SCOTTISH QUALIFICATIONS AUTHORITY

2003 Chemistry

Higher

Finalised Marking Instructions

Higher Chemistry

General information for markers

The general comments given below should be considered during all marking.

1 Marks should **not** be deducted for incorrect spelling or loose language as long as the meaning of the word(s) is conveyed.

Example: Answers like 'distiling' (for 'distillation') and 'it gets hotter' (for 'the temperature rises') should be accepted.

2 A right answer followed by a wrong answer should be treated as a cancelling error and no marks should be given.

Example: What is the colour of universal indicator in acid solution?

The answer 'red, blue' gains no marks.

3 If a right answer is followed by additional information which does not conflict, the additional information should be ignored, whether correct or not.

Example: Why can the tube not be made of copper?

If the correct answer is related to a low melting point, 'It has a low melting point and is coloured grey' would **not** be treated as having a cancelling error.

4 Full marks are usually awarded for the correct answer to a calculation on its own; the part marks shown in the marking scheme are for use when working is given. An exception is when candidates are asked to 'Find, by calculation, …..'.

5 A half mark should be deducted in a calculation for each arithmetic slip.

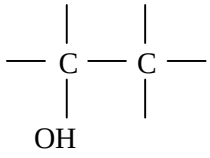
6 A half mark should be deducted for incorrect or missing units **only when stated in the marking scheme**. No marks should be deducted for incorrect or missing units at intermediate stages in a calculation.

7 Where a wrong numerical answer (already penalised) is carried forward to another step, no further penalty is incurred provided the result is used correctly.

8 Ignore the omission of one H atom from a full structural formula provided the bond is shown.

9 With structures involving an –OH or an $–NH_2$ group, a half mark should be deducted if the 'O' or 'N' are not bonded to a carbon, i.e. $OH–CH_2$ and $NH_2–CH_2$.

10 When drawing structural formulae, a half mark should be deducted if the bond points to the 'wrong' atom, eg



11 A symbol or correct formula should be accepted in place of a name **unless stated otherwise in the marking scheme**.

12 When formulae of ionic compounds are given as answers it will only be necessary to show ion charges if these has been specifically asked for. However, if ion charges are shown, they must be correct. If incorrect charges are shown, no marks should be awarded.

13 If an answer comes directly from the text of the question, no marks should be given.

Example: A student found that 0·05 mol of propane, C_3H_8 burned to give 82·4 kJ of energy.

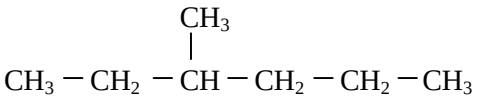
$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$$

Name the kind of enthalpy change which the student measured.

No marks should be given for 'burning' since the word 'burned' appears in the text.

14 A guiding principle in marking is to give credit for (partially) correct chemistry rather than to look for reasons not to give marks.

Example 1: The structure of a hydrocarbon found in petrol is shown below.



Name the hydrocarbon.

Although the punctuation is not correct, '3, methyl-hexane' should gain the full mark.

Example 2: A student measured the pH of four carboxylic acids to find out how their strength is related to the number of chlorine atoms in the molecule. The results are shown.

Structural formula	**pH**
CH_3COOH	1·65
$CH_2ClCOOH$	1·27
$CHCl_2COOH$	0·90
CCl_3COOH	0·51

How is the strength of the acids related to the number of chlorine atoms in the molecule?

Although not completely correct, an answer such as 'the more Cl_2, the stronger the acid' should gain the full mark.

15 Unless the question is clearly about a non-chemistry issue, eg costs in industrial chemistry, a non-chemical answer gains no marks.

Example: Why does the (catalytic) converter have a honeycomb structure?

A response such as 'to make it work' may be correct but it is not a chemical answer and the mark should not be given.

16 When it is very difficult to make a decision about a partially correct answer, a half mark can be awarded.

17 When marks have been totalled, a half mark should be rounded up.

2003 Chemistry Higher

Marking Scheme

Section A

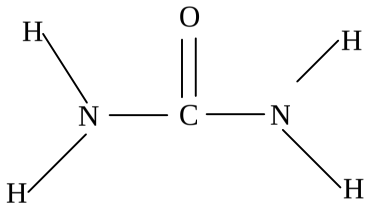
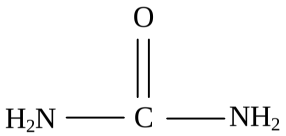
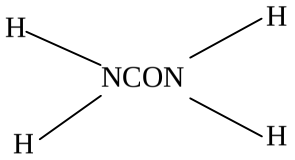
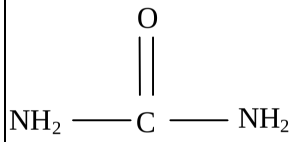
1.	C	11.	D	21.	A	31.	D
2.	D	12.	A	22.	C	32.	B
3.	B	13.	B	23.	D	33.	A
4.	C	14.	D	24.	D	34.	D
5.	D	15.	C	25.	A	35.	B
6.	B	16.	C	26.	D	36.	D
7.	C	17.	A	27.	C	37.	C
8.	B	18.	C	28.	A	38.	C
9.	C	19.	A	29.	B	39.	A
10.	D	20.	B	30.	A	40.	B

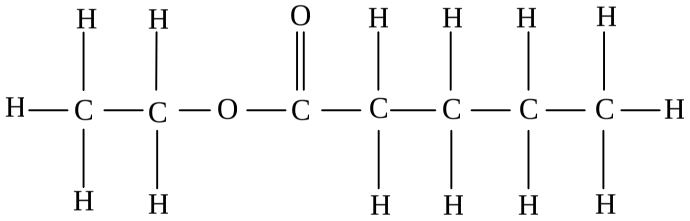
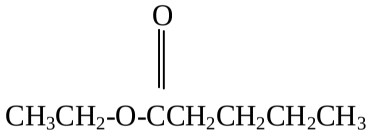
Mark Scheme				Worth ½	Worth 0
1.	**(a)**	2,3,3–trimethylpentane **or** 3,3,2–trimethlypentane (commas, dash may be omitted)	**1**	2-methyl, 3-dimethylpentane **or** 3,3,4–trimethylpentane **or** 2,3,3–methylpentane	2,3–methylpentane **or** methylpentane
	(b)	cycloalkanes **or** aromatics (benzenes) **or** benzyl hydrocarbons	**1** **(2)**	ring structure **or** cyclic	naphtha **or** phenol

Mark Scheme				Worth ½	Worth 0
2.	**(a)**	Strong **or** rigid **or** durable **or** tough **or** hard **or** hard to puncture	**1**		light **or** does not burn
	(b)	amide link **or** peptide link	**1**	polyamide **or** polypeptide	amino group **or** amine group
			(2)		

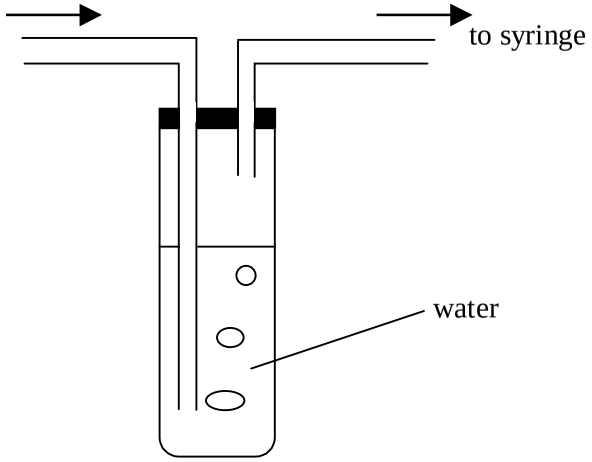
Mark Scheme				Worth ½	Worth 0
3.	**(a)**	plotting points correctly and joining with a line	**1**	points not joined **or** one point not plotted correctly **or** points joined by straight line	
	(b)	$^{210}Po \longrightarrow {}^{206}Pb + He$ (or α) **or**		numbers on rhs	any wrong subscript or superscript
		$^{210}Po \xrightarrow{\alpha} {}^{206}Pb$	**1**		
	(c)	210 g contain 6×10^{23} (atoms)	**(½)**		6×10^{23} in 1 mol
		105 g contain ½ x 6×10^{23} (atoms)			
		$= 3 \times 10^{23}$	**(½)**		
			(3)		

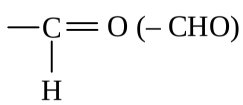
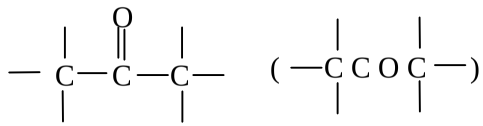
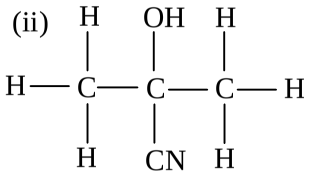
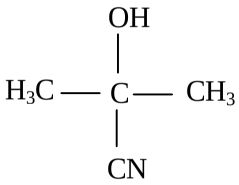
Mark Scheme				Worth ½	Worth 0
4.	**(a)**	any suggestion that iron formed is molten or in liquid state **or** answer implies that iron flows down into crack	**1**		iron is formed (in question) **or** exothermic **or** rail melts, etc
	(b)	ΔH required = $\Delta H_1 - \Delta H_2$ = (-1676) – (-825) = - 851 kJ (mol^{-1})	**(½)** **(½)** **(2)**		

Mark Scheme				Worth ½	Worth 0
5.	**(a)**	synthesis gas **or** syn. gas	**1**		synthetic gas
	(b)	oxidation **or** dehydrogenation	**1**		
	(c)	(i) 	**1**	 	
		(ii) thermosetting	**1**		thermohardening
			(4)		

Mark Scheme			Worth ½	Worth 0
6.	**(a)**	(i) reactants or products could go on fire (flammable) **or** to prevent burning **1**		
		(ii) to condense any vapours (or reactants or products which evaporate) **1**	easier to control the temperature/condensation **or** safer way to heat	
	(b)			
		or  **1**		

Mark Scheme	Worth ½	Worth 0
6. (c) 1 mol C_2H_5OH = 46 g **(½)** 46 g ⟶ $\frac{70}{100}$ x 130 g **(½)** 3.6 g ⟶ $\frac{70}{100}$ x 130 x $\frac{3.6\ g}{46}$ **(½)** = 7.12 g **(½)** **or** 1 mol C_2H_5OH = 46 g **(½)** 46 g ⟶ 130 g 3.6 g ⟶ 130 x $\frac{3.6}{46}$ = 10.174 g **(½)** actual yield = 10.174 x $\frac{70}{100}$ **(½)** = 7.12 g **(½)** (-½ for wrong or no units) **(5)**		

Mark Scheme			Worth ½	Worth 0
7.	**(a)**	moles of Mg $= \frac{4.0}{24.3} = 0.165$ mol (½) moles of acid $= \frac{4 \times 50}{1000} = 0.2$ moles (½) mole ratio = 1 mol Mg : 2 mol acid Not enough HCl(aq). Therefore Mg in excess (1)	**2**	
	(b)		**1**	System not sealed
	(c)	rate – slower (½) volume – same (½)	**1**	
			(4)	

Mark Scheme			Worth ½	Worth 0
8.	**(a)**	(i) carbonyl group at end of carbon chain in aldehyde **or** only one H attached to carbonyl **or** aldehyde  **or** ketone  **1**		
		(ii) blue (½) ⟶ orange/brick red/brown (½) **1**		
		(iii) $C_3H_6O + H_2O \longrightarrow 2H^+(aq) + C_2H_5COOH + 2e^-$ **1**	$H^+(aq)$ and e^- on rhs but not balanced	
		(iv) propanoic (acid) **1**		
	(b)	(i) addition **or** reduction **1**		
		(ii)  **or**  **1**		
		(6)		

Mark Scheme				Worth ½	Worth 0
9.	**(a)**	total volume not kept constant (changes, increases) **or** changes concentration of all reactants – not just potassium iodide **or** more than one variable changed	**1**		
	(b)	use more accurate measuring cylinders (or syringes) for smaller volumes in step 1 **or** start timer while adding hydrogen peroxide (when half of the peroxide has been added) **or** put white tile/paper below beaker **or** repeat experiment (any two)	**1** **(2)**		

Mark Scheme				Worth ½	Worth 0
10.	**(a)**	rate of forward reaction equals rate of backward reaction **or** concentrations of reactant(s) and product(s) are constant	**1**		rates are constant
	(b)	iodine will go from chloroform layer (bottom layer) into the KI layer (top layer) to restore equilibrium **or** equilibrium moves to left (rate of backward reaction increases)	**1**		
	(c)	0.3 g of iodine is dissolved in chloroform (½) therefore, concentration = $\frac{0.3}{0.01}$ = 30 g l^{-1} (½) (units not necessary)	**1** **(3)**		

