



2009 Chemistry

Higher

Finalised Marking Instructions

© Scottish Qualifications Authority 2009

The information in this publication may be reproduced to support SQA qualifications only on a non-commercial basis. If it is to be used for any other purposes written permission must be obtained from the Question Paper Operations Team, Dalkeith.

Where the publication includes materials from sources other than SQA (secondary copyright), this material should only be reproduced for the purposes of examination or assessment. If it needs to be reproduced for any other purpose it is the centre's responsibility to obtain the necessary copyright clearance. SQA's Question Paper Operations Team at Dalkeith may be able to direct you to the secondary sources.

These Marking Instructions have been prepared by Examination Teams for use by SQA Appointed Markers when marking External Course Assessments. This publication must not be reproduced for commercial or trade purposes.

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 'distilling' (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?

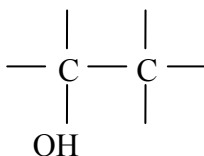
The answer 'red, blue' gains no marks.

- 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.

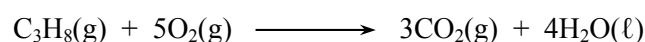
- 4 Full marks are usually awarded for the correct answer to a calculation on its own; the part marks shown in the marking scheme are for use when working is given. An exception is when candidates are asked to 'Find, by calculation,'.
5 A half mark should be deducted in a calculation for each arithmetic 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 – NH₂ group, a half mark should be deducted if the 'O' or 'N' are not bonded to a carbon, ie OH–CH₂ and NH₂–CH₂.
- 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 have 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, C₃H₈ burned to give 82.4 kJ of energy.

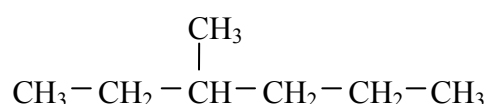


Name the kind of enthalpy change which the student measured.

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 ₃ COOH	1.65
CH ₂ ClCOOH	1.27
CHCl ₂ COOH	0.90
CCl ₃ COOH	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 Cl₂, 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.

2009 Chemistry Higher

Marking Scheme

Section A

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

Mark Scheme		Worth ½	Worth 0
1	(a) increases (or gets bigger or rises) 1		
	(b) more energy is needed to remove the electron from a full shell (or complete shell or noble gas shell) or an electron is being removed from an energy level closer to the nucleus or there is a greater nuclear pull on the electron being removed or second energy level is nearer the nucleus or second energy level is full (or complete), etc. 1		
	(c) forces of attraction between molecules (or intermolecular forces or van der Waals' forces) increase or energy needed to separate the molecules increases. 1	molecular size increases or iodine molecules (or atoms) are bigger than fluorine	bonding is stronger in iodine than fluorine or any mention of stronger covalent bonds

Mark Scheme		Worth ½	Worth 0
2	(a) $x = 7$ $y = 8$ 1		
	(b) non-polluting or no greenhouse gases or no carbon dioxide produced or burns to produce water only or a cleaner fuel, etc. 1	burns to form water	a renewable source or any answer to do with more efficient burning
	(c) renewable (or not a finite resource or carbon-neutral) 1	reduces CO emissions or more complete combustion	less polluting or any answer to do with more efficient burning, eg mention of knocking

Mark Scheme				Worth ½	Worth 0	
3	(a)	(i)	ratio of oxygen:hydrogen atoms increased (or ratio of hydrogen:oxygen atoms decreased) or removal of hydrogen	1	removal of hydrogen molecules	loss of electrons
		(ii)	orange to green (or blue/green)	1	goes green (or blue/green) or orange colour is lost	orange to incorrect colour (or colourless) or incorrect colour (or colourless) to green
	(b)	(i)	Any mention of separate layer or any mention of (ester) smell	1		
		(ii)	$\begin{array}{c} \text{O} \\ \\ \text{CH}_3 - \text{CH}_2 - \text{C} - \text{O} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \end{array}$ (accept equivalent full or shortened structural formula)	1		

Mark Scheme		Worth ½	Worth 0
4	(a) absorbs (harmful) UV radiation or reduces (or stops) UV radiation reaching earth 1	reflects (harmful) UV or absorbs harmful radiation	absorbs rays (or light) from Sun or anything to do with greenhouse effect or IR
	(b) heterogeneous 1		heterozygous
	(c) $3\text{O}_2 \rightarrow 2\text{O}_3$ 1 mol $\rightarrow$ 2/3 mol 1 mol = 6×10^{23} molecules (½) 2/3 mol = 4×10^{23} molecules (½) 1	2×10^{23} or 9×10^{23} (without any working)	

Mark Scheme				Worth ½	Worth 0
5	(a)	(i)	amino acids	1	
		(ii)	breaking up (bonds in) a molecule by the addition of (the elements from) water	1	breaking up (bonds in) a molecule or addition of water or reverse of condensation
	(b)	(i)	ester	1	
		(ii)	functional groups are only at the end of the monomers (or monomers have only two functional groups) or no chance of cross-linking	1	no chance of forming bonds with other polymer molecules no double bonds or no hydrogen bonds

Mark Scheme		Worth ½	Worth 0
6	(a) (i) initial and final temperature (or temperature range) (½) volume (or mass) of water (½) 1 (ii) 0.370 g ↔ 3.86 kJ 32 g (1 mol CH₃OH) ↔ $\frac{3.86 \times 32}{0.370}$ (½) = 333.8 kJ mol⁻¹ include negative sign in final answer -333.8 kJ mol⁻¹ (½) (units not required; (in this case) no deduction for incorrect units) 1		temperature or mass (or weight) of burner or mass of methanol used
	(b) complete combustion (or incomplete combustion in lab method) or richer supply of oxygen (or burns in air in lab method) or no evaporation of methanol 1	burns in oxygen or idea that heat is better distributed	

