Mark Scheme (Results)

January 2007

GCE

GCE Chemistry (Nuffield) (6251/01)

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, and for critical and imaginative thinking. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

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
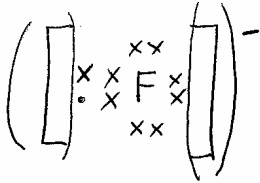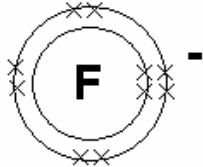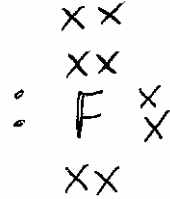• examples of responses that should NOT receive credit.

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   TE (transferred error) 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.

There is space at the bottom of each page of this mark scheme for examiners to write their notes.

Note:
If a candidate has crossed out an answer and written new text, the crossed out work should be ignored. If the candidate has crossed out work, but written no new text, the crossed out work for that question or part question should be marked, as far as it is possible to do so.

		EXPECTED ANSWER	ACCEPT	REJECT	MARK
1	(a)	H^+	H_3O^+		1 (1 mark)
	(b)	HCOOH/HCO$_2$H (1) HNO$_3$ (1) -1 for each extra incorrect answer	C and E		(2 marks)
					Total 3 marks
2	(a)	SrF$_2$ (1)		SRF$_2$	(1 mark)
	(b)	fluoride ion showing all 10 electrons and a single negative charge	All electrons can be the same Can show rings ALLOW Fl for F		(1 mark)
					Total 2 marks

NOTES:

			EXPECTED ANSWER	ACCEPT	REJECT	MARK
3	(a)	(i)	23 + 3 x 14 = 65(g) Ignore units e.g. g mol^{-1}, g/mol			(1 mark)
		(ii)	48 dm^3 = 2 moles (1) number of moles of NaN_3 = 2/3 x 2 = 4/3 mass = 4/3 x 65 = 86.7 g (1) ALLOW 2,3 or 4 SF If 2 moles of N_2 seen anywhere award 1st mark	allow TE from (a)(i) allow 87 g/86.67 g Correct answer with no working (2)	86 g 86.6 g 86.6666666 g	(2 marks)
	(b)		Formation of sodium which is reactive with water/air / oxygen (1) to produce hydrogen which is flammable / NaOH which is corrosive (1) Max 1 if only discuss sodium and air		-1 if discuss poisonous flammability of N_2 as well as correct problems with sodium Sodium is poisonous	(2 marks)
						Total 5 marks

NOTES:

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		EXPECTED ANSWER	ACCEPT	REJECT	MARK
4	(a)	$KCl + MgCl_2$ has a mass of $39 + 35.5 + 24 + 71 = 169.5$ (1) xH_2O has a mass of $277.5 - 169.5 = 108$ H_2O has a mass of 18 $x = \dfrac{108}{18} = 6$ (1)	TE for 2nd mark if final answer rounded to nearest whole number	$\dfrac{277.5}{18} = 15.41 \simeq 15$ (0 marks)	(2 marks)
	(b)	K^+ Mg^{2+} (1) – check that Mg^{2+} Cl^- (1) IGNORE H^+ and OH^-	$3Cl^-/2Cl^-$	O^{2-} (-1 mark)	(2 marks)
	(c)	(i)	(concentrated) hydrochloric acid			(1 mark)
		(ii)	lilac (1) Potassium is lilac and magnesium gives no flame colour(1)	allow shades of mauve and purple and pink through blue glass	If flame test implies burning e.g. Mg gives a white flame max 1	(2 marks)
		Total 7 marks			

NOTES:

