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Mark Scheme (Results)

Summer 2013

GCE Chemistry 6CH02/01R
Application of Core Principles of Chemistry

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.
( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication
Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear

- select and use a form and style of writing appropriate to purpose and to complex subject matter

- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Section A (multiple choice)

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

Question Number	Correct Answer	Reject	Mark
2	A		**1**

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

Question Number	Correct Answer	Reject	Mark
4	B		**1**

Question Number	Correct Answer	Reject	Mark
5	D		**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	A		**1**

Question Number	Correct Answer	Reject	Mark
9	B		**1**

Question Number	Correct Answer	Reject	Mark
10	C		**1**

Question Number	Correct Answer	Reject	Mark
11	D		**1**

Question Number	Correct Answer	Reject	Mark
12	D		**1**

Question Number	Correct Answer	Reject	Mark
13	B		**1**

Question Number	Correct Answer	Reject	Mark
14	A		**1**

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

Question Number	Correct Answer	Reject	Mark
16	D		**1**

Question Number	Correct Answer	Reject	Mark
17	C		**1**

Question Number	Correct Answer	Reject	Mark
18	D		**1**

Question Number	Correct Answer	Reject	Mark
19	C		**1**

Question Number	Correct Answer	Reject	Mark
20	A		**1**

Total for Section A = 20 Marks

Section B

Question Number	Acceptable Answers	Reject	Mark
21 (a) (i)	**In (a) any units given must be correct. Penalise once only** **IGNORE SF except 1SF. Penalise once only** **If rounding is done then must be correct, penalise once only** **TE throughout** n = (0.100 x 0.0141) = 1.41 x 10^{-3} / 0.00141 (mol)	1 x 10^{-3}	**1**

Question Number	Acceptable Answers	Reject	Mark
21 (a) (ii)	7.05 x 10^{-4} / 0.000705 (mol) ALLOW TE = ans to (i) ÷ 2 1.4 x 10^{-3} gives 7.0 x 10^{-4} 0.0014 gives 0.00070	7.10 x 10^{-4} / 0.000710	**1**

Question Number	Acceptable Answers	Reject	Mark
21 (a) (iii)	c = (7.05 x 10^{-4} ÷ 0.05) = 1.41 x 10^{-2} / 0.0141 (mol dm^{-3}) ALLOW TE = ans to (ii) ÷ 0.05 OR ALLOW TE = ans to (ii) x 20		**1**

Question Number	Acceptable Answers	Reject	Mark
21 (a) (iv)	$Ca(OH)_2$ M_r = 74.1 **(1)** ALLOW 74 m = (1.41 x 10^{-2} x 74.1) = 1.04481 = 1.045 = 1.04 (g dm^{-3}) **(1)** If M_r = 74 then m= 1.0434 = 1.04 (g dm^{-3}) ALLOW TE = ans to (iii) x 74.1 ALLOW TE for second mark if ans to (iii) x incorrect Mr value OR 7.05 x 10^{-4} x 74.1 = 0.0522405 = 0.0522 (g) **(1)** (0.0522 ÷ 0.05) = 1.044 (g dm^{-3}) **(1)**	1.05	**2**

Question Number	Acceptable Answers	Reject	Mark
21 (a) (v)	It's only a rangefinder / It's a rough OR approximate titration / It's an estimation / More than 0.2 cm^3 from other titres / Overshot on first titration / Not concordant ALLOW It is anomalous / It is out of range It differs / is not consistent with titrations 1 and 2 Titrations 1 and 2 are more consistent If a list of suggestions is given, a wrong cancels a right	Not titrated accurately It is not precise Control Just 'it's a trial'	**1**

Question Number	Acceptable Answers	Reject	Mark
21 (a) (vi)	**Pipette** 50.0 cm^3 (of distilled water) into weighed beaker and find the mass ALLOW "fill the **pipette**" (with water) and transfer into weighed beaker and find the mass / measure the mass of the **pipetted** distilled water **(1)** ALLOW alternative containers to beaker. Use the density of water to determine the exact volume / density of water is 1(.00)g cm^{-3} /check it weighs 50(.0) g **(1)** Stand-alone marks	"Transfer 50cm^3 water into a beaker" without reference to pipette. Approx. 50g Use of lime water Use of solution	2