Mark Scheme				Worth ½	Worth 0
11.	**(a)**	line should go up to + 75 (½) line should then go down to – 26 (½)	**1**		
	(b)	(i) heterogeneous	**1**		
		(ii) same starting level lower peak (½) same finishing level (½)	**1**		
	(c)	(i) $\frac{36 - 24}{10} = 1.2\ cm^3\ s^{-1}$ (-½ for wrong or no units)	**1**		

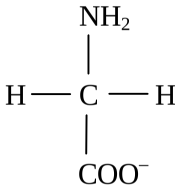
Mark Scheme					Worth ½	Worth 0
11	**(c)**	(ii)	1 mol O_2 from 2 mol of H_2O_2 (½) 1 mol H_2O_2 = 34 g (½) 24 litres O_2 from 2 x 34 g of H_2O_2 (½) 0.04 litres from $\frac{68 \times 0.04}{24}$ = 0.113 g (½) (- ½ for wrong or no units)	**2** **(6)**		

Mark Scheme				Worth ½	Worth 0
12.	**(a)**	propane molecules are held together by <u>weak forces</u> **or** ethanol molecules are held together by <u>strong forces</u>	(1)		
		the intermolecular forces in propane are <u>van der Waals' forces</u>	**(½)**		
		the intermolecular forces in ethanol are <u>hydrogen bonds</u>	**(½)**		
		van der Waals' forces are due to momentary displacement of electrons between atoms	(½) (½)		
		hydrogen bonding arises because the O-H bond is highly polarised (there is a large difference in the electronegativities of O and H)	**(½)**		
		the small positive charge on H and small negative charge on O strongly attract	**(½)**		
			(4)		

Mark Scheme				Worth ½	Worth 0
13.	**(a)**	$[H^+(aq)] = 1 \times 10^{-8}$ mol l^{-1}	**1**		
		(units not necessary)			
	(b)	this must be the salt of a strong alkali (or base) and a weak acid **or** alkali stronger than acid	**1**		
	(c)	HCN **or** CNH	**1**		
			(3)		

Mark Scheme				Worth ½	Worth 0
14.	**(a)**	Seawater (sodium chloride), carbon dioxide, ammonia (- ½ for any omission) **or** correct formulae	**1**		
	(b)	$CaCO_3 \longrightarrow CaO + CO_2$ ΔH = +ve (½)		use of exothermic/ endothermic	
		$C + O_2 \longrightarrow CO_2$ ΔH = -ve (½)	**1**		
	(c)	$Ca(OH)_2 + 2NH_4Cl \longrightarrow CaCl_2 + 2H_2O + 2NH_3$	**1**		

Mark Scheme				Worth ½	Worth 0
14.	**(d)**	magnesium carbonate is insoluble **or** magnesium carbonate forms a precipitate	**1**		
	(e)	CO_2 **or** NH_3 **or** NH_4Cl recycled (reused) **or** coke added to limestone to provide energy by reacting with O_2 from air (or by burning) **or** calcium chloride produced as by-product **or** (some) reactants found naturally (easily obtained, cheap) **or** continuous process (any two, 1 mark each)	**2**	recycling occurs **or** no waste products **or** non-polluting **or** by-products are useful	
			(6)		

Mark Scheme				Worth ½	Worth 0
15.	**(a)**	hydrolysis (hydrolysing)	**1**		digestion **or** denaturing
	(b)	(i) 	**1**		
		(ii) ACB on rhs (ignore distances; order must be correct) ABC, BAC, CAB on rhs **or** CBA on lhs (worth 1 mark)	**2**	BCA **or** CBA on rhs	
			(4)		

Mark Scheme			Worth ½	Worth 0
16.	**(a)**	$Q = It = 0.5 \times 14 \times 60$ (½) = 420 C (½) $2H^+ + 2e^- \longrightarrow H_2$ n = 2 **(½)** 2 x 96 500 C ⟶ 1 mol H_2 (½) 420 C ⟶ 0.052 litres 2 x 96 500 C ⟶ $\frac{2 \times 96\,500}{420}$ x 0.052 (½) = <u>23.895 litres</u> (½) (– ½ for wrong or no units) **3**		
	(b)	add variable resistor (to keep current constant) **or** use platinum electrodes **1** **(4)**	add a device to keep constant current	

[END OF MARKING INSTRUCTIONS]