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Mark Scheme (Results)
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GCE

GCE O Level Chemistry (7081) Paper 2

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

SECTION A

Question Number	Answer	Reject	Mark
1 (a)	suitable metal carbonate + suitable acid	NOT c H_2SO_4	**(1)**
	<u>concentrated</u> sulphuric acid / <u>anhydrous</u> calcium chloride (accept fomulae)		**(1)**
	downward delivery / upward displacement <u>of air</u>		**(1)**

Question Number	Answer	Reject	Mark
1 (b)	any ammonium salt + a strong alkali		**(1)**
	calcium oxide / CaO / quicklime		**(1)**
	upward delivery / downward displacement <u>of air</u>		**(1)**

Question Number	Answer	Reject	Mark
1(c)	hydrochloric acid + potassium manganate(VII) / potassium permanganate / $KMnO_4$ / manganese(IV) oxide / manganese dioxide / MnO_2		**(1)**
	concentrated acid *(dependent on HCl)*		**(1)**
	concentrated sulphuric acid / anhydrous calcium chloride (accept formulae)		**(1)**
	downward delivery / upward displacement <u>of air</u>		**(1)**

Question Number	Answer	Reject	Mark
2 (a)(i)	oppositely charged <u>ions</u> attraction between ions	Formation of an ionic bond by electron transfer	**(1)** **(1)**

Question Number	Answer	Reject	Mark
2 (a)(ii)	a shared <u>pair of electrons</u> / <u>electron pair</u> sharing attraction between bond pair and (two) nuclei		**(1)** **(1)**

Question Number	Answer		Reject	Mark
2 (b)(i)	Na^+ and Cl^- Correctly placed ALLOW: correctly placed Na and C1 atoms or +/- charges	Na^+ Cl^- Na^+ Cl^- Cl^- Na^+ Cl^- Na^+ Na^+ Cl^- Na^+ Cl^-		**(1)** **(1)**

Question Number	Answer	Reject	Mark
2 (b)(ii)	M1 3 bond pairs M2 other electrons correct (dependent on M1)		**(1)** **(1)**

Question Number	Answer	Reject	Mark
2 (c)	weak intermolecular forces / weak attractions between molecules little heat / energy needed to overcome them / separate <u>molecules</u>	 easily broken	**(1)** **(1)**

Question Number	Answer	Reject	Mark
3 (a)	fractional distillation / fractionation liquid air		**(1)** **(1)**

Question Number	Answer	Reject	Mark
3 (b)(i)	magnesium dissolves / reacts, (but copper remains)		**(1)**

Question Number	Answer	Reject	Mark
3 (b)(ii)	$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$ (or ionic) Allow Cu on both sides of the equation		**(1)**

Question Number	Answer	Reject	Mark
3 (b)(iii)	Filtration / centrifuge / decant		**(1)**

Question Number	Answer	Reject	Mark
3 (c)(i)	Niger Red		**(1)**

Question Number	Answer	Reject	Mark
3 (c)(ii)	Sudan Orange		**(1)**

Question Number	Answer	Reject	Mark
3 (c)(iii)	correct measurements for dye (3.0-3.5) and solvent front (3/6) = 0.5 (3.5/6) = 0.58 or any value in between 3 and 3.5		**(1)** **(1)**

Question Number	Answer	Reject	Mark
3 (c)(iv)	two circles with (Chad) Yellow outside (Mali) Blue. Ignore circle which represents the solvent front		**(1)**

Question Number	Answer	Reject	Mark
4 (a)(i)	long-chain – contains <u>many carbon</u> atoms / bonds (ignore reference to hydrogen atoms, penalise H_2) hydrocarbon – contains carbon and hydrogen <u>only</u>	Continuous chains. Long chains of C atoms	**(1)** **(1)**

Question Number	Answer	Reject	Mark
4 (a)(ii)	cracking high temperature / 450°C to 900°C / catalyst (zeolite / aluminosilicate / SiO_2 / Al_2O_3) M2 dependant on M1 (ignore any reference to pressure)	 heat / sufficient temperature any other catalyst (contradiction)	**(1)** **(1)**

