

# Mark Scheme Summer 2009

GCE

## GCE O Level Chemistry (7081)

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Summer 2009

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7081/01 O Level Chemistry Mark Scheme - June 2009

Question Number	Acceptable Answers	Reject	Mark
1	column 1 iron(III) oxide / ferric oxide		(1)
	column 2 $(\text{NH}_4)_2\text{SO}_4$		(1)
	column 3 $\text{NH}_4^+$		(1)
	$\text{Sn}^{2+}$		(1)
	$\text{Fe}^{3+}$		(1)
column 4 $\text{NO}_3^-$		(1)	
	$\text{PO}_4^{3-}$		(1)

(Total 7 Marks)

Question Number	Acceptable Answers	Reject	Mark
2 (a)	hydrochloric acid / HCl /hydrogen chloride hydrogen / H <sub>2</sub>		(1) (1)

Question Number	Acceptable Answers	Reject	Mark
2 (b)	hydrogen / H <sub>2</sub>		(1)

Question Number	Acceptable Answers	Reject	Mark
2 (c)	oxygen / O <sub>2</sub>		(1)

Question Number	Acceptable Answers	Reject	Mark
2 (d)	nitrogen dioxide / nitrogen(IV) oxide / NO <sub>2</sub>		(1)

Question Number	Acceptable Answers	Reject	Mark
2 (e)	sodium sulphite / sodium sulphate(IV) / Na <sub>2</sub> SO <sub>3</sub> or sodium hydrogensulphite/sodium bisulphite/NaHSO <sub>3</sub>		(1)

(Total 6 Marks)

Question Number	Acceptable Answers	Reject	Mark
3 (a)	B		(1)

Question Number	Acceptable Answers	Reject	Mark
3 (b)	E		(1)

Question Number	Acceptable Answers	Reject	Mark
3 (c)	A		(1)

Question Number	Acceptable Answers	Reject	Mark
3 (d)	D		(1)

Question Number	Acceptable Answers	Reject	Mark
3 (e)	C		(1)

(Total 5 Marks)

Question Number	Acceptable Answers	Reject	Mark
4 (a)	127	127g	(1)

Question Number	Acceptable Answers	Reject	Mark
4 (b)	30		(1)

Question Number	Acceptable Answers	Reject	Mark
4 (c)	20		(1)

Question Number	Acceptable Answers	Reject	Mark
4 (d)	4		(1)

Question Number	Acceptable Answers	Reject	Mark
4 (e)	18		(1)

Question Number	Acceptable Answers	Reject	Mark
4 (f)	2,8,6 / 2:8:6 / 2 8 6 Order of number must be correct		(1)

(Total 6 Marks)

Question Number	Acceptable Answers	Reject	Mark
5 (a)	white		(1)

Question Number	Acceptable Answers	Reject	Mark
5 (b)	purple / violet		(1)

Question Number	Acceptable Answers	Reject	Mark
5 (c)	(pale) blue		(1)
	dark blue ( <i>must indicate that the colour has darkened</i> )		(1)

Question Number	Acceptable Answers	Reject	Mark
5 (d)	yellow / orange / brown or any combination of the acceptable colours	Reject red	(1)

Question Number	Acceptable Answers	Reject	Mark
5 (e)	(pale) pink		(1)

Question Number	Acceptable Answers	Reject	Mark
5 (f)	white	Reject milky/chalky unless accompanied by 'white'	(1)

(Total 7 Marks)



Question Number	Acceptable Answers	Reject	Mark
6 (a)(i)	3,3		(1)

Question Number	Acceptable Answers	Reject	Mark
6 (a)(ii)	2,4		(1)

Question Number	Acceptable Answers	Reject	Mark
6 (b)(i)	$2\text{Al} + 3\text{Br}_2 \rightarrow 2\text{AlBr}_3$ formulae balance		(1) (1)

Question Number	Acceptable Answers	Reject	Mark
6 (b)(ii)	$\text{Ca}(\text{OH})_2 + 2\text{NH}_4\text{Cl} \rightarrow \text{CaCl}_2 + 2\text{NH}_3 + 2\text{H}_2\text{O}$ formulae balance		(1) (1)

