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Mark Scheme (Results)
Summer 2010

GCE O

GCE O Chemistry (7081) Paper 02

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Summer 2010

7081/02 O-LEVEL CHEMISTRY MARK SCHEME – SUMMER 2010

SECTION A

Question 1			
(a)	(i)	oxidising agent / oxidises the HCl	(1)
	(ii)	catalyst / increases the rate of reaction *(penalise if contradiction eg catalyst and reducing agent but ignore reactant in a(i) and (ii))*	(1)
(b)	(i)	(moist) litmus is bleached *(accept litmus turns pink or red then bleaches)* *(do NOT accept litmus turns blue then bleaches)*	(1)
	(ii)	relights a **glowing** splint *(do not accept O_2 burns brighter, or use of burning splint)*	(1)
(c)	M1	Mn = 69.6/55 O = 30.4/16 *(M1 for dividing by A_r)*	(1)
		= 1.27 = 1.90	
	M2	Mn : O = 1.0 : 1.5 ∴ 2 : 3 *(M2 for ratio 2 to3)*	(1)
	M3	formula is Mn_2O_3 *(M3 for formula)*	(1)
		(answer alone with no working scores (1)	
(d)		Any 3	
		variable valency / oxidation state	(1)
		forms coloured compounds / ions *(do not accept coloured oxides OR metals are coloured)*	(1)
		formation of complex ions / molecules / compounds	(1)
		can act as a catalyst	
		(ignore references to mp or bp or physical properties)	

Total 10 marks

Question 2			
(a)	(i)	C_nH_{2n+2}	(1)
	(ii) M1 M2 M3	correct bonding *(M1 for 4 C-H bonds irrespective of shape)* correct shape *(3-D effect not needed)* *(dependent on 4 C – H bonds)* tetrahedral / tetrahedron *(M3 for name of shape and mark independent of M1 / M2)* *(do not accept tetragonal)* *(Stick diagram showing 4 lines arranged tetrahedrally scores M2 but not M1)*	(1) (1) (1)
	(iii)	chemical properties unchanged / are the same / are similar	(1)
		e.g. boiling point increases / density increases *(do not accept increase in mass / M_r / chain length / physical state changes from gas to liquid)*	(1)
(b)	(i)	(compounds / molecules with the) same molecular formula but different structures / structural formulae *(penalise elements with the same molecular…….)*	(1)
	(ii)	displayed structure for $CH_2Cl.CH_2Cl$ displayed structure for $CH_3.CHCl_2$  *(ignore names)*	(1) (1)
	(iii)	CH_2Cl	(1)

Total 10 marks

Question 3			
(a)		burette	(1)
(b)	M1	e.g. methyl orange / phenolphthalein *(do not accept litmus)*	(1)
	M2	yellow to orange / red / pink / violet to colourless *(M2 is for the colour change and dependent on M1)*	(1)
(c)		swirl / shake / stir (contents or flask)	(1)
		add dropwise near end-point / add slowly near end point	(1)
		wash down sides of flask (with water) use of white tile *(Any two)*	
		(ignore rinsing out burettes etc, meniscus readings etc)	
(d)	(i)	Rough titration / overshot end-point / too much (sulphuric) acid added	(1)
	(ii)	25.65 (cm^3)	(1)
	(iii)	*(in this question penalise answers less than 3 sf once only)*	(1)
	M1	moles of H_2SO_4 = 0.05 x 0.02565 = 1.283 x 10^{-3} *(0.05 x answer to d(ii))*	
	M2	moles NaOH = 2.566 x 10^{-3} *(M2 = 2 x answer to M1)*	(1)
	M3	concentration of NaOH = 2.566 x 10^{-3} / 0.025 = 0.1026 (mol dm^{-3}) *(accept 0.102 to 0.103)* *(M3 = M2 / 0.025)* *(ans 0.1026 followed by 0.1 loses M3)* *(ignore units)*	(1)
OR	M1	(0.05 x 25.65) = (m_2 x 25)	
	M2	(0.05 x 25.65) / 1 = (m_2 x 25) / 2	
	M3	= 0.1026 (*must not be less than 3 sf)*	

Total 10 marks

Question 4			
(a)	(i)	$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$	(1)
	(ii)	platinum *or* platinum-rhodium *or* Pt *or* Pt-Rh	(1)
	(iii)	Any temperature in range 800-1000 ^0C	(1)
	(iv)	reaction is exothermic *or* reaction gives out heat	(1)
(b)	M1	$M_r(NO) = 30$	(1)
	M2	30 g has a volume of 30 x (112 / 0.150) cm^3 *(M_1 x (112 / .150))*	(1)
	M3	= 22400 cm^3 (or 22.4 dm^3) *(answer to M2)*	(1)
OR	M1	M_r NO = 30	
	M2	moles of NO = 0.15 / 30 = 0.005	
	M3	volume of I mole = 112 / 0.005 = 22400 cm^3	
(c)		200 cm^3 / 200 / 0.2 dm^3 / 0.20 dm^3 / 0.200 dm^3	(1)
		(NOT 0.2 on its own)	
(d)	(i)	number of (specified) particles in 1 mole (of particles / substance)	(1)
	(ii)	0.02 L **OR** L/50	(1)

Total 10 marks

Question 5			
(a)	(i)	Equation $CoO + 2HCl \rightarrow CoCl_2 + H_2O$ *(do not accept Ca)*	(1)
	(ii)	warmed – to speed **up reaction** increase <u>rate of reaction</u> / <u>rate of dissolving</u> gain energy for more successful collisions provides energy to particles so that more have E_a *(do not accept provides energy to start the reaction)*	(1)
	(iii)	excess CoO so that <u>all the acid or HCl</u> was used up / neutralised / reacted	(1)
	(iv)	filtered to remove <u>excess CoO / excess oxide / unreacted CoO</u>	(1)
	(v)	evaporation to half volume: to make solution more concentrated <u>so that crystals will form</u> / to form a <u>saturated</u> solution / to reach <u>saturation</u> point	(1)
	(vi)	effect of cooling forms <u>larger / large</u> crystals	(1)
	(vii)	evaporation <u>anhydrous</u> salt formed / <u>anhydrous</u> $CoCl_2$ formed / would <u>not</u> have water of crystallisation / would <u>not</u> form hydrated crystals *(do not accept forms as a powder)*	(1)
(b)	M1	M_r of $CoCl_2$ = 130	(1)
	M2	xH_2O = 238 – 130 = 108 *(M2 = 238 – M1)* *(if M_r > 238 scores zero)*	(1)
	M3	x = 6	
		130 + 18x = 238 scorers M1 and M2	

Total 10 marks

SECTION A TOTAL: 50 MARKS

SECTION B

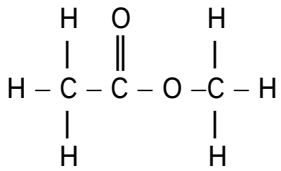
Question 6			
(a)	(i)	(H_2O / water vapour) freezes / ice formed / solid formed *(if temperature is mentioned it must be zero or negative)*	(1)
	(ii)	pipes blocked / pipes freeze	(1)
	(iii)	*(what happens, M1 and M2)*	(1)
	M1	oxygen and nitrogen liquefy / become liquid	
	M2	neon remains as a gas / does not liquefy / neon removed *(remaining gases liquefy alone scores M1 but not M2 gases condense to liquid except neon scores M1 and M2)* *(do not accept liquid air is formed)*	(1)
		(separation M3 – M5)	
	M3	nitrogen and oxygen OR liquids OR gases separated by fractional distillation / or implied, eg separated according to boiling points, or use of fractionating column *(M3 must be for a statement and is not implied from M5)*	(1)
	M4	temperature is allowed to rise / mixture is heated Or boiled	(1)
	M5	nitrogen boils off (vaporises) at –196 ^{0}C / oxygen at –183 ^{0}C nitrogen boils off <u>first</u> / nitrogen boils off at low<u>er</u> temperature *(comparison needed for M5)* *(do not accept N_2 at top of column and O_2 at bottom, there must be an indication that N_2 is obtained first)* *(a general account of FD without reference to question loses M3, M4 and M5)*	(1)

(b)		*(experiment M1 to M6)* *(D) in M1,2,3 can be scored from a diagram*	
	M1	copper pieces placed in glass tubing *(D)*	(1)
	M2	one of the syringes is set at 100 cm^3 / stated volume / full of air (the other at 0cm^3 / empty) 2 syringes have a specified total volume *(D)* *(2 syringes, 1 containing air scores M2 but check figures before giving M8)*	(1)
	M3	copper is heated *(D)*	(1)
	M4	air is passed OR shunted back and to over copper (by pushing each syringe several times) air is passed continually over copper *(M4 is for the idea that air is continually passed over Cu do not accept "air is passed over Cu")*	(1)
	M5	until no further change in volume / volume is constant / volume remains or is constant at 78 / 79 / 80 cm^3 *(could score M8 as well)*	(1)
	M6	allow to cool *(M7 and 8, are for the observations)*	(1)
	M7	copper turns black / black copper oxide formed** *(**could score M9 for CuO)*	(1)
	M8	remaining volume should be 80 / 79 / 78 cm^3 volume OR decrease of 20 / 21 / 22 cm^3 *(if alternative vol given in M2, score M8 for corresponding final vol* *remaining vol and decrease in vol must be given if statement in brackets given in M2)*	(1)
		(M9 and M10 are for the explanation and equation)	
	M9	Copper has reacted with oxygen / copper has removed oxygen / Copper is oxidised / CuO formed *(do not accept Cu reacts with air)*	(1)
	M10	$2Cu + O_2 \rightarrow 2CuO$	(1)

(c)	(i)	a fuel (burns to) give out heat or energy / source of heat or energy / provides heat or energy	(1)
	(ii)	$C_8H_{18} + 12½O_2 \rightarrow 8CO_2 + 9H_2O$ formulae	(1)
		(equation can be doubled) **NOTE TWO MARKS** balance	(1)
		NAME carbon monoxide	(1)
	(iii) M1	CO_2 dissolves in water / soluble in water / reacts with water / dissolves in water vapour and falls as acid rain	(1)
	M2	forms carbonic acid / H^+ ions / H_2CO_3 / <u>more</u> acidic solution	(1)
	M3	$H_2O + CO_2 \rightarrow H_2CO_3$ *or* $H_2O + CO_2 \rightarrow 2H^+ + CO_3^{2-}$	(1)
		or $H_2O + CO_2 \rightarrow H^+ + HCO_3^-$	
	(iv)	Global warming / greenhouse gas / effect *(do not accept acid rain)*	(1)

Total 25 marks

Question 7			
(a)	(i)M1	cathode: $2H^+ + 2e \rightarrow H_2$	(1)
	M2	anode: $2Cl^- \rightarrow Cl_2 + 2e$ *(if electrodes reversed OR not stated, but equations are both correct, allow 1 mark for M1, M2)*	(1)
	M3	$\underline{Na^+ \text{ and } OH^- \text{ ions}}$ left / remain (in solution) *use of mercury cathode cell, stated OR sodium forms amalgam* *M1 cathode* $Na^+ + e \rightarrow Na$ *(only with Hg cathode cell)* *M2 anode* $2Cl^- \rightarrow Cl_2 + 2e$ *M3 NaOH* *Na reacts with H_2O to give NaOH and H_2*	(1)
	(ii)		
	M1	$Mg^{2+} + 2e \rightarrow Mg$	(1)
	M2	electrons are gained (by the magnesium ion) ∴reduction *(dependent on an equation that shows electron gain by magnesium ions for M2)* *(do not accept Mg gains electrons)*	(1)
	M3	in aqueous solution, hydrogen evolved OR formed at cathode / H^+ ion discharged at cathode *(accept an equation eg $2H^+ + 2e \rightarrow H_2$)* *(do not accept H^+ ions are formed at cathode)*	(1)
	(iii)		
	M1	electrolyte is aqueous copper(II) sulphate	(1)
	M2	cathode is sheet of pure copper/stainless steel	(1)
	M3	anode is impure copper	(1)
	M4	at anode OR impure Cu electrode $Cu \rightarrow Cu^{2+} + 2e$ / $Cu - 2e \rightarrow Cu^{2+}$	(1)
	M5	at cathode OR pure Cu electrode $Cu^{2+} + 2e \rightarrow Cu$	(1)
		(if electrodes reversed but equations are both correct, allow 1 mark for M4/5) *(if M2/M3 are reversed, allow 1 mark for electrodes BUT mark electrode equations consequentially on the material of each electrode)*	

(b)	M1	**NAME** hydrogen chloride (gas) *(do not accept hydrochloric acid)*	(1)
	M2	sunlight / uv light / light / ignite / flame / burn / heat high temperature *(ignore mention of pressure)*	(1)
	M3	$H_2 + Cl_2 \rightarrow 2HCl$	(1)
	M4	acidic in <u>aqueous</u> solution / when water present	(1)
	M5	gives H^+ / H_3O^+ / hydrochloric acid / HCl<u>(aq)</u> *(M5 dependent on M4)*	(1)
(c)	(i)		
	M1	(vegetable) oil / fat / (tri)glyceride / ester of glycerol *(M1 could be scored from a structure of oil/fat in an equation)* *(do not allow ester alone)*	(1)
	M2	<u>boil / heat</u> with (aqueous) NaOH	(1)
	M3	cooled (to precipitate soap) / salt out soap	(1)
	M4	filter (off soap) / take off (soap) crust / equation *(minimum oil/fat/ester + alkali → soap + glycerol either as word equation or as formulae)* *if formulae used in equation,* *must have correct formula or structure for oil/fat,* *for glycerol* *and for sodium salt* *(allow use of R for long chain acid)* *equation need not balance*	(1)
	(ii)		
	M1	displayed formula of methyl ethanoate 	(1)
	M2	**NAME** ethanoic acid	(1)
	M3	**NAME** methanol	(1)
(d)	M1	metals have <u>delocalised</u> electrons / sea of electrons	(1)
	M2	electrons move / flow / mobile *(not free electrons)*	(1)

Total 25 marks

Question 8			
(a)	(i)	Zinc/metal: malleable / ductile / high mpt (or bpt) / shiny / conducts electricity (or heat) / sonorous *Any two x (1)*	(2)
		sulphur / non-metal: brittle / low mpt (or bpt) / dull / non-conductor / insulator *Any two x (1)* *(must be a positive statement, do not accept not malleable etc*	(2)
	(ii)	zinc: hydrogen / bubbles of gas evolved / effervescence	(1)
		$Zn + 2HCl \rightarrow ZnCl_2 + H_2$ OR $Zn + 2H^+ \rightarrow Zn^{2+} + H_2$	(1)
		sulphur: no reaction / forms nothing	(1)
(b)	(i) M1	ionic bond formed / ionic compound there is attraction between oppositely charged ions	(1)
	M2	Mg loses 2 electrons (to oxygen) *(do not accept Mg^{2+} ion loses electrons)*	
	M3	oxygen gains 2 electrons (from magnesium) *(transfer of 2 electrons from Mg to O scores M2 and M3* *electron transfer from Mg to O scores 1 mark for M2, M3* *(do not accept O^{2-} ions gain electrons)*	(1)
	M4	to give 8 electrons in outer shell / complete or full outer shell / noble gas OR Ne configuration / stable configuration / stable octet *(M4 requires a statement in words)* *(do not accept to become stable without reference to configuration)*	(1)
	M5	Mg^{2+} ion formed / (or equation, $Mg \rightarrow Mg^{2+} + 2e$)	(1)
	M6	O^{2-} ion formed / (or equation, $O + 2e \rightarrow O^{2-}$)	(1)
	M7	each ion has an electron configuration of 2,8	(1)
		(M5,M6,M7 could be scored from diagram showing formulae of ions and 2.8 configurations)	
		(Any reference to covalent bond instead of ionic negates only M1 if rest of the answer relates to ionic bonding) *(An answer contradicted by diagram of electron sharing or description of covalent bond scores zero)*	