Question Number	Answer	Reject	Mark
4 (a)(iii)	M1 $C_2H_4 + C_3H_6$ M2 $C_{13}H_{28} \rightarrow C_2H_4 + C_3H_6 + C_8H_{18}$ (allow balance equation if M1 incorrect, provided formulae given in M1 are correct formulae for an alkane / alkene)		**(1)** **(1)**

Question Number	Answer	Reject	Mark
4 (b)(i)	50 – 100 atmos (or 5000-10000 kPa) <u>acid</u> catalyst / H_3PO_4 / phosphoric acid (Ignore any reference to temperature)	High pressure	**(1)** **(1)**

Question Number	Answer	Reject	Mark
4 (b)(ii)	$C_2H_4 + H_2O \rightarrow C_2H_5OH$ (Accept CH_3CH_2OH, ignore state symbols)	C_2H_6O	**(1)**

Question Number	Answer	Reject	Mark
4 (b)(iii)	fast reaction / continuous / pure product (ignore reference to cost)	High yield Answers based on a disadvantage of fermentation	**(1)**

Question Number	Answer	Reject	Mark
5 (a)(i)	Burette ONLY	Biurette / birette Burette with any other piece of apparatus eg burette and pipette	**(1)**

Question Number	Answer	Reject	Mark
5 (a)(ii)	(faint) pink / (pale) pink accept colourless to pink	Any reference to red	**(1)**

Question Number	Answer	Reject	Mark
5 (a)(iii)	add dropwise (near the end-point) swirl the flask / wash down the inside of the flask / use of white tile /	repeat titration	**(1)** **(1)** **any 1 for M2**

Question Number	Answer	Reject	Mark
5 (b)(i)	moles NaOH = 0.0246 x 0.50 = 0.0123 (0.123 scores (1) only)		**(1)** **(1)**

Question Number	Answer	Reject	Mark
5 (b)(ii)	moles HX = 0.0123 (allow te)		**(1)**

Question Number	Answer	Reject	Mark
5 (b)(iii)	M1 M_r = 1.50 / 0.0123 (allow te) M2 M_r = 121.95 / 122 (dependent on correct expression for M1)		**(1)** **(1)**

Question Number	Answer	Reject	Mark
5 (c)	To obtain accurate / average / concordant titrations / values		**(1)**

TOTAL FOR SECTION A: 50 MARKS

SECTION B

Question Number	Answer	Reject	Mark
6 (a)(i)	substance that speeds up / alters the rate of a reaction without being used up itself / remains unchanged / does not take part	Specific catalyst other than MnO_2	**(1)** **(1)**

Question Number	Answer	Reject	Mark
6 (a)(ii)	(re)lights a glowing splint		**(1)**

Question Number	Answer	Reject	Mark
6 (b)(i)	Sealed flask / glass tube + cork / connections (allow dropping funnel/ thistle funnel below the surface of the liquid) suitable collection method (syringe / labelled graduated tube over water) (If flask is heated negates M1)		**(1)** **(1)**

Question Number	Answer	Reject	Mark
6 (b)(ii)	Scale using over half of the graph paper. 7 or 8 correct plots smooth curves		**(1)** **2x1 = (2)** **2x1 = (2)**

Question Number	Answer	Reject	Mark
6 (b)(iii)	32 – 36 seconds		**(1)**

Question Number	Answer	Reject	Mark
6 (c)(i)	gradient decreases with time concentration of H_2O_2 decreases / fewer particles in same volume fewer collisions in unit time / less frequent collisions		**(1)** **(1)** **(1)**

Question Number	Answer	Reject	Mark
6 (c)(ii)	gradient increases as concentration increases more particles (in a given volume) more frequent collisions **NOTE** 'frequent' in either (i) or (ii) **DO NOT PENALISE OMISSION TWICE**		**(1)** **(1)** **(1)**

Question Number	Answer	Reject	Mark
6 (d)	Experiment 3 gradient less than Experiment 1 final volume 30 cm^3 Experiment 4 gradient greater than Experiment 2 final volume 90 cm^3		 **(1)** **(1)** **(1)** **(1)**

Question Number	Answer	Reject	Mark
6 (e)	M1 60/24000 = 0.0025 mol M2 0.005 mol H_2O_2 M3 M_r H_2O_2 = 34 M4 mass H_2O_2 = 0.005 x 34 = 0.17g If 24000 **not** used in M1, score M3 and M4 only If ratio 1 : 2 **not** used in M2, score M1, M3 and M4 If genuine arithmetical error made lose 1 mark.		**(1)** **(1)** **(1)** **(1)**

Question Number	Answer	Reject	Mark
7 (a)	M1 sulphur burnt / heated in <u>air</u>	oxygen	**(1)**
	M2 $S + O_2 \rightarrow SO_2$		**(1)**
	M3 SO_2 mixed with air	oxygen	**(1)**
	M4 at 350° to 500°C		**(1)**
	M5 at pressure of 1 atm to 3 atm	atmospheric pressure/ 1 atm	**(1)**
	M6 use catalyst of vanadium (V) oxide / V_2O_5		**(1)**
	M7 $2SO_2 + O_2 \rightarrow 2SO_3$		**(1)**
	M8 SO_3 dissolved in 98% / conc sulphuric acid		**(1)**
	M9 water added (to give conc H_2SO_4 / required concentration)		**(1)**
	M10 $SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$ $H_2S_2O_7$ $H_2O \rightarrow 2H_2SO_4$ OR $SO_3 + H_2O \rightarrow H_2SO_4$		**(1)**

Question Number	Answer	Reject	Mark
7 (b)	M1 H^+ SO_4^{2-} OH^-		**(1)**
	M2 $2H^+ + 2e^- \rightarrow H_2$		**(1)**
	M3 $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$		**(1)**
	M4 H^+ gains electrons / are reduced		**(1)**
	M5 OH^- lose electrons / are oxidised		**(1)**
	M6 H_2 at cathode / O_2 at anode		**(1)**

Question Number	Answer	Reject	Mark
7 (c)(i)	M1 add zinc oxide to acid until in excess / no more dissolves		**(1)**
	M2 heat / warm		**(1)**
	M3 filter off excess /(or excess understood from M1)		**(1)**
	M4 partially evaporate and cool / leave to crystallise		**(1)**
	M5 $ZnO + H_2SO_4 \rightarrow ZnSO_4 + H_2O$		**(1)**

Question Number	Answer	Reject	Mark
7 (c)(ii)	M1 2.52 g of water		**(1)**
	M2 moles $ZnSO_4$ = 3.22 / 161 = 0.02		**(1)**
	M3 moles H_2O = 2.52 / 18 = 0.14		**(1)**
	M4 x = 0.14 / 0.02 = 7		**(1)**
	If M1 incorrect, score M2 and M3 (conseq, mass/18)		
	If M2 incorrect, score M1 and M3		
	If M1 and M2 incorrect, score M3 only (conseq, mass/18)		
	Alternative		
	M1 5.74 / M_r hydrate = 3.22 / 161		**(1)**
	M2 M_r = 287		**(1)**
	M3 xH_2O = 287 – 161 = 126		**(1)**
	M4 x = 126 / 18 = 7		**(1)**

Question Number	Answer		Reject	Mark
8 (a)	Group I	Group VII		
	M1 1 electron in outer shell			**(1)**
		M2 7 electrons in outer shell		**(1)**
	M3 lose 1 electron			**(1)**
		M4 gain 1 electron		**(1)**
	M5 shiny/grey metals/solids		M5	**(1)**
		M6 chlorine – green gas	Solids	**(1)**
		M7 bromine – brown liquid	only	**(1)**
		M8 iodine grey/black solid		**(1)**
		Alternative if M6,7,8 not scored. *Gas to liquid to solid (1)* *Colour darkens (1)*		
	M9 more reactive down group			**(1)**
		M10 less reactive down group		**(1)**
	M11 increase size / outer electron further from nucleus / increased shielding/ more shells			**(1)**
	M12 less attraction for outer electron			**(1)**
	M13 outer e^- lost more easily			**(1)**
		M14 smallest atom has strongest attraction for electron		**(1)**
	Need reference to outer e^- to score all 3 marks M11 to M13			
		M15 easier to gain an Electron		**(1)**
	M9 incorrect Lose M11,12,13			
		M10 incorrect Lose M14 and M15		