Question Number	Acceptable Answers	Reject	Mark
6 (c)	$\text{Ca}^{2+} + \text{CO}_3^{2-} \rightarrow \text{CaCO}_3$ formulae of ions on left hand side A balanced equation (Ignore any state symbols)		(1) (1)

(Total 8 Marks)

Question Number	Acceptable Answers	Reject	Mark
7 (a)(i)	order 3,1,2		(1)

Question Number	Acceptable Answers	Reject	Mark
7 (a)(ii)	magnesium is more reactive (than iron) reacts before the iron /is a sacrificial metal <i>Explanation accepted only if experiment 2 is chosen as slowest in 7(a)(i)</i>	Mg rusts before iron	(1) (1)

Question Number	Acceptable Answers	Reject	Mark
7 (b)(i)	nail in test tube with suitable drying agent ( <u>anhydrous</u> calcium chloride or silica gel) allow CaO  bung in top of test tube	conc. H <sub>2</sub> SO <sub>4</sub> anhydrous CaCl <sub>2</sub> (aq)	(1)  (1)

Question Number	Acceptable Answers	Reject	Mark
7 (b)(ii)	nail in boiled water  layer of oil on top (or similar) allow a bung if there is no air space		(1)  (1)

(Total 7 Marks)

Question Number	Acceptable Answers	Reject	Mark
8	A is platinum / platinum-rhodium / Pt / Pt-Rh B is nitrogen oxide / nitrogen(II) oxide / nitric oxide / NO (accept nitrogen monoxide) C is nitrogen dioxide / nitrogen(IV) oxide / NO <sub>2</sub> D is nitric acid / nitric(V) acid / HNO <sub>3</sub>	rhodium  D Ignore any reference to nitrous acid / HNO <sub>2</sub>	(1) (1) (1) (1)

(Total 4 Marks)

Question Number	Acceptable Answers	Reject	Mark
9 (a)	sulphur dioxide/SO <sub>2</sub> <i>Gas must be correct in order to score test marks.</i>		(1)
	potassium dichromate(VI) / K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> or potassium manganate(VII) / potassium permanganate / KMnO <sub>4</sub> <i>Penalise an incorrect oxidation state but allow the colour change</i>		(1)
	potassium dichromate(VI) turns green or potassium manganate(VII) is decolourised		(1)

Question Number	Acceptable Answers	Reject	Mark
9 (b)	flame test		(1)
	lilac/purple/pink flame		(1)

(Total 5 Marks)



Question Number	Acceptable Answers	Reject	Mark
11 (a)	gas / carbon dioxide given off		(1)
Question Number	Acceptable Answers	Reject	Mark
11 (b)	to stop spray/acid/water escaping		(1)
Question Number	Acceptable Answers	Reject	Mark
11 (c)	plot (lose 1 mark for any one error) smooth curve (allow t.e. from incorrect plot)		(2) (1)
Question Number	Acceptable Answers	Reject	Mark
11 (d)(i)	fast(est) at the start then slows/rate decreases (with time)		(1)
Question Number	Acceptable Answers	Reject	Mark
11(d)(ii)	HNO <sub>3</sub> / H <sup>+</sup> / reactants used up <i>or</i> concentration decreases / less reactant particles less frequent / less chance of collisions		(1) (1)
Question Number	Acceptable Answers	Reject	Mark
11 (e)	any two of increase temperature increase concentration of <u>acid</u> use smaller pieces (of marble) (not just 'increase surface area')	use a catalyst	(1) (1) (1)
Question Number	Acceptable Answers	Reject	Mark
11 (f)	0.56 g of CO <sub>2</sub> = 0.56/44 mol (= 0.0127 or 0.013) volume of gas = 24000 x no. of moles calculated  above Accept as answers 300 / 304.8 / 305 / 310 / 312 cm <sup>3</sup> or 0.30 / 0.3048 / 0.305 / 0.31 / 0.312 dm <sup>3</sup> correct unit required allow t.e. from incorrect <u>moles</u>		(1)         (1)

(Total 12 Marks)

Question Number	Acceptable Answers	Reject	Mark
12 (a)(i)	isotopes		(1)

Question Number	Acceptable Answers	Reject	Mark
12(a)(ii)	<i>mark vertically:</i> 92 protons, 92 protons 143 neutrons, 146 neutrons (order must be correct) 92 electrons, 92 electrons Allow transferred error from 'protons' column		(1) (1) (1)

Question Number	Acceptable Answers	Reject	Mark
12(a)(iii)	same number of electrons (in outer shell)		(1)

Question Number	Acceptable Answers	Reject	Mark
12(b)(i)	L / 1L (Ignore any other figures or working)		(1)

Question Number	Acceptable Answers	Reject	Mark
12(b)(ii)	10L (Ignore any other figures or working)		(1)

Question Number	Acceptable Answers	Reject	Mark
12(b)(iii)	4L (Ignore any other figures or working)		(1)

(Total 8 Marks)

Question Number	Acceptable Answers	Reject	Mark
13(a)(i)	—CONH— ( <i>correctly displayed</i> )		(1)

Question Number	Acceptable Answers	Reject	Mark
13(a)(ii)	condensation Accept addition-elimination condensation	'polyamide' on its own 'addition condensation'	(1)

Question Number	Acceptable Answers	Reject	Mark
13(b)(i)	displayed formula of monomer		(1)

Question Number	Acceptable Answers	Reject	Mark
13(b)(ii)	displayed formula of repeating unit		(1)

Question Number	Acceptable Answers	Reject	Mark
13(b)(iii)	addition (polymerisation)		(1)

Question Number	Acceptable Answers	Reject	Mark
13(b)(iv)	monomer is unsaturated because it has a double bond		(1)
	polymer is saturated because it has single bonds (only)/does not contain double bonds		(1)

Question Number	Acceptable Answers	Reject	Mark
13(b)(v)	displayed formula of $\text{CH}_2\text{ClCHCl}_2$		(1)

(Total 8 Marks)



Question Number	Acceptable Answers	Reject	Mark
14(a)	Any two of metal conducts electricity, non-metal does not (accept only metals conduct electricity) metal has a high m.pt., non-metal has a low m.pt. (accept metal has higher m.pt.) metal is malleable/ductile, non-metal is brittle (accept only metals are malleable/ductile) metal is shiny, non-metal is dull (accept only metals are shiny) metal conducts heat well, non-metal poor (accept metals are better conductors of heat) metals usually solids, non-metals gases or liquids (or solids) metals sonorous, non-metals are non-sonorous	metals strong /hard, non- metals weak/soft	(1)  (1)

Question Number	Acceptable Answers	Reject	Mark
14(b)(i)	<i>Mark each part independently</i> $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$		(1)
	calcium hydroxide (only)	if any other products present	(1)

Question Number	Acceptable Answers	Reject	Mark
14(b)(ii)	<i>Mark each part independently</i> $\text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_3$		(1)
	sulphurous acid / sulphuric(IV) acid	if any other products present	(1)

Question Number	Acceptable Answers	Reject	Mark
14(c)(i)	$\text{Ca}^{2+}$ electron arrangement 2,8,8 $\text{O}^{2-}$ electron arrangement 2,8		(1) (1) (1) (1)

Question Number	Acceptable Answers	Reject	Mark
14(c)(ii)	ionic bond is the (electrostatic) <u>attraction</u> between oppositely charged ions /between $\text{Ca}^{2+}$ and $\text{O}^{2-}$	if any reference to atoms or molecules	(1)

(Total 11 Marks)

PAPER TOTAL 100 MARKS

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Question Number	Acceptable Answers	Reject	Mark
1 (a)	In M2, 4, 6 any extra product scores 0. If name and formula given, both must be correct to score		
	M1 <b>NAME</b> nitric acid (ignore dilute or concentrated)		(1)
	M2 <b>NAME or FORMULA</b> carbon dioxide/CO <sub>2</sub> <u>and</u> water/H <sub>2</sub> O		(1)
	M3 <b>NAME</b> sulphuric acid / dilute sulphuric acid, <u>OR</u> any soluble sulphate eg of Na, K, Li, Mg	Conc H <sub>2</sub> SO <sub>4</sub> BaSO <sub>4</sub> PbSO <sub>4</sub>	(1)
	M4 <b>NAME or FORMULA</b> nitric acid / HNO <sub>3</sub> <u>or</u> the corresponding nitrate eg NaNO <sub>3</sub> / KNO <sub>3</sub> / Mg(NO <sub>3</sub> ) <sub>2</sub>		(1)
	M5 <b>NAME</b> hydrogen chloride (gas)	Hydrochloric acid	(1)
	M6 <b>NAME or FORMULA</b> hydrogen / H <sub>2</sub>		(1)