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			EXPECTED ANSWER	ACCEPT	REJECT	MARK
5	(a)		Isotope(s)			(1 mark)
	(b)		40			(1 mark)
	(c)	(i)	mass spectrometer	Mass spectrometry		(1 mark)
		(ii)	$(60.2 \times 69 + 39.8 \times 71) \div 100$ (1) $= 69.796 = 69.8$ (1) must be 3sf	Correct answer with no working (2) Allow g or g mol^{-1} or g/mol	1, 2, 4 or 5sf Units of % (-1 mark)	(2 marks)
	(d)	(i)	$(1s^2)\ 2s^2\ 2p^6\ 3s^2\ 3p^6$ (1) $3d^{10}\ 4s^2\ 4p^1$ (1)	capitals/ subscripts/ any order		(2 marks)
		(ii)	$Ga(g) \longrightarrow Ga^+(g) + e^{(-)}\ ((g))$ or $Ga(g) - e^{(-)}\ ((g)) \longrightarrow Ga^+(g)$ Mark independently formulae (1) state symbols (1)	$Ga^{1+}(g) + e^{(-)}$	(s) is wrong - take care to distinguish from (g)	(2 marks)
		(iii)	B	579,1979,2963, 6200		(1 mark)
						Total 10 marks

NOTES:

		EXPECTED ANSWER	ACCEPT	REJECT	MARK
6	(a)	A round-bottom(ed)/distillation flask (1)	Pear-shaped flask Flask long neck flask	Liebig flask Conical flask Bottle ended flask Volumetric flask	6
		B (Liebig) condenser (1)	Condenser	Cooling water jacket condensing tube	(3 marks)
		C anti-bumping beads/granules (1)	Porcelain/ silica Correct names in any order		

NOTES:

7

		EXPECTED ANSWER	ACCEPT	REJECT	MARK

	(b)	No stopper in top of flask (1)
		
		No jacket on condenser (1)
		
		Water direction wrong way round (1)
		
		Ignore:/ neutral
		    "flask sealed off from rest of apparatus"
		    "water bath not needed"
		    "cork in conical flask not needed"
		    "gap between top of condenser & still head"
		    "air condenser sufficient"
		    "fume cupboard not needed"
		
		If they give 4 or more errors : loses 1 mark for each "reject" but neutral ones are ignored e.g.
		3 correct + sealed apparatus = 3-1=2
		3 correct+ water bath not needed = 3-0 = 3
		
		[if this part is completely blank send to review under out of clip category]
				"side arm on conical flask not needed"
				
				i.e. implying sealed apparatus
				
				thermometer should be in liquid
				
				no need for anti bumping beads
					(3 marks)

NOTES:

		EXPECTED ANSWER	ACCEPT	REJECT	MARK
(c)		(concentrated) sulphuric/sulfuric acid	dilute		(1 mark)
(d)		Oxidation (1) partial oxidation hydrogen atoms lost (as organic reactant changes to product) (1)	Allow oxidation number of carbon increases (from -2 to -1) Redox if the rest of the answer makes clear that the ethanol has been oxidised	Reduction Redox	(2 marks)
(e)	(i)	$Cr_2O_7^{2-}$			(1 mark)
	(ii)	Orange to green	blue		(1 mark)
(f)		Ethanoic acid (1) CH_3CO_2H / CH_3COOH (1) Mark independently	Correct structural or displayed formula Accept molecular formula $C_2H_4O_2$ correct if name is correct	empirical fomula C_2H_3OOH, CH_3CHO_2	(2 marks)
					Total 13 marks

NOTES:
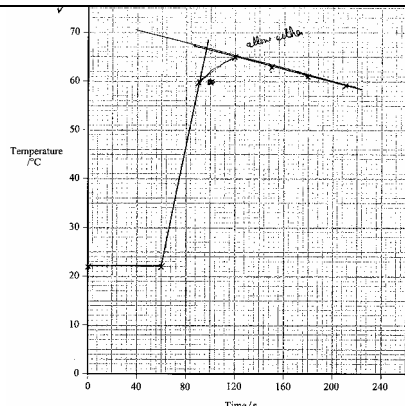
			EXPECTED ANSWER	ACCEPT	REJECT	MARK
7	(a)	(i)	An ion which is unchanged during the reaction owtte An ion which does not take part in the reaction		An ion which does not change its state use of word "element" instead of "ion"	(1 mark)
		(ii)	SO_4^{2-}			(1 mark)
		(iii)	$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$ *IGNORE state symbols*	$Zn + Cu^{++} \rightarrow Zn^{++} + Cu$ $Zn + Cu^{2+} = Zn^{2+} + Cu$		(1 mark)
	(b)		measuring cylinder	burette pipette volumetric pipette graduated pipette 50 cm^3 pipette pipette = pipette filter reasonable phonetic spelling e.g. pipet, biurette	Beaker Biuret Graduated flask Volumetric flask Beaker or a pipette pepite conical flask	(1 mark)