Question Number	Answer	Reject	Mark
8 (b)	**There must be contrasting statements to score**. <u>Potassium</u> — <u>Calcium</u> ignites / explodes — does not ignite moves on surface — sinks / does not move on surface melts — does not melt fizzes vigorously — fizzes less vigorously If no comparisons allow 1 mark for 3 correct observations of potassium in calcium $2K + 2H_2O \rightarrow 2KOH + H_2$ formulae balance $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$ formula balance		**Any 3 by (1) mark each** **(1)** **(1)** **(1)** **(1)**

Question Number	Answer	Reject	Mark
8 (c)	M1 8 electrons in outer shell (He = 2) / complete octet/ Full outer shell	Stable configuration only	**(1)**
	M2 do not gain or lose electrons (reference to both gain and lose)		**(1)**
	M3 use: light bulbs / in bags for food preservation / inert atmosphere for welding / steel making manufacture of titanium dating rocks		**(1)**

Question Number	Answer	Reject	Mark
9 (a)(i)	M1 different forms of the same <u>element</u> M2 in the same physical state (M2 dependent on M1)		**(1)** **(1)**

Question Number	Answer	Reject	Mark
9 (a)(ii)	M1 macromolecular / giant molecule M2 (carbon atoms) covalently bonded		**(1)** **(1)**

Question Number	Answer	Reject	Mark
9 (a)(iii)	diamond – tetrahedral graphite – layers/ hexagonal Allow 1 mark for each C in diamond bonds to 4 other and each C in graphite bonds to 3 other, if no marks awarded above		**(1)** **(1)**

Question Number	Answer	Reject	Mark
9 (a)(iv)	diamond – covalent bonds between <u>all atoms</u> covalent bonds are strong / difficult to break / rigid structure graphite – weak forces (of attraction) between layers so layers slide		**(1)** **(1)** **(1)** **(1)**

Question Number	Answer	Reject	Mark
9 (b)(i)	carbon dioxide / CO_2 plentiful supply / excess of air $C + O_2 \rightarrow CO_2$ carbon monoxide / CO limited / small supply of air $2C + O_2 \rightarrow 2CO$ / $C + ½O_2 \rightarrow CO$	sufficient / right amount / good / enough bad / less	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**

Question Number	Answer	Reject	Mark
9 (b)(ii)	**either** CO_2 turns limewater milky but CO has no effect **or** CO burns when lighted taper is applied CO_2 extinguishes the taper		**(1)** **(1)** **(1)** **(1)**

Question Number	Answer	Reject	Mark
9(b)(iii)	Carbon monoxide is the reducing agent (can score from equation) (black) goes to red brown / pink brown / pink $CuO + CO \rightarrow Cu + CO_2$	 red OR brown 	**(1)** **(1)** **(1)**

Question Number	Answer	Reject	Mark
9 (c)	M1 $M_r\ MgCO_3 = 84$ and $M_r\ Na_2CO_3 = 106$ M2 mol $MgCO_3 = 3.36/84 = 0.04$ M3 mol $Na_2CO_3 = 0.04$ M4 mass = 0.04 x 106 = 4.24g If 1 incorrect M_r in M1 treat as arithmetic error, lose 1 mark If both M_r incorrect max 2 for question. If 1:1 ratio not used score M1, M2 and M4. M2 and M3 could be scored as $\frac{3.36 \times 106}{84}$		**(1)** **(1)** **(1)** **(1)**

TOTAL FOR PAPER: 100 MARKS