SCOTTISH QUALIFICATIONS AUTHORITY

2005 Chemistry

Higher

Finalised Marking Instructions

These Marking Instructions have been prepared by Examination Teams for use by SQA Appointed Markers when marking External Course Assessments.

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.

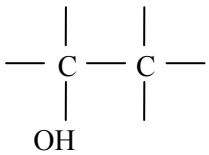
6 A half mark should be deducted for incorrect or missing units **only when stated in the marking scheme**. No marks should be deducted for incorrect or missing units at intermediate stages in a calculation.

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.

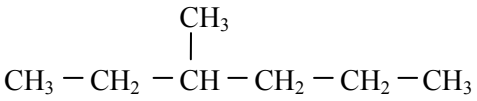
$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$$

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.

2005 Chemistry Higher

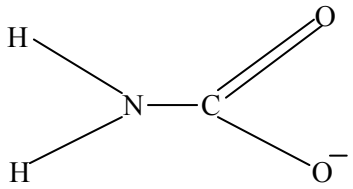
Marking Scheme

Section A

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

		Mark Scheme		Worth ½	Worth 0
1	**(a)**	glycerol (or glycerine) or propan(e) – 1, 2, 3 – triol (or propan(e) triol) (or 1, 2, 3 – propan(e) triol)	**1**	a triol or trialcohol or trihydric alcohol or trialcohol	glyceride or an alcohol
	(b)	oils (or they) are unsaturated (or less saturated) or contain a (carbon to carbon) double bond or have kinks (bends) or have molecules that don't pack as well together (or loosely packed) or have weaker (or fewer) van der Waals' forces (or intermolecules bonds or bonds between molecules) or fats are (more) saturated, etc.	**1**		
2	**(a)**	catalyst or enzyme	**1**		naming a catalyst or temperature
	(b)	activated (or active or activation) complex or transition(al) state	**1**	correct diagram with labels/ explanation	or activation energy

Mark Scheme					Worth ½	Worth 0
3	**(a)**	**(i)**	primary	**1**	alkan-1-ol or 1-ols	
		(ii)	orange (½) ⟶ green or blue (½)	**1**		
	(b)	**(i)**	water bath or heating mantle or reflux	**1**		
		(ii)	46 g ↔ 88 g	½		
			5 g ↔ 9.6 g	½		
			% yield = $\frac{5.8}{9.6}$ x 100	½		$\frac{5}{5.8}$ x 100 = 86.2
			= 60.4 % (accept 60% or 61%)	½		
			or			
			moles of ethanol = 0.11	½		
			mass of ethanoic acid = 0.11 x 88 = 9.68	½		
			% yield = $\frac{5.8}{9.68}$ x 100	½		
			= 59.8% (60%)	½		
			(do not penalise incorrect rounding)			

Mark Scheme					Worth ½	Worth 0
4	**(a)**	**(i)**	moves to left or goes to reverse (or backwards) or favours reactants	**1**		reverse reaction speeds up
		(ii)	more moles of gas on right or less (moles of) gas on left or moves in the gas direction or a gas on the r.h.s	**1**	suitable explanation without mention of gas, eg pressure or volume alone or water is a gas	more moles on right
	(b)		 or $NH_2\ COO^-$ (or H_2NCOO^- or $NH_2\ CO^-_2$) (accept with no charge shown or charge in incorrect position)	**1**		

		Mark Scheme		Worth ½	Worth 0
5	**(a)**	$\frac{90 - 65}{20 - 10}$	½	$\frac{90 - 65}{20} = 1.25$	
		$= 2.5\ cm^3\ s^{-1}$	½		
		(no units required; deduct ½ for incorrect units)			
	(b)	B reaches same height	½		
		B slope steeper than A	½		
		C reaches half the height of slope A	½		
		(accept within $\pm$ 7.5 cm^3)			
		C slope less steep than A	½		
	(c)	reaction vessel for gas preparation	**1**		
		gas syringe or measuring cylinder (or graduated test-tube) for displacement of water	**1**	non graduated collection vessels, eg unmarked test-tube	
		(labels not necessary if diagram is clear)			