NOTES:

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			EXPECTED ANSWER	ACCEPT	REJECT	MARK
(c)			Any two	Discussion of either polystyrene or metal		(2 marks)
			polystyrene conducts heat less well than metals/less heat lost to surroundings (1)			
			has a lower (specific) heat capacity/absorbs less heat energy (1)			
			Plastic inert whereas metal container might react (with $CuSO_4$) (1)			
(d)	(i)		Zinc 5/65.4 = (0.0765/0.08/0.076/0.77) (1)			
			Copper sulphate 50/1000 = 0.05 (1)			
			Copper sulphate / Cu^{2+} / $CuSO_4$ (1)	Consequential on copper being less than zinc		
			IGNORE sig figs	Zinc is in excess		(3 marks)

NOTES:

			EXPECTED ANSWER	ACCEPT	REJECT	MARK
		(ii)	Blue to colourless (1)	Greeny blue to colourless	green to colourless Blue to white Blue to grey Blue to clear	
			grey to brown/ pink/ red-brown/orange-brown (1)	silver/silvery grey Black grey and copper (coloured) Red/orange	Copper Copper - coloured	(2 marks)
(e)	(i)		correctly plotted points (1) - *All 7 (including 0, 22)* *must be correctly plotted* points joined by suitable lines (1) [If you cannot see a line, check twice, if still not visible send to review as out of clip]	curve/straight lines		(2 marks)

NOTES:

			EXPECTED ANSWER	ACCEPT	REJECT	MARK
		(ii)	reaction not instant / so some time before all heat energy released/measured (1) (temperature (slowly) declines) as heat energy given out (to the surroundings) (1)	Energy lost	No temp change for first 60 s because zinc has not been added. Slow to start temp slowly declines because reaction is complete No marks for describing shape of graph without explanation	(2 marks)
		(iii)	66 - 69 °C		65.5 and less and 69.5 and more	(1 mark)
	(f)	(i)	50 x 4.2 x 45 = 9450 (J) for 67°C Ignore units unless value and units are incompatible e.g. 9240 kJ (0) 9.24 J (0)	TE from e(iii) e.g. 66 = 44 ° rise = 9240 68 = 46 ° rise = 9660 69 = 47 ° rise = 9870 65 = 43 ° rise = 9030 (Allow minus sign) ignore sign 70 = 48 ° rise = 10080 65.5 = 43.5 ° rise = 9135 allow use of 65° even if different value in (iii)	55 for mass of solution + zinc	(1 mark)

NOTES:

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			EXPECTED ANSWER	ACCEPT	REJECT	MARK
		(ii)	Max Temp			
			$\dfrac{9870}{0.05} \equiv$ -197,000 = -197 kJ mol^{-1} 69			
			$\dfrac{9660}{0.05} \equiv$ -193,000 = -193 kJ mol^{-1} 68			
			$\dfrac{9450}{0.05} \equiv$ -189,000 = -189 kJ mol^{-1} 67			
			$\dfrac{9240}{0.05} \equiv$ -185,000 = -185 kJ mol^{-1} 66			
			$\dfrac{9030}{0.05} \equiv$ -180,600 = -181 kJ mol^{-1} 65			
			This first mark is for dividing by 0.05 (1)	If ÷ 0.08 only 1st mark lost		
			Value and sign (1) units and 3 or 4sf (1)			(3 marks)
						Total 20 marks

NOTES: