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Mark Scheme (Results)
Summer 2008

GCE

GCE O Level Chemistry

7081/02

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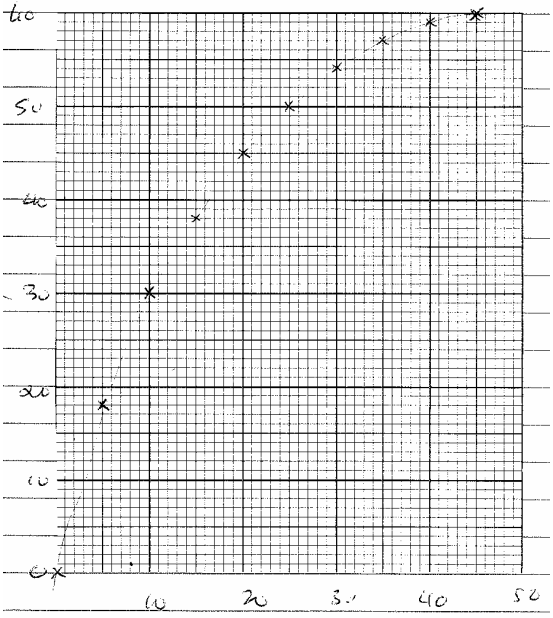
7081/02 O-Level Chemistry Mark Scheme – June 2008

Question Number	Acceptable Answers	Reject	Mark
1 (a)	 • all plots correct (2) • [9/10 plots correct (1)] • • line of best fit (1)		**(2)** **(1)**

Question Number	Acceptable Answers	Reject	Mark
1 (b)(i)	10 (s) (1)	Penalise incorrect units	**(1)**

Question Number	Acceptable Answers	Reject	Mark
1 (b)(ii)	(15 /60=) 0.25 / ¼ (1)		**(1)**

Question Number	Acceptable Answers	Reject	Mark
1 (c)	M1 moles H_2 = 60/24000 OR 2.50×10^{-3} (1) M2 mass of Mg = $2.5 \times 10^{-3} \times 24 = 0.06$ (1) M2 dependent on the use of 24000 cm^3 in M1	Answer only scores (0) (60/1000 = 0.06)	**(1)** **(1)**

Question Number	Acceptable Answers	Reject	Mark
1 (d)	M1 increases (1) M2 greater surface area (1) M3 more (effective) collisions per unit time/ more frequent collisions (1)	M1 incorrect, does not score M2/M3	**(1)** **(1)** **(1)**

(Total 10 marks)

Question Number	Acceptable Answers	Reject	Mark
2 (a)(i)	carboxylic acid group identified (1) (circle around COOH only)		**(1)**

Question Number	Acceptable Answers	Reject	Mark
2 (a)(ii)	ester group identified (1) (circle around OCO or $OCOCH_3$)		**(1)**

Question Number	Acceptable Answers	Reject	Mark
2 (b)(i)	$C_6H_9NO_5$ (1)		**(1)**

Question Number	Acceptable Answers	Reject	Mark
2 (b)(ii)	M1 mass of carbon = 6 x 12 = 72 (1) [ecf from C atoms in b(i)]		**(1)**
	M2 (72 x 100)/175 = 41.14 / allow 41.1 (1) [ecf from M1]	41	**(1)**

Question Number	Acceptable Answers	Reject	Mark
2 (c)(i)	bubbles / effervescence / fizz (1)	Carbon dioxide Gas Contradiction	**(1)**

Question Number	Acceptable Answers	Reject	Mark
2 (c)(ii)	$2H^+ + C0_3^{2-} \rightarrow H_2O + CO_2$ (2)		**(2)**
	or		
	allow (1) mark for $2H^+ + CO_3^{2-} \rightarrow H_2CO_3$		**(1)**
	or $H^+ + C0_3^{2-} \rightarrow H_2O + CO_2$		
	(1)		

Question Number	Acceptable Answers	Reject	Mark
2 (d)	M1 Sweeterex / molecules / particles diffuse / molecules / particles move (through the coffee) (1)		**(1)**
	M2 (Sweeterex) molecules / particles in collision (with other molecules) (1)		**(1)**

(Total 10 marks)

Question Number	Acceptable Answers	Reject	Mark
3 (a)	$CH_2 = CH\text{-}CH_3$ (1) Butene / but-1-ene (1) 70 (1)		**(1)** **(1)** **(1)**

Question Number	Acceptable Answers	Reject	Mark
3 (b)	boiling point increases as length of carbon chain increases (1)		**(1)**

Question Number	Acceptable Answers	Reject	Mark
3 (c)(i)	addition / hydration (1)		**(1)**

