

GCE

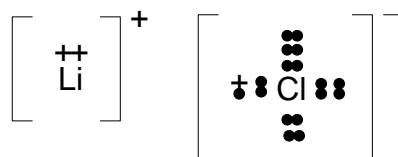
Edexcel GCE

Chemistry (Nuffield) (6251/01)

January 2006

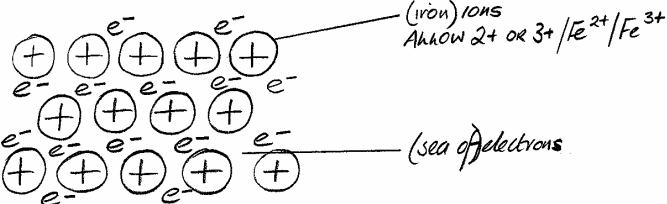
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Mark Scheme (Results)

1	(a)	$\rightarrow \text{CuCO}_3(\text{s}) + 2 \text{NaNO}_3(\text{aq})$ <p style="text-align: center;">(1) (1)</p> <p>2 correct formulae without state symbols and balancing (1) NOT ppt as an alternative to (s)</p>	(2 marks)	
	(b)	(persistent) yellow ALLOW orange OR orange-yellow OR yellow-orange	(1 mark)	
	(c)	Copper d (block) sodium s (block) ALLOW upper case D and S	(1 mark)	
2	(a)	<p>Number of moles / $\frac{3.5}{7} = 0.50 / \frac{1}{2}$ (1)</p> <p>If candidate does first part only, working must be shown</p> <p>Number of atoms = 3.01×10^{23} (1) ACCEPT 3.0 OR 3 OR $3.010(\times 10^{23})$ NOT 3.01^{23}</p> <p>If all working shown, allow TE for 2nd mark Ignore units Correct answer with no working (2)</p>	(2 marks)	
	(b)	(i)	$2\text{Li}(\text{s}) + 2\text{H}^+(\text{aq}) \rightarrow 2\text{Li}^+(\text{aq}) + \text{H}_2(\text{g})$ <p>ALLOW multiples Ignore state symbols</p>	(1 mark)
		(ii)	<div style="text-align: center;">  </div> <p style="text-align: center;">(1) (1)</p> <p>Allow all dots or all crosses on Cl⁻ Max 1 if no/wrong charges If covalent (0) Do NOT penalise if electrons not shown in pairs Maximum 1 if Li and Cl not labelled Li and Cl symbols can go below diagram Square brackets not essential Allow number of protons/positive charges in nucleus as alternative to symbols for Li and Cl</p>	(2 marks)

		(iii)	<p>Any two from:</p> <p>Temp 298 K/ 25 °C <i>OR</i> "at a specified temperature" <i>Unit of temperature needed</i> <i>NOT</i> "room temperature"</p> <p>(Acid/solution) concentration 1 mol dm⁻³ / 1 molar</p> <p>Pressure 1 atm / 10⁵ Pa / 1.01×10⁵ Pa/10² k Pa / 101 k Pa/10⁵ N m⁻² / 76 cm Hg <i>NOT</i> "pressure of hydrogen" <i>OR</i> "pressure of reactants" <i>NOT</i> atmospheric pressure</p> <p>Must be the most stable/usual/normal physical states <i>NOT</i> "standard states" If more than 2 conditions given, deduct 1 mark for each incorrect answer</p>	(2 marks)
3	(a)	Alkene		(1 mark)
	(b)	$\text{CH}_2=\text{CHCH}_2\text{CH}_3$ / $\text{CH}_3\text{CH}=\text{CHCH}_3$ / $\text{CH}_2=\text{C}(\text{CH}_3)_2$ / $\text{CH}_2=\text{C}(\text{CH}_3)\text{CH}_3$ <i>double bond need not be shown</i> <i>ACCEPT displayed formula</i> <i>Mark independently of a</i> <i>Watch for incorrect numbers of H in the middle of the chain</i>		(1 mark)
Total for Section A: 13 marks				

Section B

4	(a)	<p>Metallic (1) Labelled diagram of lattice of + charged ions in sea of electrons with approx equal numbers of + and - charges (1) Positive ions must not be touching; should be regular arrangement Minimum of 6 positive ions</p>  <p><i>Charges need not be shown on electrons</i> <i>ACCEPT e- without label</i> <i>Circles shown as 2+/3+ must be labelled as ions</i> <i>Circles labelled Fe²⁺ and Fe³⁺ can be assumed to be ions</i></p>	(2 marks)
	(b)	<p>(i) Fe²⁺ and Fe³⁺ both needed OR Fe⁺⁺ and Fe⁺⁺⁺ OR Fe⁺² and Fe⁺³ ALLOW 2Fe³⁺ NOT Roman numerals NOT Fe₂³⁺, (Fe³⁺)₂ NOT just +2, +3 or 2+, 3+ IGNORE formula of sulphate ion if iron correct.</p>	(1 mark)
		<p>(ii) Iron loses electrons/ iron forms positive ions / oxidation number of iron increases /becomes more positive / becomes less negative NOT iron becomes charged NOT iron loses charge If b(i) is answered in terms of sulphate, iron must be mentioned in b(ii) Ignore 'gaining oxygen'</p>	(1 mark)
		<p>(iii) Iron $\frac{0.500}{56} = 8.93 \times 10^{-3} / 0.00893 / 0.0089 / 0.008929 / 0.009 \text{ mol (1)}$ Ignore SF Sulphuric acid $\frac{10.0 \times 2.00}{1000} = 0.0200 / 0.02$ $/2 \times 10^{-2} / 2.0 \times 10^{-2} / 2.00 \times 10^{-2} \text{ (mol) (1)}$</p>	(2 marks)

