

Mark Scheme (Results) January 2009

GCE

GCE O level Chemistry
7081/02

SECTION A

Question Number	Acceptable Answers	Reject	Mark
1 (a)	<i>Accept name or formula</i> Zn / Mg / Fe <u>AND</u> dil H ₂ SO ₄ / H ₂ SO ₄ / dil HCl / conc HCl / HCl <u>conc.</u> H ₂ SO ₄ / <u>anhydrous</u> CaCl ₂ / silica gel / CaO / soda lime / P ₂ O ₅ upward delivery / downward displacement of <u>air</u> / syringe	Conc H ₂ SO ₄	(1) (1) (1)

Question Number	Acceptable Answers	Reject	Mark
1 (b)(i)	2H ₂ + O ₂ → 2H ₂ O / H ₂ + ½O ₂ → H ₂ O <i>(ignore state symbols)</i>		(1)

Question Number	Acceptable Answers	Reject	Mark
1 (b)(ii)	add to anhydrous / white CuSO ₄ / <u>OR</u> anhydrous / blue CoCl ₂ OR CoCl ₂ paper (CuSO ₄) turns blue / (CoCl ₂) turns pink		(1) (1)

Question Number	Acceptable Answers	Reject	Mark
1 (b)(iii)	find b.pt. / m.pt. 100 °C / 0 °C		(1) (1)

Question Number	Acceptable Answers	Reject	Mark
1 (c)	H ₂ + Cl ₂ → 2HCl / ½H ₂ + ½Cl ₂ → HCl hydrogen chloride	hydrochloric acid	(1) (1)

(Total 10 marks)

Question Number	Acceptable Answers	Reject	Mark
	<i>Incorrect reagent / no reagent scores 0/3</i>		
2 (a)	add barium chloride / BaCl ₂ (and HCl)		(1)
	NaCl: no precipitate / no reaction / no observation / no change		(1)
	Na ₂ SO ₄ : white precipitate		(1)

Question Number	Acceptable Answers	Reject	Mark
2 (b)	add sodium hydroxide / NaOH		(1)
	FeCl ₂ : green ppt.	Green solution	(1)
	FeCl ₃ : brown ppt.	Brown solution	(1)

Question Number	Acceptable Answers	Reject	Mark
2 (c)	heat and pass gas through lime water / Ca(OH) ₂		(1)
	Na ₂ CO ₃ : no ppt. / no reaction / does not decompose		(1)
	MgCO ₃ : turns milky / white ppt.		(1)
	<i>Lime water mark could be scored in M3, (gas turns LW milky)</i>		

Question Number	Acceptable Answers	Reject	Mark
2 (d)	Na ₂ SO ₄ + BaCl ₂ → BaSO ₄ + 2NaCl / SO ₄ ²⁻ + Ba ²⁺ → BaSO ₄		(1)
	FeCl ₂ + 2NaOH → Fe(OH) ₂ + 2NaCl / Fe ²⁺ + 2OH ⁻ → Fe(OH) ₂		
	FeCl ₃ + 3NaOH → Fe(OH) ₃ + 2NaCl / Fe ³⁺ + 3OH ⁻ → Fe(OH) ₃		
	MgCO ₃ → MgO + CO ₂		
	CO ₂ + Ca(OH) ₂ → CaCO ₃ + H ₂ O		

(Total 10 marks)

Question Number	Acceptable Answers	Reject	Mark
3 (a)(i)	fraction 1 name use fraction 2 name LPG calor gas / camping gas / fuel Petrol / gasoline motor fuel Naphtha petrochemicals / cracking Kerosene / paraffin aircraft fuel / petrochemicals Gas oil / diesel central heating fuel / motor fuel / Petrochemicals Mineral / lubricating oil lubrication / petrochemicals Fuel oil fuel for ships / fuel for power stations Wax / grease candles / grease / polish Bitumen roofing / road surfacing		(1) (1) (1)

Question Number	Acceptable Answers	Reject	Mark
3 (a)(ii)	(thermal / catalytic) cracking provides high value / more useful products demand for short chain molecules / petrol / alkenes > supply need more short chain molecules / petrol / alkenes		(1) (1)

