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Mark Scheme (Final)
Summer 2008

GCE

GCE Chemistry Nuffield (6252/01)

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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.

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.

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (a)(i)	AgI Or AgI(s)/(ppt)	Ag^+I^- ie any correct answers with **both** charges	Silver Iodide Ag^+I, AgI^+, AgI^-	1

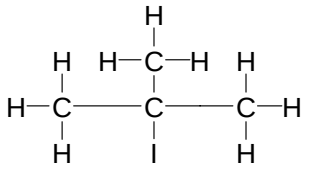
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (a)(ii)	$Ag^+(aq) + I^-(aq) \rightarrow AgI(s)$ Mark independently of (i), unless acceptable answer TE	TE of Cl, Br, X from (i) TE $Ag^{2+}(aq) + 2I^-(aq) \rightarrow AgI_2(s)$ from AgI_2 in (i)	TE from AgI_3, Ag_2I etc $Ag^+(aq) + I^-(aq) \rightarrow$ AgI**(ppt)**	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (b)(i)	$C_4H_9I+H_2O \rightarrow C_4H_9OH/C_4H_{10}O$ + HI/IH IGNORE states	"$H^+ + I^-$" for "HI" Accept Cl , Br , or X instead of I Allow combination of X on the left with I, Br, or Cl on the right or X on the right with I, Br, or Cl on the left		1

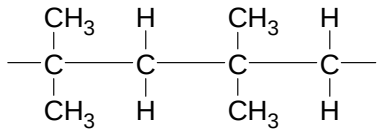
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (b)(ii)	Substitution IGNORE nucleophilic (but note this may get 1st mark for (iii))	hydrolysis	Displacement/ replacement/ electrophilic/free radical substitution	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (b)(iii)	Nucleophile – can be awarded from (ii) **(1)** Because of non-bonding/unbonded / lone/unshared **pair** of **electrons (**on oxygen/water) **(1)**		Just "pair of electrons" 'spare' pair of electrons unshared pair of electrons on the hydroxide ion/OH^-	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (c)(i)	**ceramic fibre** in **horizontal** tube **(1)** soaked in reagents /reactants/halogenoalkane and (alcoholic) KOH with heat/Bunsen **(1)** collection over water **(1)**  <u>Penalties (cumulative)</u> poor diagram -1 e.g. delivery tube through side of trough/no water in trough. Use of pumice/aluminium oxide/Al_2O_3 in test tube -1	Mineral/glass/cotton wool Vertical flask/side arm test tube/boiling tube and reagents with heat for 2nd mark Heat indicated anywhere along the test tube syringe (with three-way tap) IGNORE diagram and position of Bunsen valve	Steel wool Arrow without heat	3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (c)(ii)	 (1) Must be fully displayed 2-iodo(-2-)methylpropane / (2-)methyl-2-iodopropane **(1)**	X, Cl or Br for 1st mark Chloro/bromo compounds if TE from diagram Fully correct formula for 2-methyl-1-iodopropane with correct name gains 1 max again allow Br/Cl	All other structures for 1st mark All other names for 2nd mark	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (d)	Three attached methyl groups /tertiary **(1)** Weaken/weaker/weak C-I/C-X/C-halogen/C-Cl/C-Br bond Or Carbocation stabilised **(1)**	two attached methyl groups /secondary **(1)** the iodine /halogen/ chlorine/ bromine/X bond is weak		2

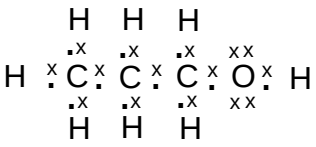
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (e)(i)	 CH_3 groups on positions 1,1,3,3, <u>or</u> 2,2,4,4 <u>or</u> 1,1,4,4 <u>or</u> 2,2,3,3 Ignore brackets and n's	Part/fully displayed Part/fully structural Allow $-CH_2-$ Allow CH_3 | Allow more than two units	Skeletal formulae (missing out hydrogens)	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (e)(ii)	Reaction goes to favour lowest number of/no **gaseous/gas** molecules OR **gas** to solid		Just "by Le Chatelier's Principle"	1

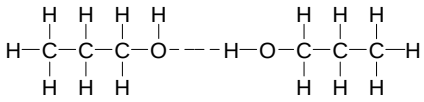
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (e)(iii)	A catalyst provides an alternative route/mechanism for a reaction… **(1)** …with a **lower activation energy (1)** Mark independently		Additional totally incorrect comment negates 2nd mark e.g. "…and provides energy for the reaction"	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (a)(i)	van der Waal(s)	Reasonable phonetic spelling London/dispersion forces	vdw	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (a)(ii)	Same/similar/about the same number of electrons IGNORE numbers of electrons even if incorrect BUT allow "Both have 34 electrons" without any other comment	Allow additional comments like 'both are straight chain'	"Similar molar mass" on its own	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (b)(i)	 Check non bonding electrons on oxygen (which can be ".x")	All dots and crosses	Four carbon chain	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (b)(ii)	Hydrogen bond(ing)	H bonding	'Hydrogen' on its own	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (b)(iii)	 **(1)** The hydrogen bond can be represented by any number of dots/dashes but not a continuous straight line <u>Bond angles</u> COH **103-106.5^{o} (1)** Between molecules **180^{o} (1)** Mark independently throughout	O---H-O do not have to be in straight line but…	…reject two hydrogen bonds between two molecules Chain not fully displayed	3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (b)(iv)	An electric kettle/heater of **known power** rating Or Measure rate of heating by Bunsen burner **(1)** Mass/volume of liquid **boiled** off /evaporated **(1)** IGNORE additional references to temperature changes In measured (boiling) time **(1)** Other methods considered on their merits	This could be an electric heater connected to a Joulemeter Allow heating method (no power), balance and stopwatch for 1 max (i.e. no indication of what they are measuring but correct apparatus)	Any reference to finding enthalpy change of combustion scores zero	3

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (b)(v)	(14.8 – 6.9 =) 7.9 (kJ mol^{-1})	No units kJ for unit	-7.9 J for unit or other wrong unit	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (c)(i)	(Permanent) dipole – (permanent) dipole (forces/ interactions/ attractions)	Permanent dipole (alone)	'Dipole' alone	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (c)(ii)	Propan-1-ol can form hydrogen bonds to propanone… **(1)** …using the oxygen of the carbonyl group/propanone (and the hydrogen of the OH group) Or Interactions/bonds made are of a similar strength to those broken **(1)**	Can be shown by a diagram labelling "hydrogen bond" Can be shown as a diagram	Answers based on dipoles	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (d)(i)	(thermal/catalytic) cracking	pyrolysis		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (d)(ii)	Type: Substitution **(1)** Mechanism: Free radical/radicle **(1)** 2nd mark is <u>not</u> conditional on the 1st The answers can be given on either line, providing there is no contradictory information.	"Free radical substitution" on **either** line with other line blank gets 2 marks	More than one name of mechanism in either answer loses 2nd mark e.g. 'nucleophilic substitution' and 'free radical' (1 max)	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (a)(i)	Boiling / hot / heat /high temperature/100 ^{o}C	Qualified heat e.g strong heat/gentle heat Or warm	Heat/reflux with alcohol/acid etc Heat under reflux "Reflux" on its own any mention of pressure or catalyst as additional condition (0)	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (a)(ii)	Iodine: 0 Potassium iodate: **+**5 Potassium iodide: -1 All 3 → 2 marks Any 2 → 1 mark	5+ 1-	5 (no sign)	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (a)(iii)	$6KOH(aq) + 3I_2(s/aq) \rightarrow 5KI(aq) + KIO_3(aq/s) + 3H_2O(l)$ Entities and state symbols (allow one error in/missing state symbol) **(1)** e.g. $H_2O(aq)$ counts as one error Balancing conditional on correct entities only **(1)**	$6OH^-(aq) + 3I_2(s/aq) \rightarrow 5I^-(aq) + IO_3^-(aq/s) + 3H_2O(l)$		2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (a)(iv)	One oxidation state of iodine/ an element changes to give a higher and lower oxidation state. Or iodine goes from 0 to +5 and -1 Allow transferred error from (a) (ii) provided ON increases and decreases	An element/iodine oxidises and reduces itself **Iodine** is (both) oxidised and reduced	Iodine changes to two different oxidation states An **element** is (both) oxidised and reduced	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (b)(i)	Potassium iodide (Dilute) Sulphuric acid	KI / any soluble iodide H_2SO_4	"I^-" on its own For 2nd mark: Sulphuric acid **and** sodium/potassium hydroxide Concentrated sulphuric acid/concentrated H_2SO_4 "H^+" instead of "sulphuric acid"	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (b)(ii)	(Sodium) **thiosulphate** (solution/aq)	$Na_2S_2O_3$ (solution/aq)		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (b)(iii)	Indicator: Starch **(1)** From: Blue/black/blue-black/dark blue/deep blue To: colourless **(1)** 2nd mark is dependent on starch	'no indicator used' **with** (pale) yellow/ straw coloured to colourless **(2)**	Purple/grey in any combination of colours	2

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (a)	H-C≡C-H Bond angle: 180 ^{o} Both needed with HCCH in a straight line			1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (b)	It also contains phosphine/PH_3 hydrogen sulphide/H_2S ammonia/NH_3 **all 3 required**			1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (c)	This method does not require crude oil (which may become too expensive) Or This method is more efficient (no tar deposition) Or Lime **and** coke are cheap/readily available	 Second method is less efficient	1,2-dibromoethane is expensive [i.e. not an industrial method] No heat required for cracking Calcium carbide is cheaper	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (d)	Ethyne reacts only **slowly** Or product still unsaturated/is an alkene/contains C=C/1,2-dibromoethene forms	Answers in terms of ethene e.g. ethene reacts more quickly etc		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (e)	Any two from: Reaction with copper(I) Reaction with silver ion **If neither** of above given then "Acidity of ethyne" counts as one difference Decomposition under pressure Addition of water/reaction with dilute sulphuric acid to form ethanal		Reaction with halogen/hydrogen/polymerisation (any reaction from second to last paragraph) **but** if given with **two** correct answers is neutral.	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (f)(i)	Ethene and bromine (water)	Ethene and bromine water formulae	Ethene liquid…	1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (f)(ii)	Side arm flask/or equivalent with dropping funnel attached/stopper and teat pipette and heat indicated	Any workable set up		1

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (g)	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. 2300 K, 1500 K each count as two words (number and unit) rmm/M_r one word water-quenched one word **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. The detail of each point is needed, even if it is not all in **bold** type.			8

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
	Key Points **1** Lime/calcium oxide is heated with coke at 2300 K to form calcium carbide.	Calcium carbide can be implied by next sentence		
	2 This/calcium carbide is fed (from a hopper) into (a tank containing) water and ethyne is collected in a gas holder			
	3 **Cold** water is flushed/pumped through/added (to the generating tank) to cool the mixture/remove sludge waste/remove calcium hydroxide			
	4 Ethyne is purified, dried and compressed			
	5 **Low** (relative) **molecular mass/molar mass/rmm/M_r alkanes** are **cracked** at **1500 K** (in an endothermic process) Or short chain alkanes are **cracked** at **1500 K** (in an endothermic process)			
	6 A **mixture including ethyne/alkynes** is produced which is **water-quenched**…	Ethyne can be implied by a subsequent sentence		
	7 …before **separation** by **selective absorption** Or by solvents under **low** temperature and **high** pressure		**"High** temperature and **low** pressure" on its own or in addition to selective absorption	
	8 On **heating ethyne** is released/produced from the **solvent** Note: solvent must be mentioned here, it cannot be implied	"the gas" instead of "ethyne" if clearly implied		
	Any six key points			

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.			

Note to the examiner:
This passage lends itself to a simple structure: there are two industrial methods. The first is…. The second is…..
This structure will often be seen in a response worthy of 2 for QWC.