Question Number	Acceptable Answers	Reject	Mark
21 (b)	A – (Strong) heat / high temperature **(1)** B – $CaCl_2 + H_2O$ (Both needed) **(1)** C – $Ca(OH)_2$ **(1)** D – Ca **(1)** IGNORE state symbols even if wrong IGNORE any number in front of species, e.g.$½O_2$ or 2Ca given in D	Warm / Gentle heat Reflux Combustion / burnt Answers suggesting reaction with air or oxygen CaCl CaOH Ca_2	**4**

Question Number	Acceptable Answers	Reject	Mark
21 (c)	Bubble(s) / Fizz(ing) / Effervescence IGNORE references to colourless solution, solid disappearing and energy / temperature changes and further tests eg effect on limewater	Coloured or colourless fumes Cloudy solution Just 'CO_2 forming' Just '(colourless) gas forming' Bubbles of any gas except CO_2	**1**

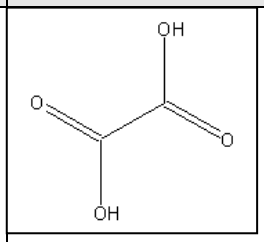
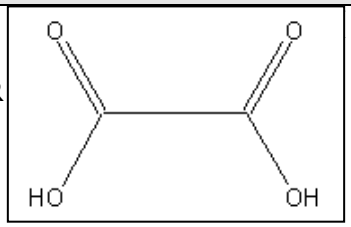
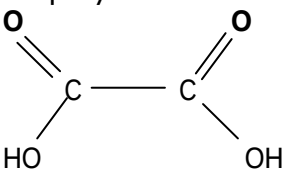
Question Number	Acceptable Answers	Reject	Mark
21 (d)	**Method 1:** Calcium is larger **ion** / calcium has a bigger **ionic** radius / or reverse argument for magnesium **ion** Use of the reverse argument applies throughout **(1)** (Distance between centres of ions increases so) weaker attraction/weaker bond between (calcium and carbonate) ions OR Shielding is greater in the calcium ion so weaker attraction (of calcium nucleus for carbonate ion) **(1)** **Method 2:** Calcium **ion** has a lower charge density **(1)** weaker attraction (between ions) **(1)** IGNORE references to polarization and the breaking of the covalent bonds in the carbonate ion	Calcium is bigger Any reference to atoms/molecules scores 0 Reference to ionization energy/weaker attraction for own electrons	2

Question Number	Acceptable Answers	Reject	Mark
21 (e)	Calcium's flame is yellow-red /orange-red / red / brick red Magnesium has no colour (Both needed for first mark) **(1)** Electrons excited / promoted (by heat energy) **(1)** (Colour produced from) energy / light emitted as electron returns (to ground state) **(1)**	Crimson Magnesium is white / bright Just "Mg / Ca decomposes" Electrons escape the orbitals	**3**

Total for Question 21 = 18 Marks

Question Number	Acceptable Answers	Reject	Mark
22 (a)	$2Na + CH_2OHCH_2OH \rightarrow CH_2O^{(-)}Na^{(+)}CH_2O^{(-)}Na^{(+)} + H_2$ This equation scores **(2)** marks Accept multiples and $(CH_2OH)_2$ and $(CH_2O^{(-)}Na^{(+)})_2$ Organic product (Charges not needed) **(1)** Balancing and the rest **(1)** ALLOW for one mark: $Na + CH_2OHCH_2OH \rightarrow CH_2OHCH_2O^{(-)}Na^{(+)} + ½H_2$ Accept multiples	$2\ CH_2O^{(-)}Na^{(+)}$ $CH_2Na^{(+)}O^{(-)}CH_2Na^{(+)}O^{(-)}$ Reject bond from C to Na	**2**

Question Number	Acceptable Answers	Reject	Mark
22 (b)	Remove thermometer / still-head / leave the top of condenser open **(1)** Place condenser directly on top of flask/in vertical position **(1)** ALLOW correct diagram for 2 marks IGNORE comments on use of electric heaters, changing concentration of reagents	Sealed apparatus, e.g. with thermometer in the top	**2**

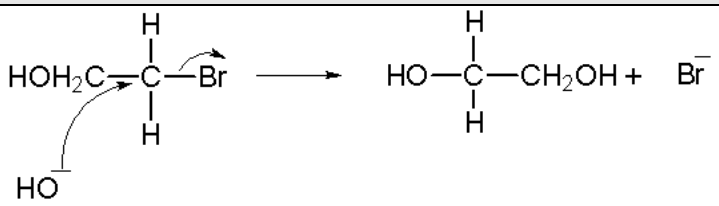
Question Number	Acceptable Answers	Reject	Mark
22 (c)	 OR  ALLOW the OH bond to be displayed ALLOW displayed formula as 'working out' ALLOW any orientation IGNORE bonds of different lengths or incorrect bond angles	Displayed formula  Just 'Structural formula' Bond from carbon clearly to the H of the OH	**1**