Question Number	Acceptable Answers	Reject	Mark
3 (a)(iii)	Minimum requirement $-\text{CH}_2-\text{CH}_2-$ <i>(accept any number of $-\text{CH}_2-$ units but must have bond at each end)</i>		(1)

Question Number	Acceptable Answers	Reject	Mark
3 (b)(i)	structural / displayed formula for isomer 1 structural / displayed formula for isomer 2 <i>(if 3 structures given all 3 must be different to score (2))</i> one correct name <i>(if 2 names given both must be correct)</i>		(1) (1) (1)
	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ pentane $\begin{array}{c} \text{CH}_3\text{CH}_2\text{CHCH}_3 \\ \\ \text{CH}_3 \end{array}$ (2-)methylbutane $\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3\text{CCH}_3 \\ \\ \text{CH}_3 \end{array}$ (2,2-)dimethylpropane		

Question Number	Acceptable Answers	Reject	Mark
3 (b)(ii)	structural / displayed formula <i>(must show double bond)</i>		(1)
	$\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$ $\text{CH}_3\text{CH}=\text{CHCH}_3$ $\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3\text{C}=\text{CH}_2 \\ \\ \text{CH}_3 \end{array}$ <i>(as bi for > 1 formula ignore names)</i>		

(Total 10 marks)

Question Number	Acceptable Answers	Reject	Mark
4 (a)	red-brown / brown solution OR black precipitate / solid		(1)
	(name) iodine		(1)
	(name) sodium chloride (any extra product >2 loses mark)		(1)
	$\text{Cl}_2 + 2\text{NaI} \rightarrow 2\text{NaCl} + \text{I}_2$		(1)

Question Number	Acceptable Answers	Reject	Mark
4 (b)	black solid/crystals OR black (or brown) fumes formed		(1)
	(name) iron(III) / ferric chloride (any extra product loses mark)		(1)
	$2\text{Fe} + 3\text{Cl}_2 \rightarrow 2\text{FeCl}_3$		(1)

Question Number	Acceptable Answers	Reject	Mark
4 (c)	cream / off-white / <u>pale</u> yellow precipitate	yellow	(1)
	(name) silver bromide (any extra product loses mark)		(1)
	$\text{AgNO}_3 + \text{NaBr} \rightarrow \text{AgBr} + \text{NaNO}_3$		(1)

(Total 10 marks)

Question Number	Acceptable Answers	Reject	Mark
5 (a)(i)	M1 $0.05 \times 4.2 \times 24$		(1)
	M2 5.04 kJ <i>(accept 5040 J)</i> <i>(M2 dependent on M1)</i>		(1)

Question Number	Acceptable Answers	Reject	Mark
5 (a)(ii)	M3 moles $\text{CuSO}_4 = (0.5 \times 0.05) = 0.025$		(1)
	M4 enthalpy change = $5.04/0.025$		(1)
	M5 = 201.6 or $202 \text{ kJ (mol}^{-1}\text{)}$		(1)
	<i>(M4 ecf M2 / M3)</i> <i>(M5 dependent on M4, (accept 201600 J(mol⁻¹))</i>		

Question Number	Acceptable Answers	Reject	Mark
5 (a)(iii)	M6 -202 (or -201.6) (negative sign essential) <i>(M6 must be negative answer to M5 in kJ)</i>		(1)

Question Number	Acceptable Answers	Reject	Mark
5 (b)(i)	$\text{Fe(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Fe}^{2+}(\text{aq}) + \text{Cu(s)}$		
	M7 formulae + balance		(1)
	M8 state symbols <i>(M8 dependent on M7)</i>		(1)

Question Number	Acceptable Answers	Reject	Mark
5 (b)(ii)	M9 <u>Fe</u> loses electrons therefore oxidised		(1)
	M10 <u>Cu²⁺</u> gains electrons therefore reduced		(1)
	or		
	M9 <u>Fe</u> loses electrons, <u>Cu²⁺</u> gains electrons		
M10 <u>Fe</u> oxidised, <u>Cu²⁺</u> reduced			
	<i>(must be answered in terms of <u>electron transfer</u>)</i>		

(Total 10 marks)

SECTION B

Question Number	Acceptable Answers	Reject	Mark
6 (a)(i)	M1 O ₂ and N ₂ have different b.pts. / boil off at different temperatures		(1)
	M2 fractional distillation		(1)
	M3 liquid air		(1)
	M4 N ₂ boils off before O ₂ / N ₂ has lower b.pt. <i>(M4 could score both M1 and M4)</i>		(1)

Question Number	Acceptable Answers	Reject	Mark
6 (a)(ii)	M1 spill <u>burns brighter</u> / <u>continues to burn</u> in O ₂		(1)
	M2 spill is <u>extinguished</u> in N ₂ <i>(do not accept answers in terms of a glowing splint / lighted splint rekindles in O₂ / no effect with N₂)</i>		(1)

Question Number	Acceptable Answers	Reject	Mark
6 (a)(iii)	Names of any two gases + uses Helium balloons, air/helium mixture for diving, inert atmosphere for welding neon advertising signs, lights etc argon inert atmosphere for welding extraction of metals preserving food krypton electric lamps, discharge tubes, lasers etc xenon arc lamps, lasers		(1x2)

Question Number	Acceptable Answers	Reject	Mark
6 (a)(iv)	M1 <i>(name)</i> carbon dioxide		(1)
	M2/M3 CH ₄ + 2O ₂ → CO ₂ + 2H ₂ O		
	M2 formulae (1)		(1)
	M3 balance (1) <i>(M3 dependent on M2)</i>		(1)

Question Number	Acceptable Answers	Reject	Mark
6 (b)(i)	M1 correct arrangement for triple bond		(1)
	M2 1 lone pair on each N atom (M2 dependent on M1)		(1)
	M3 triple bond strong / hard to break		(1)

Question Number	Acceptable Answers	Reject	Mark
6 (b)(ii)	M1 300 - 550°C		(1)
	M2 150 - 400 atm		(1)
	M3 (name) <u>iron</u> catalyst		(1)
	M4 low temperature because exothermic reaction		(1)
	M5 high pressure because less mol(e)s/volume on right		(1)
	M6 low temperature means slow rate		(1)
	M7 use higher / compromise temperature (to increase rate)		(1)
	M8 add catalyst to increase rate		(1)

Question Number	Acceptable Answers	Reject	Mark
6 (b)(iii)	M1 moles NH_4Cl = $0.535/53.5 \text{ mol} = 0.01 \text{ mol}$		(1)
	M2 moles NH_3 formed = 0.01		(1)
	M3 volume NH_3 = 0.01×24 or $24000 = 0.24 \text{ dm}^3 / 240 \text{ cm}^3$ (ecf from M1 to M2) (ecf from M2 to M3, M3 = answer M2 x 24) (accept any correct method for 3 marks)		(1)
	eg M1 53.5g NH_4Cl gives 24 dm^3 of NH_3		
	M2 0.533g gives $(0.533 \times 24) / 53.5$ (ecf from M _r) M3 = $0.24 \text{ dm}^3 / 240 \text{ cm}^3$ (ecf from M2)		

(Total 25 marks)

Question Number	Acceptable Answers	Reject	Mark
7 (a)(i)	M1 allotropy an <u>element</u> can exist in two (or more) forms in the <u>same physical state</u>	substance molecule compound atom	(1)
	M2 / M3 rhombic / α Monoclinic / β		(1) (1)

Question Number	Acceptable Answers	Reject	Mark
7 (a)(ii)	M1 A and B		(1)
	M2 addition of oxygen / increase in oxidation state of S		(1)

Question Number	Acceptable Answers	Reject	Mark
7 (a)(iii)	M1 $2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$ (<i>accept single arrow</i>)		(1)
	M2 300 to 500°C		(1)
	M3 1 to 3 atms		(1)
	M4 V_2O_5 / vanadium(V) oxide catalyst (<i>M4 penalise any other oxidation state of V for</i>)		(1)

Question Number	Acceptable Answers	Reject	Mark
7 (a)(iv)	M1 add SO_3 to conc/98% sulphuric acid		(1)
	M2 add / dilute with water		(1)
	M3 gets too hot / mist of acid droplets / exothermic reaction / dangerous with qualification		(1)

Question Number	Acceptable Answers	Reject	Mark
7 (b)(i)	<i>Incorrect reagent scores zero. Incomplete reagent eg dichromate lose M1 but allow M2</i>		
	M1 (acidified) potassium dichromate / (VI) / $K_2Cr_2O_7$ OR (acidified) potassium manganate / (VII) / $KMnO_4$ potassium permanganate		(1)
	M2 colour change (from orange) to green OR (purple) to colourless		(1)
	<i>(M1 penalise any other oxidation state of Mn or Cr but allow M2)</i>		

Question Number	Acceptable Answers	Reject	Mark
7 (b)(ii)	$2NaOH + SO_2 \rightarrow Na_2SO_3 + H_2O$		
	M1 formulae		(1)
	M2 balance <i>(M2 dependent on M1)</i>		(1)
	M3 <i>(name)</i> sodium sulphite / sulphate(IV)		(1)
	<i>(mark M3 independent of M1/M2, ignore other products in equation)</i>		

Question Number	Acceptable Answers	Reject	Mark
7 (c)(i)	M1 heat / 150 to 200°C / use hot conditions		(1)
	M2 $C_2H_5OH \rightarrow C_2H_4 + H_2O$		(1)
	M3 role of H_2SO_4 : dehydrating agent / removes water		(1)
(ii)	<i>(M2 allow CH_3CH_2OH and $CH_2=CH_2$ / CH_2CH_2)</i>	C_2H_6O	
	M4 warm / heat (60 to 100°C)		(1)
	M5 $CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$		(1)
	M6 role of H_2SO_4 : catalyst / to increase rate		(1)
	M7 structure <i>(M7 could be scored in the equation)</i>		(1)
	$\begin{array}{c} O \\ \\ CH_3 \cdot C - OCH_2CH_3 \end{array}$ allow C_2H_5		
	M8 ethyl ethanoate <i>(Mark M8/M7 independently)</i>		(1)

(Total 25 marks)

Question Number	Acceptable Answers	Reject	Mark
8 (a)(i)	M1 sodium has delocalised electrons (in solid and liquid)		(1)
	M2 electrons <u>move</u> (to carry the current)		(1)
	M3 NaCl has ions / is an ionic compound		(1)
	M4 ions fixed in solid / cannot move / only vibrate		(1)
	M5 ions can <u>move</u> in liquid state		(1)

Question Number	Acceptable Answers	Reject	Mark
8 (a)(ii)	M1 covalent compounds consist of molecules		(1)
	M2 <u>weak</u> attractive forces between molecules / intermolecular forces / Van der Waals forces		(1)
	M3 ionic compounds consist of positive and negative ions / oppositely charged ions		(1)
	M4 strong attraction between ions		(1)
	M5 hence covalent particles / molecules further apart than solid particles / ions in solid state		(1)

Question Number	Acceptable Answers	Reject	Mark
8 (a)(iii)	M1 gas is hydrogen / H ₂ (<i>accept H₂ in equation</i>)		(1)
	M2 HCl in water is acidic / forms hydrochloric acid / forms ions / is ionic		(1)
	M3 H ⁺ (aq) ions present in water (gives acidic properties)		(1)
	M4 HCl in methylbenzene consists of molecules / remains covalent		(1)

Question Number	Acceptable Answers	Reject	Mark
8 (a)(iv)	M1 powder reacts faster		(1)
	M2 powder has a larger surface area		(1)
	M3 so more (frequent) collisions (between acid and solid)		(1)
	<i>(M2/M3 dependent on M1)</i>		

Question Number	Acceptable Answers	Reject	Mark
	<i>Q8b(i) and (ii) require descriptions of experiments and a statement of the observation made.</i>		
8 (b)(i)	M1 t.t / flask with H ₂ O ₂ only M2 t.t / flask with H ₂ O ₂ and MnO ₂ / catalyst M3 gas evolved / effervescence with catalyst OR gas evolved with catalyst only <i>For M1/M2: apparatus must be mentioned M3: observation mark can be scored independently</i>		(1) (1) (1)