Question Number	Acceptable Answers		Reject	Mark
3 (c)(ii)	**H H** **| |** **H-C-C-O-H** **| |** **H H** (1)	Structure must show the bonds but allow OH	-C-H-O	**(1)**

Question Number	Acceptable Answers	Reject	Mark
3 (d)(i)	$CH_3CH_2OH + O_2 \rightarrow CH_3COOH + H_2O$ (1) Accept C_2H_5OH and CH_3CO_2H	C_2H_6O and $C_2H_4O_2$	**(1)**

Question Number	Acceptable Answers	Reject	Mark
3 (d)(ii)	oxidation / redox (1)	combustion	**(1)**

Question Number	Acceptable Answers	Reject	Mark
3 (e)(i)	sodium ethoxide (1)		**(1)**

Question Number	Acceptable Answers	Reject	Mark
3 (e)(ii)	chloroethane / ethyl chloride (1)		**(1)**

(Total 10 marks)

Question Number	Acceptable Answers	Reject	Mark
4 (a)	17 and 18 (1) 17 and 20 (1)		**(1)** **(1)**

Question Number	Acceptable Answers	Reject	Mark
4 (b)	^{35}Cl to ^{37}Cl 3 to 1 / 75% to 25%(1) If ^{35}Cl and ^{37}Cl not stated, the first number refers to ^{35}Cl		**(1)**

Question Number	Acceptable Answers	Reject	Mark
4 (c)(i)	$Fe + 2HCl \rightarrow FeCl_2 + H_2$ Correct formulae (1) Balnced equation (1)		**(2)** **or** **(1)** **(1)**

Question Number	Acceptable Answers	Reject	Mark
4 (c)(ii)	$2Fe + 3Cl_2 \rightarrow 2FeCl_3$ (2) Correct formulae (1) Balanced equation (1)		**(2)** **or** **(1)** **(1)**

Question Number	Acceptable Answers	Reject	Mark
4 (d)	M1 Add (aqueous) sodium hydroxide / NaOH / (aqueous) ammonia / NH_3. (1) Allow M2/M3 for partially correct reagent eg OH^- ion /hydroxide / alkali M2 Fe^{2+} gives green precipitate (1) M3 Fe^{3+} gives brown /red brown /orange precipitate (1) There are other possible reagents, eg acidified $KMnO_4$	Incorrect or no reagent scores (0)	**(1)** **(1)** **(1)**

(Total 10 marks)

Question Number	Acceptable Answers	Reject	Mark
5 (a)	M1 hexagonal structure (minimum of 2 fused hexagons) (1) M2 layers (minimum of 2 layers) (1) M2 dependent on at least one hexagon in M1		**(1)** **(1)**

Question Number	Acceptable Answers	Reject	Mark
5 (b)	M1 contain delocalised electrons / electron cloud (between layers) (1) M2 (delocalised) electrons move (to carry current) (1)		**(1)** **(1)**

Question Number	Acceptable Answers	Reject	Mark
5 (c)(i)	exothermic <u>because</u>: energy of products lower than reactants / energy released (in forming bonds) is greater than energy required (to break bonds) (1)	Heat given out	**(1)**

Question Number	Acceptable Answers	Reject	Mark
5 (c)(ii)	M1 incomplete combustion (-) 110 kJ mol^{-1} (1) M2 complete combustion (-) 391 to (-)399 kJ mol^{-1} (1) M3 both M1 / M2 shown as negative values (1)		**(1)** **(1)** **(1)**

Question Number	Acceptable Answers	Reject	Mark
5 (d)	M1 gives out less heat (1) M2 poisonous gas CO formed CO attacks haemoglobin / red blood cells forms carboxyhaemoglobin / CO causes asphyxia (1)	Acid rain Attacks ozone Harmful / pollutant gas without qualification	**(1)** **(1)**

(Total 10 marks)

Question Number	Acceptable Answers	Reject	Mark
6 (a)	M1 chemical reaction / decomposition brought about by passage of electricity (1) M2 raw material identified as bauxite (1) M3 electrolyte is purified bauxite / alumina / aluminium oxide / Al_2O_3 (1) M4 (dissolved in) molten (1) M5 cryolite (1) M6 graphite / carbon electrodes / cathode (1) M7 aluminium formed at cathode (1) M8 $Al^{3+} + 3e^- \rightarrow Al$ (1) M9 aluminium collects at bottom of cell / aluminium siphoned off (1)		**(9)**