	(iv)	$214 \text{ cm}^3 = \frac{214}{24000} = 8.92 \times 10^{-3} / 8.917 \times 10^{-3} / 8.9 \times 10^{-3} / 0.009 \text{ mol (1)}$ <p><i>Ignore SF</i></p> <p>In equation 1 number of moles Fe = number of moles H₂ <i>OWTTE</i> (1) <i>MUST link equation to calculation</i></p>	(2 marks)
	(v)	<p>To make sure iron reacts completely <i>OR</i> to make sure all iron reacts <i>OR</i> if excess iron is used expt would not work as moles H₂SO₄ = moles H₂ in both equations <i>OR</i> to provide enough acid for the 2nd equation to occur.</p> <p><i>NOT</i> to ensure reaction reaches completion <i>NOT</i> all reactants must be used up <i>NOT</i> arguments based on purity</p>	(1 mark)
(c)	(i)	<p>Indicator (1) Colours (1) Methyl orange red to yellow Litmus red to blue <i>ALLOW</i> Phenolphthalein colourless to pink/purple/mauve/red <i>OR</i> other indicators from p.123 of Book of Data <i>ALLOW</i> phonetic spellings of phenolphthalein Allow litmus paper</p>	(2 marks)
	(ii)	<p>Concentrate the mixture by heating / heat until saturated (1) Leave to cool/ evaporate slowly (1) (filter/pick out/decant and) pat dry/leave to dry/put in warm oven/oven less than 40 °C (1) NOT hot oven</p> <p><i>IGNORE filtering at the start</i> <i>Boiling to dryness at start (0)</i></p> <p><i>3 correct points (2)</i> <i>2 correct points (1)</i></p>	(2 marks)
			Total for question: 13 marks

5	(a)	(i)	Redox <i>ALLOW</i> oxidation / partial oxidation <i>NOT</i> reduction / complete oxidation	(1 mark)
		(ii)	Sodium or potassium dichromate ((VI)) / $\text{Na}_2\text{Cr}_2\text{O}_7$ / $\text{K}_2\text{Cr}_2\text{O}_7$ (1) Sulphuric acid / H_2SO_4 dilute or concentrated (1) <i>IGNORE any Roman numerals</i> <i>ALLOW</i> H^+ and $\text{Cr}_2\text{O}_7^{2-}$ / acidified dichromate 1 (out of 2) <i>H_2SO_4 mark not allowed if mixed with an alkali/carbonate</i>	(2 marks)
		(iii)	Orange to green / blue / blue green <i>ALLOW</i> TE of purple to colourless / brown if MnO_4^- used in ii	(1 mark)
		(iv)	<div style="text-align: center;"> </div> <p>Arrow is enough to show heat</p> <p>Pear-shaped/round bottomed flask/tube with side arm + reagents/reaction mixture + heat (1) Side-arm from adaptor/delivery tube from side-arm tube/condenser + collecting vessel (1)</p> <p><i>-1 for poor drawing eg line not tube, sealed apparatus, open at top, collecting under water, large gaps in equipment, one-piece equipment (ie flask must be separate from rest)</i> <i>IF condenser used ignore water direction</i> <i>No marks if refluxed/apparatus would not work</i></p>	(2 marks)

		(v)	$ \begin{array}{cccc} & \text{H} & \text{H} & \text{H} & & \\ & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & \\ & & & & // & \\ & \text{H} & \text{H} & \text{H} & \text{O} & \\ & & & & & \text{H} \end{array} $ <p>Watch for $\begin{array}{c} \text{OH} \\ \\ -\text{C} \\ \\ \text{O} \end{array}$ (0)</p>	(1 mark)
		(vi)	<p>Benedict's solution (+ heat + NaOH) (1) Red/brick-red (precipitate) (1) ALLOW green/yellow/brown/red-brown/orange Stays blue (solution) (1) ALLOW nothing happens / no change if Benedicts colour given earlier</p> <p><i>OR</i> potassium/sodium dichromate + acid (1) goes green (1) ALLOW goes blue stays orange solution (1) ALLOW correct results with Fehlings solution or Tollens reagent</p>	(3 marks)
	(b)	$ \begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{H} & & \\ & & & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - \text{O} & - \text{H} \\ & & & & & & & \\ & \text{H} & & \text{H} & & \text{H} & & \\ & & & & & & & \\ & & & \text{H} & & & & \end{array} $ <p>(1)</p> <p>(2-)methylpropan -1-ol (1) Do not penalise if OH and CH₃'s not fully displayed. ONLY ALLOW T.E. for name if (2-)methylpropan-2-ol is drawn.</p>	(2 marks)	
Total for Question: 12 marks				

