Mark Scheme (Results)

Summer 2007

GCE Chemistry (6243) Paper 02

General Guidance on Marking

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.

Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Using the mark scheme

The mark scheme gives you:
• 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.

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.

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 <u>meaning</u> 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

Questions which involve the writing of continuous prose will expect candidates to:
•   show clarity of expression
•   construct and present coherent arguments
•   demonstrate an effective use of grammar, punctuation and spelling.

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.

			EXPECTED ANSWER	ACCEPT	REJECT	MARK
1.	(a)	A	ammonium sulphate / $(NH_4)_2SO_4$ / $(NH_4^+)_2SO_4^{2-}$ (1) B ammonia / NH_3 (1) C barium sulphate / $BaSO_4$ / $Ba^{2+}SO_4^{2-}$ (1)	Correct oxidation numbers e.g. barium (II) sulphate(VI)	For each: -any incorrect name -any incorrect formula. -any incorrect ion or incomplete charges if given. -incorrect oxidation number	(3)
	(b)	D	potassium bromide / KBr /K^+Br^- (1) E bromine / Br_2 (1) F sulphur dioxide / sulphur(IV) oxide / SO_2 (1)		For each: -any incorrect name -any incorrect formula. -any incorrect or incomplete ion charges if given. - incorrect oxidation number	(3) (Total 6 marks)
2	(a) Q W C		Sequence must be chemically correct to score Add ≥ 50 cm^3 (distilled) water (1) Stir (to dissolve sodium carbonate) (1) Filter (mixture) (1) Wash residue (to remove excess solution) (1)	Any volume ≥ 47.6 cm^3 Ignore additional processes (e.g. evaporate to dryness) Mix, shake or warm (above room temp if a temperature is stated) decant solution Re-crystallisation method scores max 3	Sequence without water	(4)
	(b)		Flame test (on residue) gives (brick) red colour (only) or gives no yellow colour	orange instead of yellow Sodium gives yellow flame calcium gives (brick) red flame Use of 'burning' for flame test	Crimson, carmine	(1)
						Total 5 marks

		EXPECTED ANSWER	ACCEPT	REJECT	MARK
3	(a)	Test: (excess) (dilute) nitric acid / HNO_3 (1) Inference: chlorine / Cl (1)	concentrated	Any other reagent including any other acid. Cl^- / chloride ion / Cl_2	(2)
	(b)	Observation: misty / steamy (1) Inference: hydrogen chloride / HCl (1)	White / cloudy	White smoke Hydrochloric acid / acidic	(2)
	(c)	Observation stays orange / (1) Inference tertiary / $3°$ (1) stand alone	Does not turn (from orange to) green OR no change in colour	No reaction, OR no change OR no observation OR incorrect colour (e.g. green remains green)	(2)
	(d)	 Must be tertiary; halogen consequential on inference in 3(a)	$CH_3CCl(CH_3)CH_3$ $(CH_3)_3CCl$ Full structural formula showing all atoms separate.	Formula with X or OH in place of halogen Correct name	(1)
					Total 7 marks

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			EXPECTED ANSWER	ACCEPT	REJECT	MARK
4	(a) Q W C		IGNORE filling burette, use of pipette and other preliminaries even if there are errors. Add NaOH (quickly) to 20 - 23 cm^3 (1) Drop by drop (near end point) OR until one drop changes colour (1) **stand alone** Swirl / rinse in drops solution in neck of flask (1) Colourless to pink (1) **both required**	Idea of NaOH addition fast intially then slow down near end point can score first mark Mix or shake or swill Colourless to red or Colourless (solution) starts to turn pink	Slowly does not score drop by drop mark Colourless to purple or magenta Clear to anything	(4)
	(b)	(i)	Line with bottom of meniscus mid-way between 23.60 and 23.70. (1) 	Bottom of meniscus reasonably close to mid-way. Straight **horizontal** line Clear indication of correct volume (e.g. arrow to 23.65)	Inverted meniscus Non-horizontal lines 	(1)

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			EXPECTED ANSWER	ACCEPT	REJECT	MARK
		(ii)	Ticks on titres 2 and 3 (1) 23.55 (cm^3) (1) <u>not</u> consequential	Ticks in 2 & 3 with cross in 1 Correct answer with no ticks (2)	Inclusion of titre 1 in calculation of mean scores zero Only one decimal place	(2)
	(c)		In (i) and (ii) penalise 1SF on the first occasion only. ACCEPT ≥ 2SF in (i) and (ii)			
		(i)	$\dfrac{25 \ \times \ 0.0500}{1000}$ = 0.00125 (moles)	0.001250 or 0.0013		(1)
		(ii)	Answer to (i) x 2 = 0.00250 (moles)	0.0025; CQ on 2 i)		(1)
		(iii)	$\dfrac{0.00250 \times 1000}{23.55}$ = 0.106 (mol dm^{-3}) 3sf **only** Consequential on b(ii) and c(ii)	Correct answer (3 sf) no working	0.106 if 1000 omitted in (c)(i) and (iii) (0)	(1)
						Total 10 marks

