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Mark Scheme (Results)
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GCE

GCE Chemistry (6CH02/01)

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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

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

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

Question Number	Correct Answer	Reject	Mark
1 (c)	C		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	D		1

Question Number	Correct Answer	Reject	Mark
5	D		1

Question Number	Correct Answer	Reject	Mark
6	C		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	C		1

Question Number	Correct Answer	Reject	Mark
10	B		1

Question Number	Correct Answer	Reject	Mark
11	A		1

Question Number	Correct Answer	Reject	Mark
12	D		1

Question Number	Correct Answer	Reject	Mark
13	D		1

Question Number	Correct Answer	Reject	Mark
14	C		1

Question Number	Correct Answer	Reject	Mark
15	A		1

Question Number	Correct Answer	Reject	Mark
16	B		1

Question Number	Correct Answer	Reject	Mark
17 (a)	B		1

Question Number	Correct Answer	Reject	Mark
17 (b)	A		1

Section B

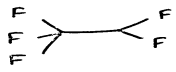
Question Number	Correct Answer	Reject	Mark
18 (a)(i)	(Dilute) Sodium hydroxide / potassium hydroxide /NaOH / KOH (1) (Heat/warm in)aqueous solution / Mixture of water and ethanol (1) Ignore references to pressure and temperature Allow 2nd mark for water without reference to sodium hydroxide etc unless contradicted by inappropriate reagent e.g. acids	Concentrated Ethanol	2

Question Number	Correct Answer	Reject	Mark
18 (a)(ii)	Ammonia / NH_3 (in ethanol) (1) Heat and pressure / heat in a sealed tube (1)		2

Question Number	Correct Answer	Reject	Mark
18 (a)(iii)	(concentrated) Sodium hydroxide / potassium hydroxide / NaOH / KOH (1) ignore dilute (heat and)dissolved in ethanol (1)	 aqueous solution	2

Question Number	Correct Answer	Reject	Mark
18 (b)	Sulfuric acid is a (strong enough) oxidising agent (1) To oxidise iodide ions/hydrogen iodide (to iodine) (1) Allow reverse argument based on iodide ions as a reducing agent	Oxidise iodine	2

Question Number	Correct Answer	Reject	Mark
18 (c)(i)	Bromochlorodifluoromethane Allow halogens not in alphabetical order Ignore 'correct' but unnecessary numbers given in name		1

Question Number	Correct Answer	Reject	Mark
18 (c)(ii)		Hydrogen atom shown in skeletal formula	1

Question Number	Correct Answer	Reject	Mark
18 (c)(iii)	Any two from Halogenoalkanes; Absorb heat from fire Prevent oxygen from reaching the fire/form a layer that excludes oxygen Absorb free radicals in combustion propagation Strength of C-F bond makes molecules inert / strength of C-F bond makes it hard to break	Reacts with oxygen	2

Question Number	Correct Answer	Reject	Mark
18 (c)(iv) QWC	• Halogenoalkanes such as CF_2ClBr can release Cl free radicals • Cl free radicals react with O_3 • Ozone layer depletes • Leading to greater levels of UV exposure • Greater risk of skin cancer (Any 3 from above, in context and using correct terminology) AND CF_3CHF_2 has strong C-F bonds so does not release F radicals		4

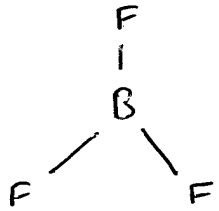
Question Number	Correct Answer	Reject	Mark
19 (a)	Reduction (1) Has gained 1 electron / oxidation number has decreased (from (+)2 to (+)1) (1) Oxidation = 0		2

Question Number	Correct Answer	Reject	Mark
19 (b)(i)	Starch (1) Blue-black / Blue / black to colourless (1)	 Purple, clear	2

Question Number	Correct Answer	Reject	Mark
19 (b)(ii)	Moles of thiosulfate = (12.75/1000 x 0.2) = 0.00255 mol (1) Moles of iodine = (0.00255 /2) = 0.001275 / 1.275×10^{-3} / 0.00128 / 1.28×10^{-3} (1) Allow TE for correct use of ratio for 2nd mark Correct answer alone = 2 marks		2

Question Number	Correct Answer	Reject	Mark
19 (b)(iii) QWC	Moles of Cu^{2+} = 0.00255 (1) Allow TE from b (ii) $[Cu^{2+}]$ = 0.255 mol dm^{-3} (1) Allow TE for scaling up correctly Correct answer alone = 2 marks 3SF is the least accurate level of the measurements used in the calculation/experiment (1) OWTTE		3