6	(a)	<table border="1"> <tr> <td>Protons</td> <td>18</td> </tr> <tr> <td>Electrons</td> <td>18</td> </tr> <tr> <td>Neutrons</td> <td>22</td> </tr> </table>	Protons	18	Electrons	18	Neutrons	22	<p>} (1)</p> <p>(1)</p>	(2 marks)
Protons	18									
Electrons	18									
Neutrons	22									
	(b)	<p>Position depends on proton number/ atomic number (not mass) / Ar atom has 1 less proton than K atom.</p> <p><i>IGNORE</i> references to number of protons = number of electrons</p>		(1 mark)						
	(c)	<p>Average = $\frac{36 \times 1.34 + 38 \times 0.16 + 40 \times 98.5}{100}$</p> <p>= 39.9</p> <p>-1 for more or less than 3 SF</p> <p><i>IGNORE</i> units</p>	<p>(1)</p> <p>(1)</p>	(2 marks)						
	(d)	<p>$1s^2 2s^2 2p^6 3s^2 3p^6$</p> <p>Numbers following letters can be subscript or superscript</p> <p>s and p can be upper or lower case</p>		(1 mark)						
	(e)	(i)	<p>$\text{Ar(g)} \rightarrow \text{Ar}^+(\text{g}) + \text{e}^{-}(\text{g})$</p> <p><i>OR</i> $\text{Ar(g)} - \text{e}^{-}(\text{g}) \rightarrow \text{Ar}^+(\text{g})$</p> <p><i>Symbol of Ar must be correct</i></p>	(1 mark)						
		(ii)	<p>Potassium value well below sulphur in range 250-750 (1)</p> <p>Low ionisation energy as electron which is removed is more shielded / further from the nucleus / in a higher energy level (1)</p> <p>NOT just 'because electron is in fourth shell'</p>	(2 marks)						
		(iii)	<p>Sulphur has 4 electrons in (3)p / phosphorus has 3 (1)</p> <p><i>Plus any one from:</i></p> <p>Electrons in shared p orbitals repel (so are lost more easily) (1)</p> <p>half-filled sub-shells are (more) stable (1)</p> <p>phosphorus has half-filled sub-shell (1)</p>	(2 marks)						
		(iv)	<p>Chlorine has more protons/greater nuclear charge (1)</p> <p>Shielding unchanged / electrons in same shell/ electrons same distance from nucleus(1)</p> <p><i>Could be answered in terms of S having fewer protons</i></p>	(2 marks)						
	(f)	<p>Argon inert / unreactive so filament can't react/ vaporises less easily/ lasts longer (1)</p>		(1 mark)						
				Total for Question:14 marks						

7	(a)	Thermal decomposition/redox		(1 mark)
	(b)	(i)	$2\text{Mg(s)} + 2\text{N}_2\text{(g)} + 6\text{O}_2\text{(g)}$ formulae of elements (1) balancing and state symbols (1)	(2 marks)
		(ii)	$\Delta H_f = \Delta H_2 - \Delta H_1$ Stated or used (1) $\Delta H_f = 2(-601.7) + 4(33.2) - 2(-790.7)$ (1) <i>Error in multiple or copying data = 0</i> $\Delta H = +510.8 / +511 / +510 \text{ kJ mol}^{-1}$ (1) -1 for wrong sign or units. <i>Do NOT penalise lack of + sign if working clear</i> If no multiples used : (+) 222.2 kJ mol ⁻¹ (max 2 out of 3) If one multiple missing (max 2 out of 3) e.g. one Mg(NO ₃) ₂ : - 279.9 kJ mol ⁻¹ one MgO: (+) 1112.5 kJ mol ⁻¹ one NO ₂ : (+) 411.2 kJ mol ⁻¹ Maximum 1 out of 3 if answer based on wrong Hess' law	(3 marks)
	(c)	$\text{O}^{2-} + \text{H}_2\text{O} \rightarrow 2\text{OH}^-$ <i>IGNORE state symbols</i> <i>ALLOW if Mg²⁺ shown on both sides</i>		(1 mark)
	(d)	Conducts as ions are present in solutions of acids / H ⁺ ions are present / other ions are present, correct name or formula given		(1 mark)
				Total for Question: 8 marks
				TOTAL FOR PAPER: 60 MARKS