Question Number	Acceptable Answers	Reject	Mark
22 (d)	Both have OH / hydroxyl groups OR Both would produce steamy / misty /white **and** fumes /gas (of HCl)	Hydroxide ions White smoke Just 'both produce HCl' Both give the same products'	**1**

Question Number	Acceptable Answers	Reject	Mark
22 (e)(i)	(Strong) Peak at 1750-1700 (cm^{-1}) **(1)** Peak(s) (either or both) at 2900-2700(cm^{-1}) **(1)** ALLOW these if merged	peak at 3300-2500 (cm^{-1}) peak at 3750-3200 (cm^{-1})	**2**

Question Number	Acceptable Answers	Reject	Mark
22 (e)(ii)	(Unreacted) ethanol C_2H_5OH /displayed /skeletal IGNORE references to O-H bonding	Molecular formula Just "O-H in alcohol" Ethane-1,2-diol	**1**

Question Number	Acceptable Answers	Reject	Mark
22 (e)(iii)	$COOH^+$ ALLOW CO_2H^+ ALLOW CH_3COO^+ ALLOW CH_2COOH^+ ALLOW the + sign wherever it is seen Also allow correct displayed, semi-displayed or structural formulae	$COOH^-$ or any other formula with – charge $CH_3CO_2H^+$ CH_3COOH^+ $C_2H_3O_2^+$	**1**

Question Number	Acceptable Answers	Reject	Mark
22 (f)(i)	 One mark for curly arrow from hydroxide ion; (This arrow can be drawn from anywhere on the hydroxide ion) **(1)** One mark for curly arrow from C-Br bond **(1)** Correct products; **(1)** If SN1 is shown, then intermediate with positive charge must be shown after loss of Br, followed by attack by hydroxide. This mechanism can score all 3 marks	Carbon with ∂- Bond to H of OH	**3**

Question Number	Acceptable Answers	Reject	Mark
22 (f)(ii)	Mechanism: Nucleophilic **(1)** Type: Substitution **(1)** ALLOW either way round Just S_N scores **(1)** ALLOW nucleophile and phonetic spelling IGNORE Heterolytic fission	Elimination SN with elimination or other type of reaction Homolytic fission	2

Question Number	Acceptable Answers	Reject	Mark
22 (g)	$Ag^+(aq) + Br^-(aq) \longrightarrow AgBr(s)$ Species **(1)** State symbols **(1)** ALLOW one mark for chemical equation with state symbols rather than ionic equation, e.g. $AgNO_3(aq) + NaBr(aq) \longrightarrow AgBr(s) + NaNO_3(aq)$	Spectator ions included	**2**

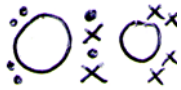
Question Number	Acceptable Answers	Reject	Mark
22 (h)	Both silver chloride and silver bromide dissolve /give colourless solution in conc. ammonia **(1)** If the solid doesn't dissolve in dilute ammonia then it is silver bromide OR Add conc. sulfuric acid to the (solid) silver bromide and get red-orange bromine gas **(1)**	Alternative tests which don't work eg displacement of bromine, use of organic solvent, leave in sunlight to see if bromine forms, add conc. sulfuric acid to halide solution.	**2**

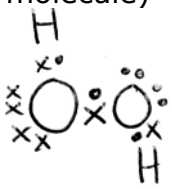
Total for Question 22 =19 Marks

Total for Section B = 37 Marks

Section C

Question Number	Acceptable Answers	Reject	Mark
23 (a)	$H_2O_2 \longrightarrow H_2O + \frac{1}{2}O_2$ IGNORE state symbols even if wrong ALLOW multiples		**1**

Question Number	Acceptable Answers	Reject	Mark
23 (b)	Correct shared pairs of electrons between the two oxygens and two lone pairs of electrons on each of the oxygens  ALLOW either all dots or all crosses IGNORE any 'circles' given If inner electrons given then must be correct		**1**