(b)	(ii) M1	covalent bond formed / covalent molecule	(1)
	M2	by electrons (pair) sharing *(do not accept e sharing between oxygen molecules)*	(1)
	M3	to complete outer shell / both atoms need to gain electrons / atoms need two electrons *(M4/M5 for diagram of bonding)*	(1)
	M4	must show 2 bond pairs between the two O atoms	(1)
	M5	must show 2 lone pairs on each O atom *(M5 dependent on M4 being scored)*	(1)
		(Any reference to ionic bond instead of covalent negates only M1 if rest of the answer relates to covalent bonding)	
	(iii)	both metals need to lose electrons	(1)
(c)	M1	outer electron further from nucleus / atoms increase in size / more electron shells / more shielding	(1)
	M2	less attraction for outer electrons	(1)
	M3	outer electron lost more easily *(need reference to 'outer shell' somewhere to score 3 marks)* *(accept valence shell as outer shell)*	(1)
(d)	M1	noble gases / inert gases / group 0	(1)
	M2	complete <u>outer</u> shells / 8 electrons in <u>outer</u> shell / no tendency to lose or gain electrons *(M2 is dependent on M1)* *(allow valency shell for outer shell)*	(1)

Total 25 marks

Question 9			
		In a (i) and (ii) *incorrect reagent scores zero* *partially correct reagent eg alkali or OH^- in a(i) and a(ii) loses M1 only*	
(a)	(i)		
	M1	add NaOH / NH_3	(1)
	M2	green / dirty green / grey-green <u>precipitate</u> formed	(1)
	M3	IONIC EQUATION ONLY $Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2$	(1)
	M4	add HCl/HNO_3 and $BaCl_2/Ba(NO_3)_2$ *($BaCl_2$ without acid loses M4 only* *Ba^{2+} loses M4 only* *BaCl loses M4 only* *Acidified $BaCl_2$ loses M4 only* *use of H_2SO_4, treat as incorrect reagent, scores zero* *Dil HCl alone ie without $BaCl_2$, incorrect reagent scores zero)*	(1)
	M5	white <u>precipitate</u> formed	(1)
	M6	IONIC EQUATION ONLY $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$	(1)
	(ii)		
	M1	add NaOH / $Ca(OH)_2$ / lime water / heat (if followed by attempt at M2/3)	(1)
	M2	ammonia gas evolved	(1)
	M3	turns red litmus blue / gives white fumes with HCl *(allow HCl, or use a rod dipped into conc HCl, penalise dilute HCl)*	(1)
	M4	IONIC EQUATION ONLY $NH_4^+ + OH^- \rightarrow NH_3 + H_2O$	(1)
	M5	add <u>specified</u> acid eg HCl heat (if followed by attempt at M6/7) *(if conc H_2SO_4 used lose M5 only)*	(1)
	M6	CO_2 evolved	(1)
	M7	turns lime water milky / goes cloudy / milky / turbid / white precipitate	(1)
	M8	IONIC EQUATION ONLY $CO_3^{2-} + 2H^+ \rightarrow CO_2 + H_2O$	(1)

		In part (b) allow marks for the formulae of the ions ONLY. *Ignore any names or formulae for compounds*	
(b)	(i)	**P**: Ca^{2+}	(1)
		I^-	(1)
	(ii)	**R**: K^+	(1)
		SO_3^{2-}	(1)
	(iii)	**T**: H^+	(1)
		Cl^-	(1)
		$Mg + 2HCl \rightarrow MgCl_2 + H_2$ OR $Mg + 2H^+ \rightarrow Mg^{2+} + H_2$ *(If T is an incorrect acid eg H_2SO_4, allow 1 mark for a correct equation)*	(1)
(c)		*(if both name and formula given for X, Y and Z, both must be correct to score)*	
		X = C_8H_{18} / octane	(1)
		Y = C_3H_6 / propene	(1)
		Z = C_5H_{12} / pentane *(a correct equation: $C_8H_{18} \rightarrow C_3H_6 + C_5H_{12}$ scores (3) marks*	(1)
		$C_3H_6 + Br_2 \rightarrow C_3H_6Br_2$ $CH_3CH=CH_2 + Br_2 \rightarrow CH_3CHBr.CH_2Br$	(1)
		(if C_5H_{10} and C_3H_8 are given as products, allow the equation *$C_5H_{10} + Br_2 \rightarrow C_5H_{10}Br_2$)*	

Total 25 marks

SECTION B TOTAL: 50 MARKS

PAPER TOTAL: 100 MARKS

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