Question Number	Acceptable Answers	Reject	Mark
6 (b)	M1 separation of liquids on basis of boiling point difference (1) M2 raw material identified as crude oil / petroleum (1) M3 heat (in a furnace) (1) M4 to vaporise / crude oil becomes vapour (1) M5 (vapours) pass into fractionating column (1) M6 temperature gradually falls rising up the tower (1) M7 (petrol) fraction condenses / becomes liquid (1) M8 petrol collected near the top of tower (1) Points could be scored on a labelled diagram	Heat in column	**(8)**

Question Number	Acceptable Answers	Reject	Mark
6 (c)	M1 when the rate of reaction is increased by the addition of a catalyst (1) M2 the catalyst remains unchanged at the end of the reaction / the catalyst provides an alternative route of lower energy of activation (1) M3 starting materials sulphur dioxide (1) M4 and air (1) M5 catalyst identified as vanadium(V) oxide / V_2O_5 (1) M6 temperature 300 — 550 °C (1) M7 pressure 1 — 3 atm (1) M8 $2SO_2 + O_2 \rightarrow 2SO_3$ (1)	Any other ox state of V	**(8)**

(Total 25 marks)

Question Number	Acceptable Answers	Reject	Mark
7 (a)	M1 heat the (blue) copper(II) sulphate (in a test tube) (1) M2 colour change to white (1) M3 colourless liquid condenses near top of tube water collected in cooled receiver (1) M4 turns blue / anhydrous cobalt chloride paper pink (1) M5 $CuSO_4.5H_2O \rightarrow CuSO_4 + 5H_2O$ (1) Allow boils at 100^o for M4 M3 could be scored for holding $CoCl_2$ paper in vapours	Addition of water to white $CuSO_4$	**(5)**

Question Number	Acceptable Answers	Reject	Mark
7 (b)	M1 add iron to specified copper(II) salt <u>solution</u> (1) M2 pink-brown / red brown solid formed / deposit (1) M3 $Zn + Cu^{2+} \rightarrow Cu + Zn^{2+}$ / or molecular (1) M4 add iron to specified zinc salt <u>solution</u> (1) M5 no reaction (so iron does not displace zinc ions) (1) Allow for M4/M5 add Zn to $FeSO_4$(aq), grey black solid Allow Zn and Cu in $FeSO_4$(aq) for all marks Alternative answers: M1 add the 3 metals to dilute hydrochloric/ sulphuric acid (1) M2 copper has no reaction (1) M3 zinc and iron: effervescence /bubbles / fizz (1) M4 zinc gives faster effervescence / more vigorous M5 Zn (or Fe) + 2HCl → $ZnCl_2$ (or $FeCl_2$) + H_2 (1)	Metal / oxide reactions	**(5)**

Question Number	Acceptable Answers	Reject	Mark
7 (c)	M1 cotton wool pads soaked in (concentrated) hydrochloric acid and in (concentrated) ammonia (solution) (1) M2 place pads at opposite ends of a (long) tube (1) M3 white ring / deposit / fumes / smoke (of ammonium chloride) (1) M4 nearer to hydrogen chloride end of tube (1) M5 $NH_3 + HCl \rightarrow NH_4Cl$ (1) Labelled diagram could score M1 to M4 If gas jars of NH_3 and HCl mixed together, allow M5 only	If gases are used	**(5)**

Question Number	Acceptable Answers	Reject	Mark
7 (d)	M1 two test tubes / flasks containing equal volumes of hydrochloric acid of same concentration (1) M2 heat one test tube / flask (1) M3 add equal masses equal surface area / same amount of zinc to test tubes / flask (1) M4 reaction in warm acid more vigorous / more effervescence (1) M5 $Zn + 2HCl \rightarrow ZnCl_2 + H_2$ / or ionic (1)		**(5)**

7 (e)	M1 Grind / crush leaf in solvent / alcohol / propanone / acetone (1) M2 spot onto chromatography / filter paper (1) M3 stand paper in solvent / alcohol / propanone / acetone (to elute) (1) M4 spot just above solvent (1) M5 series of spots obtained / colours separate (1) Labelled diagram could score M2 to M5.	water water	**(5)**

(Total 25 marks)

Question Number	Acceptable Answers	Reject	Mark
8 (a)	M1 coloured compounds / ions (1) M2 copper (II) compounds / ions are blue /green (1) (ignore any reference to the colour of Cu(I)) M3 variable oxidation states (1) M4 Cu^{+} and Cu^{2+} / Cu(I) and Cu(II) (1) M5 form complex ions (1) M6 diaquatetraamminecopper(II) (ion) / $Cu[(NH_3)_4(H_2O)_2]^{2+}$ (1) (allow use as catalysts; Cu for dehydrogenation of alcohols)	oxides CuO black	**(6)**

