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Mark Scheme (Results)
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GCE

GCE Chemistry Nuffield (6252) Paper 1

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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.

Using the mark scheme

1 / means that the responses are alternatives and either answer should receive full credit.
2 ( ) 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.
3 [ ] words inside square brackets are instructions or guidance for examiners.
4 Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
5 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.

Quality of Written Communication is assessed in Section B.

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(a)(i)	(Concentrated) sulphuric acid/H_2SO_4 (1) Water/H_2O (1) Any order	Phosphoric acid 1 HBr 2 NaOH/KOH (2) H_2SO_4 + NaOH/KOH (1max) H_2O and high T and P and catalyst (1 max)	Dilute/aq sulphuric acid H_2SO_4 + $Na_2Cr_2O_7$ (0) H_2O alone (0) H_2O + x (eg H_2O_2) (0)	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(a)(ii)	Butan(e) -1,2-diol	Ignore punctuation 1,2-butan(e)diol 1,2-dihydroxybutane	Buta-1,2-diol But-1,2-diol 1,2-diolbutan(e) Any formula	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(a)(iii)	1,2-dibromobutane	Ignore punctuation	Any formula	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(a)(iv)	Hydrogen bromide/HBr Ignore (aq)	KBr + H_2SO_4/H_3PO_4 Any other metal bromides		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(b)	**Two** reactants come together to make **one** product	One reagent added across double bond Use judgement but in general look for 'two…become one' 'two or more reactants give one product'	'adding 1 atom' Just 'unsaturated becomes saturated' Just 'the double bond breaks' '2 molecules are joined'	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(c)(i)	A species/molecule/ion with a space for/which can accept (a pair of) electron**s** (to make a dative covalent bond)	an electron deficient entity electron deficient ion	Just 'a lover of negative charge' Positive ion Electron deficient **element**	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(c)(ii)	$Br^{\delta+}$ - $Br^{\delta-}$ / $Br^{\delta+}$	Br^+ Be generous on symbols for delta	Br_2	1

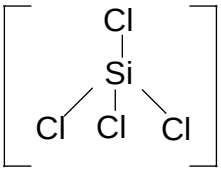
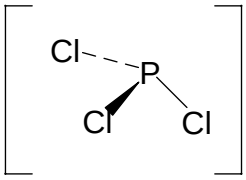
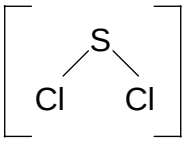
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(d)(i)	Reaction 2		Two answers	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(d)(ii)	Oxidation number of carbon increases **or** oxygen is added (to the organic compound)		Loss of electrons alone / loss of electrons and addition of oxygen	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(e)(i)	Butane/$CH_3\ CH_2\ CH_2\ CH_3$	Displayed formulae C_2H_5 instead of $CH_3\ CH_2$	C_4H_{10}	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(e)(ii)	Hydrogen (1) Nickel (1)	H_2 Ni Platinum/Pt or palladium/Pd	H	2

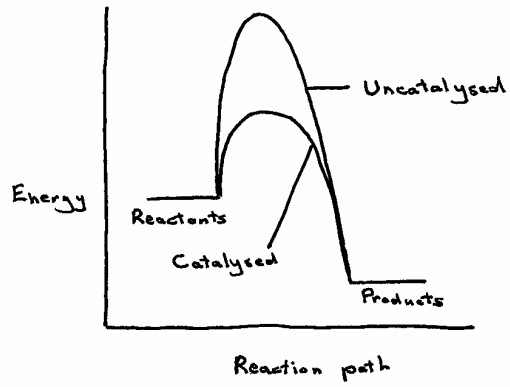
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1.(e)(iii)	Chlorine (1) UV/ultraviolet/sunlight (1)	Cl_2 visible light	Just 'light'	2