Question Number	Acceptable Answers	Reject	Mark
1 (b)(i)	to remove (soluble) salts / nitrates		(1)

Question Number	Acceptable Answers	Reject	Mark
1 (b)(ii)	M1 moles of silver = $4.32/108 = 0.04$	Do not allow M1 = 2 and M2 = 1 (read from eq)	(1)
	M2 moles of M = 0.02 e.c.f (M2 = M1 / 2)		(1)
	M3 Mr of M = $1.30/0.02 = 65$ (M3 = 1.30 / M2)		(1)

(Total 10 Marks)

Question Number	Acceptable Answers	Reject	Mark
2 (a)	M1 blue precipitate / solid		(1)
	M2 copper(II) hydroxide / $\text{Cu}(\text{OH})_2$ / copper hydroxide <i>(M2 dependent on M1)</i>		(1)
	M3 litmus turns blue		(1)
	M4 ammonia/ $\text{NH}_3$ <i>(M4 dependent on M3)</i>  <i>(If M1 and M3 not scored, allow 1 mark for two correct products in M2 / M4)</i>		(1)

Question Number	Acceptable Answers	Reject	Mark
2 (b)	<i>(incorrect reagent or use of <math>\text{H}_2\text{SO}_4</math> scores zero)</i>		
	M1 barium chloride / $\text{BaCl}_2$ or barium nitrate / $\text{Ba}(\text{NO}_3)_2$ Or barium hydroxide / $\text{Ba}(\text{OH})_2$		(1)
	M2 hydrochloric acid/ $\text{HCl}$ or nitric acid/ $\text{HNO}_3$		(1)
	M3 white precipitate		(1)

Question Number	Acceptable Answers	Reject	Mark
2 (c)	<i>(incorrect reagent or use of <math>\text{HCl}</math> / <math>\text{HBr}</math> / <math>\text{H}_2\text{SO}_4</math> scores zero)</i>		
	M1 silver nitrate / $\text{AgNO}_3$		(1)
	M2 nitric acid / $\text{HNO}_3$		(1)
	M3 cream / off-white / <u>pale</u> yellow precipitate OR	Yellow	(1)
	M1/2 pass $\text{Cl}_2$ / add $\text{Cl}_2$ water		(2)
	M3 orange / yellow / brown solution	Red Red-brown	(1)

(Total 10 Marks)

Question Number	Acceptable Answers	Reject	Mark
3 (a)(i)	M1 $2\text{H}^+ + 2\text{e} \rightarrow \text{H}_2$ / $\text{H}^+ + \text{e} \rightarrow \frac{1}{2}\text{H}_2$ ( <i>ignore state symbols</i> ) M2 presence of $\text{OH}^-$ / NaOH M3 basic or alkaline (solution) ( <i>due to <math>\text{OH}^-</math> / NaOH</i> ) M4 burns with a 'pop' / 'pops' when <b>lighted</b> splint is applied	glowing splint	(1) (1) (1) (1)

Question Number	Acceptable Answers	Reject	Mark
3 (a)(ii)	M1 Chlorine/ $\text{Cl}_2$ M2 $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}$ / $2\text{Cl}^- - 2\text{e} \rightarrow \text{Cl}_2$ <i>or</i> $\text{Cl}^- \rightarrow \frac{1}{2}\text{Cl}_2 + \text{e}$ <i>or</i> $\text{Cl}^- \rightarrow \text{Cl} + \text{e}$ followed by $2\text{Cl} \rightarrow \text{Cl}_2$	Cl	(1) (1)

Question Number	Acceptable Answers	Reject	Mark
3 (b)(i)	( <i>state symbols must be given in both answers, allow 1 mark for two correct equations without / incorrect state symbols</i> ) Cathode $(\text{Cu}^{2+}(\text{aq})) + 2\text{e} \rightarrow \text{Cu}(\text{s})$ Anode $(\text{Cu}(\text{s})) \rightarrow \text{Cu}^{2+}(\text{aq}) + 2\text{e}$		(1) (1)

Question Number	Acceptable Answers	Reject	Mark
3 (b)(ii)	M1 10 moles Cu formed by 20F / 1 mole of Cu from 2F M2 635 g ( <i>M1 consequential on cathode equation in (b)(i)</i> )		(1) (1)

(Total 10 Marks)

Question Number	Acceptable Answers	Reject	Mark
4 (a)(i)	M1 C = 17.83/12 H = 2.97/1 Br = 79.20/80 (divide by A <sub>r</sub> )  M2 1.486 2.97 0.99 1.5 3 1 3 6 2		(1) ) ) (1) )

Question Number	Acceptable Answers	Reject	Mark
4 (a)(ii)	M <sub>r</sub> / (relative) molecular mass (= 202) / mass of 1 mole / molar mass	formula mass	(1)

Question Number	Acceptable Answers	Reject	Mark
4 (a)(iii)	M1 structure of P $\begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{H} & \\ &   & &   & &   & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - \text{H} \\ &   & &   & &   & \\ & \text{H} & & \text{Br} & & \text{Br} & \end{array}$ OR CH <sub>3</sub> .CHBr.CH <sub>2</sub> Br  M2 CH <sub>3</sub> .CH = CH <sub>2</sub> + Br <sub>2</sub> → CH <sub>3</sub> CHBrCH <sub>2</sub> Br (structure of propene required, accept Br-Br but not Br=Br. M2 dependent on M1)  M3 addition reaction (ignore bromination / halogenation)  M4 bromine is decolourised OR brown / orange / yellow to colourless		(1)  (1)  (1)  (1)

Question Number	Acceptable Answers	Reject	Mark
4 (b)	Q CH <sub>4</sub>  R C <sub>2</sub> H <sub>4</sub> CH <sub>2</sub> =CH <sub>2</sub> / H <sub>2</sub> C=CH <sub>2</sub> (double bond must be shown if structure given)  Cracking / pyrolysis / (ignore thermal or catalytic / decomposition)		(1)  (1)  (1)

(Total 10 Marks)

Question Number	Acceptable Answers	Reject	Mark
5 (a)(i)	M1 2 bond pairs correct		(1)
	M2 2 lone pairs on oxygen ( <i>M2 dependent on M1</i> )		(1)

Question Number	Acceptable Answers	Reject	Mark
5 (a)(ii)	V-shaped ( <i>ignore any lone pairs on oxygen</i> )		(1)

Question Number	Acceptable Answers	Reject	Mark
5 (a)(iii)	<u>Break or weaken or overcome</u>  (weak) intermolecular forces (weak) van der Waalls forces (weak) hydrogen bonds  <i>accept little energy to separate the molecules with reason</i>  <i>(any reference to the breaking of bonds (other than hydrogen bond) scores zero)</i>		(1)

Question Number	Acceptable Answers	Reject	Mark
5 (b)	M1 cation/metal ion/positive ion		(1)
	M2 delocalised electrons /sea of electrons / electron cloud		(1)
	M3 electrons move / flow (to carry current)		(1)

Question Number	Acceptable Answers	Reject	Mark
5 (c)	M1 Na <sup>+</sup> and Cl <sup>-</sup> / sodium and chloride ions		(1)
	M2 when molten, ions can move (to carry current)		(1)
	M3 when solid, ions cannot move / in fixed positions / in lattice		(1)

(Total 10 Marks)

Question Number	Acceptable Answers	Reject	Mark
6 (a)(i)	M1 cryolite / Na <sub>3</sub> AlF <sub>6</sub> ( <i>both must be correct if both given</i> )		(1)
	M2 Al <sup>3+</sup> + 3e → Al		(1)
	M3 expensive to use electricity		(1)
	M4 <u>anode</u> needs to be replaced (frequently)		(1)