			EXPECTED ANSWER	ACCEPT	REJECT	MARK
5	(a)		In (a)(i), (ii) and (iii) penalise 1SF on the first occasion only. ACCEPT ≥ 2SF			
		(i)	Mass methanol burnt = 0.34 (g) (1) $\dfrac{0.34}{32}$ = 0.0106 (1)	0.011, 0.01063, 0.010625 CQ on incorrect calculation of mass Correct answer with some working (2)		(2)
		(ii)	Temperature rise = 43.5 – 22 (= 21.5) ($^{\circ}$C) (1) (Heat energy =) $\dfrac{21.5 \times 4.18 \times 50}{1000}$ = 4.49 (kJ) (1) The temperature rise mark can be scored from the heat energy expression	CQ on incorrect calculation of temp. Correct answer with some working (2)	Answer in Joules	(2)
		(iii)	$\dfrac{\text{Answer (ii)} = 4.49}{\text{Answer (i)} \quad 0.0106}$ (1) = − 422.9 (kJmol^{-1}) [calculator stored value] OR = − 423.6 (kJmol^{-1}) [using rounded values] (1) minus sign and value both required If the final answer is incorrect the 2nd mark is only accessible if energy is divided by moles in first part of calculation	CQ on (i) and ii) Answers in the range −420 to −424 Correct answer with some working (2)		(2)

			EXPECTED ANSWER	ACCEPT	REJECT	MARK
(b)	(i)		$\dfrac{1.0}{21.5} \times 100 = (\pm)4.65\ \%$ IGNORE SF			(1)
	(ii)		(21.5 + 1.0 =) 22.5 (°C) OR (44 – 21.5)=22.5 (°C) OR $\left(21.5 x \dfrac{104.65}{100}\right) = 22.5$ (°C) CQ on % error in b(i) if this is used to calculate the temperature		All other values	(1)
(c)	(i)		Evaporation (of methanol/alcohol)	Turns to vapour OR methanol volatile	Balance faulty or spills or Methanol reacts	(1)
	(ii)		Carbon (1) Lower/less exothermic (1) ignore references to incomplete combustion	Soot	Any other substance	(2)
						Total 11 marks

			EXPECTED ANSWER	ACCEPT	REJECT	MARK
6	(a)	(i)	Apparatus I (heating under) reflux (1) Apparatus II distillation (1)		Fractional distillation	(2)
		(ii)	(expansion of vapour will) build up pressure	Prevent explosion	Dangerous OR to prevent vapour escaping	(1)
	(b)	(i)	Reaction is vigorous OR exothermic OR (very) fast or violent		Dangerous	(1)
		(ii)	(One or both of) the liquids flammable OR ethanol is flammable OR iodoethane is flammable OR ethanol and iodoethane are flammable		Substances or Reactants are flammable	(1)
		(iii)	To allow reaction to reach completion OR reaction is slow OR reaction has high activation energy.	To maximise yield		(1)
		(iv)	The lower range is 70 to 71 The upper range is 73 to 74 e.g. 70 to 74 ^{o}C OR 71 to 73 ^{o}C OR 70 to 73 ^{o}C			(1)

			EXPECTED ANSWER	ACCEPT	REJECT	MARK
(c)			In (i), (ii) and (iii) penalise 1SF on the first occasion only. ALLOW ≥ 2SF			
	(i)		$\dfrac{20.0}{254}$ = 0.0787 (moles)	0.079 / 0.07874		(1)
	(ii)		1 mol $I_2 \rightarrow$ 2 mol C_2H_5I (1) Answer to (i) x 2 x 156 = 24.6 / 24.55 / 24.57 (g) (1) Correct answer with some working scores (2) If answer to c (i) <u>not</u> multiplied by 2 the 2nd mark only accessible if there is some attempt to work out a mole ratio or state a mole ratio in first part of calculation N.B. 156 x $\dfrac{20}{127}$ will give the correct final value (0)	mole ratio implied in method OR Mass method e.g. 127g I forms 156g C_2H_5I 20g I forms $\dfrac{20 \times 156}{127}$ = 24.6 (g) (2)		(2)
	(iii)		$\dfrac{16.7}{24.6}$ x 100 = 67.9 / 67.98 / 68.0 (%)	CQ on (ii)	Yield > 100 %	(1)
						Total 11 marks