Question Number	Acceptable Answers	Reject	Mark
8 (b)	M1 heat copper (1) M2 in air / oxygen / O_2 (1) M3 $2Cu + O_2 \rightarrow 2CuO$ (1) M4 add excess copper(II) oxide (1) M5 to (dilute) sulphuric acid / H_2SO_4 (1) M6 heat / warm (1) M7 $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$ (1) M8 filter off (excess) copper(II) oxide (1) M9 heat filtrate to remove some water / to crystallise (1) M10 allow (remaining solution) to cool (1) M11 filter off crystals / decant (1) M12 leave to dry / dry with tissue (1) Alternative M1 add concentrated nitric acid / dilute nitric acid (1) M2 heat copper (II) nitrate (1) M3 $Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$ $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$ $2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$ (1)	conc H_2SO_4 but mark on If precipitate of $CuSO_4$ no further marks heat to dryness no further marks	**(12)**

(Total 25 marks)

Question Number	Acceptable Answers	Reject	Mark
8 (c)(i)	M1 carbon dioxide (1) M2 $CuCO_3 \rightarrow CuO + CO_2$ (1)		**(2)**

Question Number	Acceptable Answers	Reject	Mark
8 (c)(ii)	M1 water (1) M2 $Cu(OH)_2 \rightarrow CuO + H_2O$ (1)		**(2)**

Question Number	Acceptable Answers	Reject	Mark
8 (c)(iii)	M1 nitrogen dioxide / nitrogen (IV) oxide AND oxygen (1) $2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$ (1) M2 all formulae correct (1) M3 balanced equation (1)		**(3)**

Question Number	Acceptable Answers	Reject	Mark
9 (a)	M1 $H_2N-(CH_2)_6-NH_2$ (1) M2 $HOOC-(CH_2)_4-COOH$ (1) $-HN-(CH_2)_6-N-C-(CH_2)_4-CO-$ | ‖ H O M3 minimum of $- CH_2 -N-C- CH_2 -$ (1) | ‖ H O M4 overall correct repeating unit (10 Allow ecf on incorrect values of x and y in M1 and M2. Allow the use of x and y in polymer structure	 OH-OC-	 **(4)**

Question Number	Acceptable Answers	Reject	Mark
9 (b)	M1 polyester (1) M2 HOOC-( )-COOH / allow $-(C_6H_4)-$ (1) M3 HO-( )-OH / allow $-(CH_2.CH_2)-$ (1)	 OH-OC-(OH-( )-OH	 **(3)**

Question Number	Acceptable Answers		Reject	Mark
9 (c)(i)	addition M1 unsaturated monomer (1) M3 no other product / no mass loss (1)	condensation M2 monomer(s) must have two different functional groups (1) M4 small molecule lost / loss of mass (1)		**(4)**
	Must be comparative properties to score >2 marks.			

Question Number	Acceptable Answers	Reject	Mark
9 (c)(ii)	M1 cracking (1) M2 use high temperature / specified temperature 450-900^{o} or catalyst / zeolite / aluminosilicate / Al_2O_3 / SiO_2 (1) M3 long-chain alkane (1) M4 changed into (short-chain) alkane plus alkene / ethene (1) M5 e.g. $C_8H_{18} \rightarrow C_6H_{14} + C_2H_4$ (1) any alkane to ethene + other alkane	heat other specified catalyst	**(5)**

Question Number	Acceptable Answers	Reject	Mark
9 (d)(i)	$-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-$ (1) must have bonds at each end and must contain 6 C atoms		**(1)**

Question Number	Acceptable Answers	Reject	Mark
9 (d)(ii)	poly(ethyne) contains carbon-carbon double bonds / unsaturated whereas poly(ethene) does not contain double bonds/ contains carbon-carbon single bonds / is saturated (1) must contain a statement for both polymers.		**(1)**

Question Number	Acceptable Answers	Reject	Mark
9 (d)(iii)	M1 poly(ethene) CH_2 ONLY (1) M2 poly(ethyne) CH ONLY (1)	Any extra formula is a contradiction.	**(1)** **(1)**

Question Number	Acceptable Answers			Reject	Mark
9 (d)(iv)	Reagent (1)	Bromine water or Br_2/H_2O	Acidified / alkaline $KMnO_4$ /potassium manganate (VII) / permanganate	$K_2Cr_2O_7$	**(1)**
	Obs with poly(ethene) (1)	no reaction	No reaction		**(1)**
	Obs with poly(ethyne) (1)	Goes colourless	Goes colourless / green (if alkaline)		**(1)**

Question Number	Acceptable Answers	Reject	Mark
9 (d)(v)	M1 combustion (1)		**(1)**
	M2 carbon monoxide / carbon dioxide and water / CO / CO_2 and H_2O (1)		**(1)**

(Total 25 marks)