Question Number	Acceptable Answers	Reject	Mark
6 (a)(ii)	M1 (ignite at) <u>high</u> temperature/use magnesium <u>fuse</u> / <u>burning</u> Mg ribbon	heat	(1)
	M2 Cr <sub>2</sub> O <sub>3</sub> + 2Al → 2Cr + Al <sub>2</sub> O <sub>3</sub>		(1)
	M3 Al oxidised because oxygen / increases	Al loses electrons/gains oxidation state	(1)
	M4 Cr <sup>3+</sup> reduced because Cr reduced because Cr <sub>2</sub> O <sub>3</sub> reduced because	Cr <sup>3+</sup> gains electrons / oxidation state decreases loses oxygen	(1)
	Allow Al oxidised and Cr <sup>3+</sup> / Cr <sub>2</sub> O <sub>3</sub> reduced for 1 mark if no reason given		

Question Number	Acceptable Answers	Reject	Mark
6 (a)(iii)	M1 2PbS + 3O <sub>2</sub> → 2PbO + 2SO <sub>2</sub>		(1)
	M2 reducing agent carbon / coke / carbon monoxide		(1)
	M3 heat or use high temperature ( <i>M3 dependent on M2</i> )		(1)
	M4 PbO + C → Pb + CO or 2PbO + C → 2Pb + CO <sub>2</sub> or PbO + CO → Pb + CO <sub>2</sub>		(1)
	M5/M6 Any two of: SO <sub>2</sub> acid rain / toxic CO <sub>2</sub> global warming / greenhouse gas CO poisonous / combines with haemoglobin  ( <i>M5/6 must relate problem to the specified pollutant</i> )		2x(1)





Question Number	Acceptable Answers	Reject	Mark
6 (b)	<p>Any two characteristics and two examples from iron:</p> <p>M1 variable valency / oxidation state</p> <p>M2 <math>\text{Fe}^{2+}</math> and <math>\text{Fe}^{3+}</math></p> <p>M3 coloured ions / compounds</p> <p>M4 Fe(II) green / Fe(III) yellow or brown (allow colour of specified salts but not oxides)</p> <p>Alternatives</p> <p>M1/M2 catalytic activity Fe used in Haber process</p> <p>Or complex ions eg <math>[\text{Fe}(\text{H}_2\text{O})_6]^{2/3+}</math> or <math>[\text{FeCl}_4]^{-/2-}</math></p>	coloured oxides	<p>2x(2)</p> <p>max 4</p>

Question Number	Acceptable Answers	Reject	Mark
6 (c)(i)	M1 formula of $\text{FeCl}_3$ as the only Fe compound		(1)
	M2 equation $2\text{Fe} + 3\text{Cl}_2 \rightarrow 2\text{FeCl}_3$		(1)

Question Number	Acceptable Answers	Reject	Mark
6 (c)(ii)	M1 formula of $\text{Fe}_3\text{O}_4$ OR $\text{Fe}_2\text{O}_3$ as the only Fe compound		(1)
	M2 equation $3\text{Fe} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$ $2\text{Fe} + 3\text{H}_2\text{O} \rightarrow \text{Fe}_2\text{O}_3 + 3\text{H}_2$		(1)

Question Number	Acceptable Answers	Reject	Mark
6 (d)	<i>Incorrect reagent scores zero. Partially correct reagent eg use alkali / <math>\text{OH}^-</math> lose M1 but allow M2/3</i>		
	M1 (aqueous) sodium hydroxide/ammonia		(1)
	M2 iron(II) gives a green precipitate	green solution	(1)
	M3 iron(III) gives a brown precipitate	brown solution	(1)

(Total 25 Marks)

Question Number	Acceptable Answers	Reject	Mark
7 (a)(i)	M1 + = endothermic/heat absorbed		(1)
	M2 - = exothermic/heat evolved		(1)

Question Number	Acceptable Answers	Reject	Mark
7 (a)(ii)	M1 reaction 2 because exothermic		(1)
	M2 low temperature means slow reaction		(1)

Question Number	Acceptable Answers	Reject	Mark
7 (a)(iii)	<i>Reaction 1</i> M1 decrease in <u>yield</u> <i>(do not allow equilib goes to LHS but allow M2)</i>		(1)
	M2 more molecules / moles / volume on right hand side of equation <i>(or converse)</i> <i>(M2 dependent on M1)</i>		(1)
	<i>reaction 2</i> M3 no effect (on yield / equilibrium)		(1)
	M4 same number of molecules / moles / volume on each side of the equation <i>(M4 dependent on M3)</i>		(1)

