR (degreasing) solvent OR fire retardant *ALLOW* fire extinguishers / putting out fires *ALLOW* making expanded polystyrene / making plastics / making polymers	pesticides / anaesthetics **just** "retardant" anti-freeze air-conditioning frying pans detergents	**1**

Question Number	Acceptable Answers	Reject	Mark
22(c)(iii) QWC	**Mark independently** **1st mark:** $O + O_3 \rightarrow 2O_2$ *IGNORE* any state symbols **(1)** **2nd mark:** (chlorine free radical acts as a) **catalyst (1)** **Last 3 marks:** any **three** from: • (the chlorine free radical) persists in the atmosphere / continues to attack / is regenerated / (starts) a chain reaction **(1)** *NOTE* 'chain reaction' may be described in terms of a chlorine radical breaking down many / a large number of / a specified number of, eg 10,000, O_3 (molecules). *NOTE:* As written, this response also earns the scoring point relating to ozone depletion. • less ozone / ozone decreases / causes hole(s) in ozone layer / breakdown of ozone (layer) / damages ozone layer / depletes ozone layer **(1)** • **UV** (reaching Earth's surface) increases / less **UV** absorbed / (more) UV reaches Earth's surface **(1)** • causes (skin) cancer/mutation / DNA damage occurs **(1)** *IGNORE* any references to "global warming" / "Greenhouse Effect"	If Cl● and / or ClO● left in equation OR $2O_3 \rightarrow 3O_2$ **Just** (UV) "harmful"	**5**

Question Number	Acceptable Answers	Reject	Mark
22(d)(i)	The C-F bond is (very) strong OR C-F bond is (much) harder to break than the C-Cl bond **OR** UV/radiation does not have enough energy /does not have (high) enough frequency	Any mention of electronegativity **OR** mention of bond polarity scores (0)	**1**

Question Number	Acceptable Answers	Reject	Mark
22(d)(ii) **QWC**	(long wavelength) IR /infrared radiation **(1)** The molecule is polar OR (the molecule) changes its polarity OR "polar bonds" OR vibrational energy/vibrations of the **bonds** / stretching or bending increases OR (IR causes) **bonds** to vibrate **(1)** **Marks are stand alone**	UV / ultraviolet **Just "molecule** vibrates" **(0)**	**2**

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