Question Number	Correct Answer	Reject	Mark
19 (b)(iv)	They are not reliable as the experiment was only carried out once so there is no evidence that the result is repeatable OWTTE		1

Question Number	Correct Answer	Reject	Mark
20 (a)	 (1) Trigonal planar (1) 120˚ (1) Allow TE (1 max) for both name and angle if BF_3 shown with lone pair	Planar alone	3

Question Number	Correct Answer	Reject	Mark
20 (b)(i)	108˚ – 106˚		1

Question Number	Correct Answer	Reject	Mark
20 (b)(ii)	3 electron pairs around central B atom but 4 electron pairs around central N atom (hence less space) / ammonia has an extra pair of e- around N Statements regarding lone pairs repelling more than bond pairs should be regarded as neutral but are not worth credit on their own		1

Question Number	Correct Answer	Reject	Mark
20 (b)(iii)	Instantaneous dipole – induced dipole / temporary dipole – induced dipole / Induced dipole – Induced dipole / / London forces / van der Waals' forces		1

Question Number	Correct Answer	Reject	Mark
20 (b)(iv)	Hydrogen bonds / H-bonds	'Hydrogen' alone	1

Question Number	Correct Answer	Reject	Mark
20 (c)(i)	-3		1

Question Number	Correct Answer	Reject	Mark
20 (c)(ii)	Curve with higher peak to left of 750˚C peak (1) Smaller area under curve above E_a (1) Reaction rate slower as fewer particles have $E \geq E_a$ (so fewer successful collisions per second) (1)	500˚C line touching x axis on rhs	3

Question Number	Correct Answer	Reject	Mark
20 (d) QWC	Provides alternative mechanism / route / pathway (1) Of lower activation energy (1) Hence a greater proportion of molecules can react (at a given T) (1)		3

Section C

Question Number	Correct Answer	Reject	Mark
21 (a) (i)	$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$ (1)		1

Question Number	Correct Answer	Reject	Mark
21 (a) (ii)	$3\ CH_3CH_2OH + 2Cr_2O_7^{2-} + 16H^+ \rightarrow 3CH_3COOH + 4Cr^{3+} + 11H_2O$ 3:2 ratio (1) Rest of equation (1) Allow 2nd mark if equation balanced but with water shown as both reactant and product		2

Question Number	Correct Answer	Reject	Mark
21 (b)(i)	To prevent the mixture heating too rapidly /prevent ethanol evaporating	'Makes the reaction too fast' alone	1

Question Number	Correct Answer	Reject	Mark
21 (b)(ii)	Suitable flask & heat indicated (1) Liebig Condenser (1) Correct water flow (1) Must be in the context of a reflux set-up	The apparatus would not work e.g. sealed apparatus -1 Poor diagram e.g. significant gap between condenser and flask -1	3

Question Number	Correct Answer	Reject	Mark
21 (b)(iii)	Green / blue		1

Question Number	Correct Answer	Reject	Mark
21 (c)(i)	They have a (very) high boiling temperature / are ionic compounds		1

Question Number	Correct Answer	Reject	Mark
21 (c)(ii)	Fractional distillation / distil of water then distil of ethanoic acid / absorb water with anhydrous drying agent		1

Question Number	Correct Answer	Reject	Mark
21 (d)(i)	Increase yield (1) As reaction moves to RHS as there are fewer (gaseous) molecules (1)	 'less moles' alone	2

Question Number	Correct Answer	Reject	Mark
21 (d)(ii)	Any two considered suggestions e.g. Yield of lab process may be low Cost of oxidising agent Toxicity of oxidising agent Disposal of Cr^{3+} Control of temperature/rate in scaled up reaction could be difficult The lab process has a lower atom economy Energy costs to separate ethanoic acid from reaction mixture Lab procedure is a batch process		2

Question Number	Correct Answer	Reject	Mark
21 (e) QWC	Discussion of four aspects of processes e.g four from Cativa runs at lower P Hence less energy required (for compression) Cativa has 100% atom economy Methanol in cativa could be obtained from renewable sources Cativa produces only one product so less separation required Cativa runs at higher temp so greater energy requirements for heating Each discussion point may made be made using reverse argument but only awarded once 2 additional pieces of information e.g 2 from		6

	Life cycle cost of catalysts Life cycle cost of capital equipment Yield of reactions Availability of renewable methanol.		