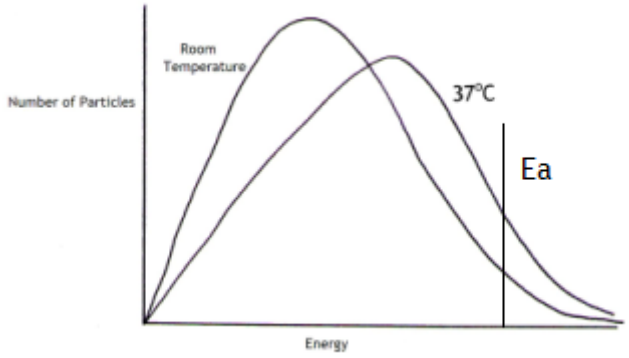
Question Number	Acceptable Answers	Reject	Mark
23 (c)	One shared electron pair between each hydrogen and an oxygen **(1)** Rest of molecule correct **(1)** (IGNORE positions of hydrogen around molecule)  Second mark consequential on first ALLOW either all dots or all crosses, even triangles IGNORE any 'circles' given	Both hydrogens bonded to the same oxygen (0)	**2**

Question Number	Acceptable Answers	Reject	Mark
23 (d)	Bond Angle = 104.5° – 95.0° **(1)** ALLOW 105° Electron pairs repel to the maximum extent / minimal repulsion **(1)** Lone pairs repel more than bonded pairs **(1)** Stand-alone marks	 Atoms repel	**3**

Question Number	Acceptable Answers	Reject	Mark
23 (e)	Glucose is a renewable / sustainable resource OR Glucose is readily available (in the body or from plants) **(1)** H_2O_2 is toxic/produces free radicals / more dangerous/poisonous (than glucose) / corrosive / introduces gas bubbles / (powerful) oxidizing agent **(1)**	Just 'safe' Just 'cheaper' Just 'harmful' Produces water which is a greenhouse gas	**2**

Question Number	Acceptable Answers	Reject	Mark
23 (f)	H_2O_2 has hydrogen bonds **(1)** IGNORE any references to London forces and dipole-dipole interactions provided hydrogen bonds have the major effect Extra energy / More energy (than expected to break) **(1)** IGNORE the number of hydrogen bonds quoted for each molecule or between each Second mark consequential on first mark	Hydrogen bonds within the molecule High energy	**2**

Question Number	Acceptable Answers	Reject	Mark
23 (g)	**Method 1** Stream of H_2O_2 liquid **(1)** (Idea of) charging a comb / rod /balloon / other suitable **(1)** Put near 'stream' and stream is diverted /attracted /deflected if polar **(1)** ALLOW marks for suitable diagram **Method 2** Add to a non-polar solvent **(1)** Named non-polar solvent **(1)** (formation / observation of) two layers **(1)** OR Add to a polar solvent **(1)** Named polar solvent **(1)** Dissolves / no layers / miscible **(1)** IGNORE references to IR	Stream of H_2O Use of metal rod Movement away from 'charged instrument'	**3**

Question Number	Acceptable Answers	Reject	Mark
23 (h)	Three marks for the diagram: One mark for a correct Maxwell-Boltzmann diagram with labelled axes and any one curve Allow fraction /proportion / percentage of particles / molecules on y axis **(1)** One mark for the peak at 37°C to be lower and clearly to the right of the peak for lab temperature; **(1)** E_a / A_e / Activation energy shown in suitable place (right of both peaks) **(1)**  Explanation: A greater proportion of /more particles / nanorockets have or exceed E_a / have sufficient energy to react **(1)**	Atoms Curve not starting from the origin Curve touching the x axis Curve going up or making a plateau over ½ way up on the right hand side	4

Question Number	Acceptable Answers	Reject	Mark
23 (i)	Lowers activation energy **(1)** (by) providing alternative reaction pathway **(1)** ALLOW 'catalytic pathway' OR ALTERNATIVE ANSWER Adsorbed onto the (catalytic) surface **(1)** Weakened bonds / desorbed from surface **(1)**		**2**

Question Number	Acceptable Answers	Reject	Mark
23 (j)	**Delocalised** electrons/ **Sea** of electrons **(1)** (Electrons) can move (and carry charge) **(1)**	Just 'free electrons' Just 'carry charge'	2

Question Number	Acceptable Answers	Reject	Mark
23 (k)	In the long term OR Due to absorption **And** they could be dangerous / toxic / carcinogenic / have side-effects	Just 'skin reaction/allergy' without reference to long term effect Block pores Just 'harmful'	1

Total for Section C = 23 Marks

Total for paper = 80 Marks

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