Question Number	Acceptable Answers	Reject	Mark
8 (b)(ii)	M1 <u>weigh</u> sample of catalyst M2 add to H ₂ O ₂ and allow reaction to go to completion M3 filter off catalyst M4 dry catalyst M5 reweigh to see if mass is the same		(1) (1) (1) (1) (1)

(Total 25 marks)

Question Number	Acceptable Answers	Reject	Mark
9 (a)(i)	M1 moles $\text{CuFeS}_2 = 367000 / 183.5 = 2000$ (<i>accept 2</i>)		(1)
	M2 moles Cu = 2000 (<i>accept 2</i>)		(1)
	M3 mass Cu = 63.5×2 or $2000 \text{ g} = 127 \text{ kg} / 127000 \text{ g}$		(1)
	(M2 <i>ecf from M1, M2 = M1 answer</i>)		
	(M3 <i>ecf from M2, answer $63.5 \times M2$, insist on units</i>)		
	OR		
M1	734 kg/g CuFeS_2 gives 254 kg/g Cu		
M2	367 kg/g CuFeS_2 gives $(367 \times 254 / 734) \text{ kg/g}$		
M3	= 127kg / 127000g		

Question Number	Acceptable Answers	Reject	Mark
9 (a)(ii)	SO_2 and water form acid rain / SO_2 is a source of acid rain <i>(ignore reference to global warming / ozone layer)</i>		(1)

Question Number	Acceptable Answers	Reject	Mark
9 (b)(i)	M1 electrolyte : <u>name</u> (aqueous) copper sulphate (solution)		(1)
	M2 pure copper cathode		(1)
	M3 impure copper anode		(1)
	M4 cathode; $\text{Cu}^{2+} + 2\text{e} \rightarrow \text{Cu}$		(1)
	M5 anode: $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}$		(1)
	M6 any <u>one</u> observation brown deposit on cathode / blue solution remains / cathode increase in size or mass anode decreases in size or mass		(1)

Question Number	Acceptable Answers	Reject	Mark
9 (b)(ii)	M1 reduction at cathode		(1)
	M2 (Cu^{2+}) gains electrons / oxidation state of Cu decreases (from +2 to 0) <i>(M1 must be in agreement with the answer in part b(i))</i>		(1)

Question Number	Acceptable Answers	Reject	Mark
9 (b)(iii)	M1 2 faradays give 63.5 g copper		(1)
	M2 200 f gives 6350 g		(1)

Question Number	Acceptable Answers	Reject	Mark
9 (c)	<p>Any 2 chemical characteristics 2x(1) with examples from <u>Cu</u> chemistry 2 x (1)</p> <p>variable valency / oxidation state e.g. Cu(I) and Cu(II) or formulae / name of compounds</p> <p>coloured salts/ions e.g. blue CuSO₄ / blue solutions of CuSO₄ or Cu(NO₃)₂ (ignore reference to CuO)</p> <p>forms complexes e.g. [Cu(NH₃)₄(H₂O)₂]²⁺ / tetraamminediaquacopper(II) (do not accept [Cu(NH₃)₄ 2H₂O]²⁺)</p> <p>catalyst e.g. dehydrogenation of alcohol (accept CuSO₄ in preparation of H₂ from Zn and acid)</p>		1+1 1+1

Question Number	Acceptable Answers	Reject	Mark
9 (d)(i)	M1 blue precipitate		(1)
	M2/M3 CuSO ₄ + 2NaOH → Cu(OH) ₂ + Na ₂ SO ₄ Or Cu ²⁺ + 2OH ⁻ → Cu(OH) ₂		
	M2 all formulae correct		(1)
	M3 balance (M3 dependent on M2)		(1)

Question Number	Acceptable Answers	Reject	Mark
9 (d)(ii)	M1 black solid/residue OR turns black		(1)
	M2 (red / yellow / orange) / brown gas (M1/M2 ignore other observations such as melting, steam evolved etc.) 2Cu(NO ₃) ₂ → 2CuO + 4NO ₂ + O ₂		(1)
	M3 all formulae correct		(1)
	M4 balance (M4 dependent on M3)		(1)

(Total 25 marks)