Mark Scheme					Worth ½	Worth 0
6	**(a)**	**(i)**	displacement	**1**		
		(ii)	$U^{4+} + 4e^- \rightarrow U$ (state symbols not required)	**1**	correct ion-electron equation but wrong positive charge on the uranium, eg $U^{2+} + 2e^- \rightarrow U$	
		(iii)	prevents formation of magnesium oxide/uranium oxide or prevents oxidation (or reaction) of magnesium/uranium or argon unreactive (or stable)	**1**	argon is a noble gas or argon is in group 0 or argon is in group 8	argon is less reactive
	(b)	**(i)**	(polar) covalent	**1**	covalent network	van der Waals' or polar
		(ii)	same	**1**		

			Mark Scheme		Worth ½	Worth 0
7	**(a)**		to minimise heat loss or polystyrene is a poor conductor	**1**		no evaporation of water or to prevent room temperature affecting the experiment
	(b)		gram formula mass KOH = 56.1 g (accept 56g)	½		
			3.6 g KOH ↔ 3.5 kJ ½	½		
			56.1 g KOH ↔ $\frac{56.1}{3.6}$ x (3.5)	½		
			= -54.5 kJ mol^{-1}	½		
			(deduct ½ mark if sign missing in final answer; deduct ½ mark if wrong unit or no unit; no penalty for kJ instead of kJ mol^{-1})			
8	**(a)**		$CuO + 2HNO_3 \longrightarrow Cu(NO_3)_2 + H_2O$	**1**	correct formulae but unbalanced or incorrectly balanced equation	
			(state symbols not required)			
	(b)	**(i)**	acid – H_2S base – H_2O **½ each** (H_3S^+ and OH^- worth 1 or 0)	**1**		
		(ii)	acid	**1**		

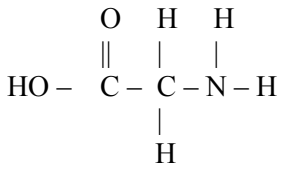
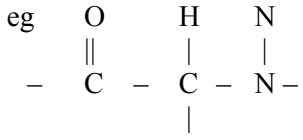
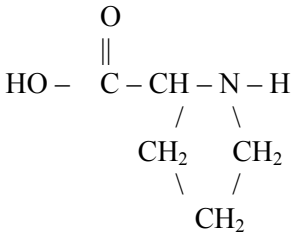
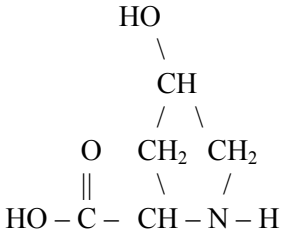
Mark Scheme				Worth ½	Worth 0
9	**(a)**		hydrogen bonding **1**		
	(b)		$H_2(g) + ½ O_2(g) \longrightarrow H_2O(l)$ $\Delta H = -286$ **1**		
			$H_2O(l) + ½ O_2(g) \longrightarrow H_2O_2(l)$ $\Delta H = 98$ **½**		
			Enthalpy change = -286 + 98 = -188 **½**		
			(no units required; deduct **½** for incorrect units; no penalty for kJ instead of kJ mol^{-1})		
	(c)	**(i)**	(total) volume (of reactant mixture) or volume of KI solution **1**		volume of water
		(ii)	measure the effect of concentration (or effect of dilution) (on reaction rate) **1**		the effect of volume of KI
		(iii)	rate = 0.02		
			$t = \frac{1}{0.02}$ **½**		
			= 50 s **½**		
			(no units required; deduct **½** for incorrect units)		

			Mark Scheme		Worth ½	Worth 0
10	**(a)**		soluble in water	**1**	soluble	biodegradable
	(b)	**(i)**	addition(al)	**1**		
		(ii)	methanol or methaneol	**1**		
11	**(a)**		2807 kJ ↔ 6 (½) x 24 litres (½)	**1**		
			418 kJ ↔ 6 x 24 x $\frac{418}{2807}$	**½**		
			= 21.44 litres	**½**		
			(no units required, deduct **½** for incorrect units)			
	(b)	**(i)**	need implication that the water that reacts comes from respiration	**1**		oxygen is produced (from water)
		(ii)	it is neutralised by (or reacts with or dissolves in or is absorbed by) the KOH (or K_2O)	**1**		