Question Number	Acceptable Answers	Reject	Mark
7 (b)	M1 300-500 °C		(1)
	M2 150-450 atm		(1)
	M3 iron / reduced iron oxide catalyst		(1)

Question Number	Acceptable Answers	Reject	Mark
7 (c)	M1 $\text{NH}_3 + \text{HNO}_3 \rightarrow \text{NH}_4\text{NO}_3$		(1)
	M2 $M_r \text{NH}_4\text{NO}_3 = 80$		(1)
	M3 $28 / 80 \times 100\%$ ecf $28 / M2 \times 100$		(1)
	M4 = 35% <i>(M4 dependent on use of 28 / M2 in M3)</i>  <i>(M2 must be dependent on the <math>M_r</math> of any incorrect formula of ammonium nitrate given in the equation)</i>		(1)

Question Number	Acceptable Answers	Reject	Mark
7 (d)(i)	M1 pipette		(1)
	M2 25 cm <sup>3</sup> alkali (or acid) or suitable stated volume		(1)
	M3 into conical flask		(1)
	M4 acid (or alkali) in burette		(1)
	M5 titrate until methyl orange turns <u>orange</u>		(1)
	M6/7 any two of: add with swirling / shake / stir dropwise <u>near</u> end-point repeat to get concordant / average of results		(1) (1)

Question Number	Acceptable Answers	Reject	Mark
7 (d)(ii)	M1 moles NaOH = $0.200 \times 0.0225 = 4.5 \times 10^{-3}$		(1)
	M2 moles HNO <sub>3</sub> = $4.5 \times 10^{-3}$		(1)
	M3 concentration of HNO <sub>3</sub> = $4.5 \times 10^{-3} / 0.025$ = 0.18 (mol dm <sup>-3</sup> )		(1)
	OR		
	M1 $25 \times m_1 = 22.5 \times 0.200$		
	M2 $m_1 = (22.5 \times 0.200) / 25$		
M3 = 0.18			

(Total 25 Marks)

Question Number	Acceptable Answers	Reject	Mark
8 (a)(i)	M1 (ethene) + steam / water		(1)
	M2 250-500°C		(1)
	M3 40-100 atm		(1)
	M4 (phosphoric) acid catalyst	other acids	(1)
	M5 $C_2H_4 + H_2O \rightarrow C_2H_5OH$ (allow $CH_2=CH_2$ and $CH_3CH_2OH$ )	$C_2H_6O$	(1)

Question Number	Acceptable Answers	Reject	Mark
8 (a)(ii)	M1 aqueous glucose		(1)
	M2 yeast		(1)
	M3 25-40 °C		(1)
	M4 exclude air / oxygen		(1)
	M5 (fractionally) distil out the alcohol		(1)
	M6 $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ (allow $CH_3CH_2OH$ )	$C_2H_6O$	(1)

Question Number	Acceptable Answers	Reject	Mark
8 (a)(iii)	Must be positive statements re fermentation		
	M1 advantage: uses renewable starting material	cheaper	(1)
	M2 disadvantage: slower / needs more purification / low yield / batch process		(1)

Question Number	Acceptable Answers	Reject	Mark
8 (b)(i)	M1 energy to break 5 C-H, C-C, C-O, O-H, 3 O=O (or 2050 + 350 + 360 + 460 + 1485)		(1)
	M2 4705 (kJmol <sup>-1</sup> or kJ)		(1)

Question Number	Acceptable Answers	Reject	Mark
8 (b)(ii)	M3 energy released forming 4 C=O + 6 O-H (or 2980 + 2760)		(1)
	M4 5740 (kJmol <sup>-1</sup> or kJ)		(1)

Question Number	Acceptable Answers	Reject	Mark
8 (b)(iii)	M5 Use of $\Sigma$ bonds broken - $\Sigma$ bonds formed 4705 - 5740 (M5 answer M2 - M4)		(1)
	M6 $\Delta H = -1035$ (kJmol <sup>-1</sup> or kJ) (dependent on M5 = M2 - M4)		(1)

Question Number	Acceptable Answers	Reject	Mark
8 (c)(i)	(1-)chloroethane / ethyl chloride displayed formula for CH <sub>3</sub> CH <sub>2</sub> Cl		(1) (1)

Question Number	Acceptable Answers	Reject	Mark
8 (c)(ii)	ethyl ethanoate displayed formula for ethyl ethanoate		(1) (1)