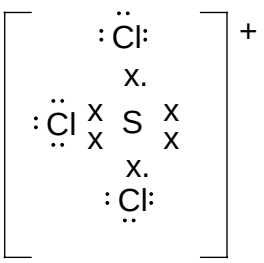
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(a)	 ClSiCl = 109(.5)^{o}  ClPCl = 107^{o} (accept 95 – 108)  ClSCl = 104.5^{o} (accept 95 – 105) First mark is for a 3dimensional diagram for the shape of $SiCl_4$ **or** PCl_3 All three bond angles correct (2) Two bond angles correct (2max) One bond angle correct (1max)			3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(b)	455.6 + 4x121.7 **-** (4x407.4) Multiples (1) Hess applied (1) = -687(.2) kJ mol^{-1}(1) ignore sig fig In general deduct one mark for each mistake One wrong or missing multiples (2max) Hess the wrong way round (2max) No sign with answer (2max) Examples: +169.9 (no multiples at all is two errors) (1) -1052.3/+535 (either multiple missing) (2) -930.6 (2xCl atomisation) (2) +687.2 (Hess misapplied) (2) +1052.3/-535/+930.6 (1) -169.9 (0)			3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(c)(i)	Lower temperature as reaction is **exo**thermic/gives out heat /ΔH is -ve (1) Higher/raise pressure as reaction moves towards fewer **gaseous** molecules (1)	…as reverse reaction is endothermic … away from more gaseous molecules	 …more gaseous **products**	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(c)(ii)	Lowering temperature decreases reaction rate (1) Increasing pressure increases reaction rate (1) Consequential on either/both parts of (i)	 Increasing pressure increases number of collisions	 Check they are consistent with (i)	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(c)(iii)	Energy of reactants above products 'hill' in between (1) Lower 'hill' for catalysed reaction form same start to same finish (1) Mark independently  	 Labelled activation energies Double hump acceptable		2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2.(d)(i)	 6 bonding electrons around S (1) all non-bonding electrons (1) – conditional on 1st mark	 All dots or all crosses Unstable Lewis double bonded structures (1 max)		2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(a)(i)	Iodine has more electrons/ 1-iodobutane has more electrons(1) stronger/greater/larger/more Van der Waals forces (1)	Recognisable spellings London/dispersion/ induced dipole-induced dipole/instantaneous dipole/fluctuating dipole/flickering dipole	vdw	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(a)(ii)	1-chlorobutane as less branched/unbranched (1) …so molecules can align/greater surface (area of contact)(1) second mark conditional on 1-chlorobutane	…greater surface contact/many points of contact	Closer packing (but ignore if rest is correct)	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(a)(iii)	**G**			1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(b)(i)	**H**			1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(b)(ii)	**E**/1-chlorobutane (1) C-Cl is strong**est**/strong**er** (1) conditional on first mark	It is the primary chloroalkane Highest activation energy		2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(b)(iii)	Alcohol/hydroxy(l)	OH	OH^-/hydroxide	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(b)(iv)	$Ag^+(aq) + X^-(aq) \rightarrow AgX(s)$	$Ag^+(aq) + Cl^-/I^-(aq) \rightarrow AgCl/I(s)$		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(b)(v)	**E** and **F**			1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(c)(i)	High temperature/heat and pressure (1) Ethanol (solvent) (1)	Conc NH_3 for a period of time (1)		2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(c)(ii)	$CH_3CH_2CH_2CH_2NH_2$ (1) + NH_4I (1)	$CH_3CH_2CH_2CH_2NH_3^+I^-$ (1) If balancing for NH_3 gets second mark INH_4 or $NH_4^+ + I^-$ for second mark		2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3.(c)(iii)	(1-)Butylamine / (1-)aminobutane	Butylammonium iodide	butanamine	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(a)(i)	Heating due to high electric current	Reaction/ electrolysis is exothermic **or** Any link between electricity and heat/energy		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(a)(ii)	Cell must not fall below melting point of mixture	Mixture must be kept molten/mixture melts at 70 ^{o}C		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(b)	+3 (1) +5 (1)			2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(c)	Reaction of uranium(IV) fluoride with fluorine/chlorine trifluoride OWTTE as uranium increases in oxidation number/goes form +4 to +6/becomes more positive/loses electrons	'the second step…'		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(d)	Examiners will need to use their judgment and reward sound arguments like: **For** It shortened the war/reduced loss of life Or use in nuclear power stations which reduces carbon dioxide emissions **Against** Bombs lead to loss of civilian life Lasting radiation damage (to civilians) Disposal problems Radioactive so handling problems Look for two distilled points BUT **For** 'power stations' **Against** 'bombs' award one mark If either point is further explained award both marks			2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4.(e)	Examiners will need to consider each answer for (i) key points and (ii) style and use of English. Candidates should have recorded their word total at the end of their answer, and this should be checked. up to 105 words: no penalty 106 - 115 words: -1 116 - 125 words: -2 126 - 135 words: -3 and at a rate of -1 penalty for every 5 words excess thereafter, up to a maximum penalty equal to the number of key points included by the answer. Note that words appearing in the title to the summary do not count in the word total. Normally hyphenated words, numbers and chemical formulae count as one word. The question does not ask for equations in the summary, but if included they should be counted in the word total. Sub headings do not count in the word total.			8

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
	Marking for key points One mark should be awarded for every key point clearly identified in an answer. **Key points minus word penalty = maximum 6 marks** To gain the mark for a key point the wording used by the candidate must make clear the essential chemistry of the point including all the detail given. Key Points 1. Fluorine is produced by the electrolysis of a 2:1 mixture of hydrogen fluoride to potassium fluoride 2. The electrolytic cell uses a carbon anode and a steel cathode 3. A low voltage/12V and high current/6000A are used… 4. …with a cell operating/working at a temperature of 90°C… 5. … so cells are cooled by/have a cooling jacket through which water is pumped at 80°C 6. Fluorine gas is produced at the anode which is contaminated with hydrogen fluoride… 7. …which is removed from the fluorine by (reaction with) sodium fluoride. 8. Fluorine is used (immediately) or liquefied and stored.			

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
	Quality of written communication This should be impression marked on a scale 2 - 1 – 0, and the mark out of 2 should be recorded in the body of the script at the end of the answer. This mark can not be lost as a result of a word penalty. Candidates are expected to: •show clarity of expression; •construct and present coherent argument; •demonstrate effective use of grammar, punctuation and spelling. The aspects to be considered are: • use of technical terms; the answer should convey a correct understanding by the writer of the technical terms used in the passage which are involved in the key points. • articulate expression; the answer should be well- organised in clear, concise English, without ambiguity. It should read fluently, with the links between key points in the original maintained. • legible handwriting; the reader should be able to read the answer without difficulty at normal reading pace, with only the occasional difficulty with a word. • points must be in a logical order. Good style and use of English, with only infrequent minor faults, no use of formulae **(2)** Frequent minor or a few major faults in style and use of English **(1)** Very poor style and use of English **(0)** NB: The quality of written communication mark cannot be lost through word penalties.			