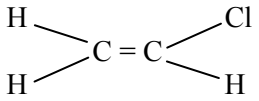
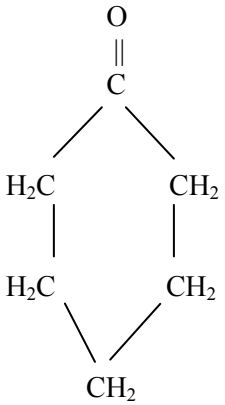
Mark Scheme		Worth ½	Worth 0
12	strong acid – lower pH (½), higher conductivity (½) greater concentration of H^+ (aq) ions (1) or greater concentration of ions (½) or weak acid – higher pH (½), lower conductivity (½) lower concentration of H^+ (aq) ions (1) or lower concentration of ions (½) strong acid fully ionised (dissociated) (½) weak acid partly ionised (dissociated) or equilibrium between molecules and ions (½) or correct equations (½ each) **3** (accept disassociated)		

			Mark Scheme		Worth ½	Worth 0
13	**(a)**	**(i)**	$2CH_3OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 4H_2O(l)$ (state symbols not required; H_2O and/or H^+ (aq) ions need not be cancelled out; accept mole ratios scaled up or down correctly)	**1**	electrons not cancelled out or top equation multiplied by 2 with bottom equation but no adding up	
		(ii)	CO_2 emissions or acidic emissions or cleaner emissions from hydrogen fuel cell or methanol toxic (or poisonous) or energy released by methanol is less than the hydrogen or methanol is heavier or methanol is corrosive or methanol is made from fossil fuels (or not renewable)	**1**		any reference to cost OR CO_2 is toxic (poisonous)
	(b)		Q = 0.5 x (30 x 60)	½		
			= 900 C	½		
			(unit not required at this stage)			
			2 x 96 500 ↔ 24 litres	**1**		
			900 ↔ $\frac{24 \times 900}{2 \times 96\,500}$	½		
			= 0.11 litres (112.8 cm^3)	½		
			(deduct ½ for no or incorrect units)			

Mark Scheme				Worth ½	Worth 0
14	**(a)**	MgO = $\frac{65}{136}$ = 0.48	½	$\frac{136}{65}$ → CsCl	NaCl type on its own
		NaCl type structure	½		
	(b)	the greater the ion size, the smaller the lattice enthalpy or the smaller the ion size the greater the lattice enthalpy	**1**	the further down the group, the smaller the lattice enthalpy or the further up the group, the greater the lattice enthalpy	

Mark Scheme					Worth ½	Worth 0
15	**(a)**	**(i)**	fibrous	**1**	structural or fibres	heligous
		(ii)			eg  (accept no bonds at ends; accept incorrect atom(s) at ends)	
			or 			
			or 	**1**		

Mark Scheme				Worth ½	Worth 0
15	**(continued)**				
	(b)	**(i)**	to show the blue (or black or purple) colour (at end point) or makes identification of end point easier or provides more visible colour change or as indicator **1**		colour change wrong way around
		(ii)	smaller samples allows averaging of volume or to increase accuracy (or reliability) or to make concordant (or congruent) **1**		
		(iii)	moles I_2 = $\frac{21.4}{1000}$ x 0.005		
			= 0.000107 (1.07×10^{-4}) **½**		
			moles vitamin C in 500 cm^3 = 1.07×10^{-3} **½**		
			relative formula mass = 176 **½**		
			mass = $1.07 \times 10^{-3} \times 176$		
			= 0.188 (or 0.2) g **½**		
			(no units required; deduct ½ for incorrect units)		

		Mark Scheme		Worth ½	Worth 0
16	**(a)**	dehydration or elimination	**1**	removal of water	evaporation
	(b)				
		or $CH_2 = CHCl$ or CH_2CHCl	**1**	C_2H_3Cl	
	(c)		**1**	cyclohexanone or $C_6H_{10}O$	

[END OF MARKING INSTRUCTIONS]