Question Number	Acceptable Answers	Reject	Mark
8 (c)(iii)	ethene displayed formula for CH <sub>2</sub> =CH <sub>2</sub>		(1) (1)

Displayed formulae

$\begin{array}{c} \text{H} \quad \text{H} \\   \quad   \\ \text{H} - \text{C} - \text{C} - \text{Cl} \\   \quad   \\ \text{H} \quad \text{H} \end{array}$	$\begin{array}{c} \text{H} \quad \text{O} \quad \text{H} \quad \text{H} \\   \quad    \quad   \quad   \\ \text{H} - \text{C} - \text{C} - \text{O} - \text{C} - \text{C} - \text{H} \\   \quad \quad   \quad   \\ \text{H} \quad \quad \text{H} \quad \text{H} \end{array}$	$\begin{array}{c} \text{H} \quad \text{H} \\   \quad   \\ \text{C} = \text{C} \\   \quad   \\ \text{H} \quad \text{H} \end{array}$
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(Total 25 Marks)

Question Number	Acceptable Answers	Reject	Mark
9 (a)(i)	M1 filings have a greater surface area		(1)
	M2 more (frequent) collisions		(1)
	M3 $3\text{Fe} + 2\text{O}_2 \rightarrow \text{Fe}_3\text{O}_4$ (allow $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$ )		(1)

Question Number	Acceptable Answers	Reject	Mark
9 (a)(ii)	M1 at r.t. molecules / particles do not have enough energy to react / do not have $E_a$	atoms	(1)
	M2 heat/flame gives (molecules / particles) energy		(1)
	M3 more molecules / particles have $E_a$ / more successful / effective collisions		(1)
	M4 $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$		(1)

Question Number	Acceptable Answers	Reject	Mark
9 (b)(i)	M1 7 / same number of electrons <u>in outer / valence shell</u>		(1)
	M2 atoms become larger as group descended		(1)
	M3 less attraction for (extra) electron / harder to gain an electron		(1)

Question Number	Acceptable Answers	Reject	Mark
9 (b)(ii)	M1 red-brown / orange-brown / dark brown / brown solution or black / grey black precipitate / solid	purple gas	(1)
	M2 <u>IONIC</u> equation $\text{Cl}_2 + 2\text{I}^- \rightarrow 2\text{Cl}^- + \text{I}_2$		(1)

Question Number	Acceptable Answers	Reject	Mark
9 (b)(iii)	<i>any one of:</i> colour darkens / green $\rightarrow$ brown $\rightarrow$ black <i>or</i> m.pt. (or b.pt.) increases / gas $\rightarrow$ liquid $\rightarrow$ solid <i>or</i> solubility decreases <i>or</i> density increases		(1)

Question Number	Acceptable Answers	Reject	Mark
9 (b)(iv)	M1 manganese(IV) oxide / manganese dioxide / $\text{MnO}_2$ / potassium permanganate / potassium manganate(VII) / $\text{KMnO}_4$		(1)
	M2 to remove HCl		(1)
	M3 concentrated sulphuric acid / anhydrous calcium chloride / silica gel	CaO	(1)
	M4 downward delivery / upward displacement of air / syringe		(1)

Question Number	Acceptable Answers	Reject	Mark
9 (c)	M1 MgO formed		(1)
	M2 $\text{Mg} + \text{H}_2\text{O} \rightarrow \text{MgO} + \text{H}_2$		(1)
	M3 $\text{Ca}(\text{OH})_2$ formed		(1)
	M4 $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$		(1)
	M5 any two of:		(1)
	M6 calcium sinks bubbles (of gas) / effervescence cloudy / white suspension / solid / deposit	milky chalky ppte	(1)
	M7 Li/Na/K/Rb/Cs or Sr/Ba ( <i>can be scored in equation</i> )		(1)
	M8 $2\text{M} + 2\text{H}_2\text{O} \rightarrow 2\text{MOH} + \text{H}_2$ (group I) $\text{M} + 2\text{H}_2\text{O} \rightarrow \text{M}(\text{OH})_2 + \text{H}_2$ (Sr / Ba)		(1)

(Total 25 Marks)

PAPER TOTAL 100 MARKS

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