Mark Scheme		Worth ½	Worth 0
7	(a) use an (upturned) measuring cylinder (or graduated tube) filled with water or collect gas over water or correct diagram (b) mass (or weight) or pH or concentration of acid or conductivity	1 1 as for 1 mark but use of a non-graduated tube or count the number of bubbles produced under water	use a measuring cylinder (or graduated tube)

Mark Scheme	Worth ½	Worth 0
9 (a) $\begin{array}{c} \text{H} \\ \\ -\text{C}-\text{OH} \\ \\ \text{H} \end{array}$ primary $\begin{array}{c} \text{OH} \\ \\ \text{C}-\text{C}-\text{C} \\ \\ \text{H} \end{array}$ secondary $\begin{array}{c} \text{OH} \\ \\ \text{C}-\text{C}-\text{C} \\ \\ \text{C} \end{array}$ tertiary or Primary: hydroxyl group attached to C attached to two H atoms (or hydroxyl group attached to C attached to one C atom) Secondary: hydroxyl group attached to C attached to one H atom (or hydroxyl group attached to C attached to two C atoms) Tertiary: hydroxyl group attached to C attached to no H atoms (or hydroxyl group attached to C attached to three C atoms) or correct answer in terms of oxidation 1	2 out of 3 correct	
(b) addition 1		
(c) pentan-3-one 1	pentanone or pentan-2-one	pentone or pentan-1-one

Mark Scheme	Worth ½	Worth 0
10 (a) neutralisation 1		titration
(b) $ \begin{array}{c} \text{O} \\ \\ \text{C} - \text{OH} \\ \\ \text{H} - \text{C} - \text{OH} \\ \\ \text{H} - \text{C} - \text{OH} \\ \\ \text{C} - \text{OH} \\ \\ \text{O} \end{array} $ (accept equivalent full or shortened structural formula) 1		
(c) $1 \text{ mol C}_4\text{H}_6\text{O}_6 \rightarrow 2 \text{ mol CO}_2 = 48 \text{ l } (\frac{1}{2})$ $150 \text{ g } (\frac{1}{2}) \rightarrow 48 \text{ l}$ $\frac{150 \times 0.105}{48} \text{ g} \rightarrow 0.105 \text{ l}$ $= 0.33 \text{ g } (\frac{1}{2}) \quad \text{mass in 1 sweet} = 0.0165 \text{ g } (\frac{1}{2})$ or $\text{no. of moles of CO}_2 = \frac{0.105}{24} = 0.0044 \text{ mol } (\frac{1}{2})$ $\text{no. of moles of C}_4\text{H}_6\text{O}_6 = 0.0022 \text{ mol } (\frac{1}{2})$ $= 0.0022 \times 150 = 0.33 \text{ g } (\frac{1}{2})$ $\text{mass in 1 sweet} = 0.0165 \text{ g } (\frac{1}{2})$ (no units required; deduct ½ mark for incorrect units) 2		

Mark Scheme		Worth ½	Worth 0
11	(a) more collisions with energy greater or equal to E_a or more collisions leading to an activated complex or correct energy distribution diagram 1	more successful collisions	just increases the number of collisions
	(b) the outer electron in potassium is further from the nucleus or the outer electron is in a higher (or the fourth) energy level (½) or the inner shells screen (or shield) the outer electron from the (pull of the) nucleus (½) or corresponding explanation based on chlorine 1		

Mark Scheme	Worth ½	Worth 0
12 (a) no. of moles sulphuric acid = $0.05 \times 0.01 = 0.0005$ (½) $28 \text{ cm}^3 \leftrightarrow 0.0005 \text{ mol}$ 1 litre $\leftrightarrow \frac{0.0005 \times 1000}{28} = 0.018 \text{ mol l}^{-1}$ (½) or $0.01 \times 50 = c \times 28$ (½) $c = 0.018 \text{ mol l}^{-1}$ (½) (no units required; deduct ½ mark for incorrect units) 1		
(b) ions in barium sulphate are not free to move (1) water contains few ions (or is made up mainly of molecules) (1) 2	there are few ions to conduct or water is a poor conductor	a precipitate is formed or a neutralisation reaction takes place or there are no ions in the products or any mention of flow of electrons

Mark Scheme	Worth ½	Worth 0
13 (a) add an ammeter (½) and a variable resistor (or constant current supply) (½) 1		
(b) no. of moles Ag = $\frac{0.365}{107.9}$ = 0.0034 (½) 2 mol Ag ↔ 1 mol Cu (½) no. of moles Cu = 0.0017 (½) mass of Cu = 0.0017 × 63.5 = 0.107 g (½) or Ag 107.9 g ↔ 96 500 C (½) 0.365 g ↔ $\frac{96\,500 \times 0.365}{107.9}$ = 326.4 C (½) Cu 2 × 96 500 C ↔ 63.5 g (½) 326.4 C ↔ $\frac{63.5 \times 326.4}{2 \times 96\,500}$ = 0.107 g (½) (deduct ½ mark for incorrect or no units) 2		

Mark Scheme		Worth ½	Worth 0
14	(a) Exp. 2 lower Exp. 3 same		
	(b) (i) pH = 1.0 $[H^+] = 1 \times 10^{-1} \text{ mol l}^{-1}$ (½) $[OH^-] = \frac{1 \times 10^{-14}}{1 \times 10^{-1}} = 1 \times 10^{-13} \text{ mol l}^{-1}$ (½) (units not required; deduct ½ mark for incorrect units) (ii) more chlorine atoms, the greater the strength of acid (1) strength of acid related to conc. of H^+ (aq) ions, (1) or strength of acid related to degree of dissociation (1)		

Mark Scheme		Worth ½	Worth 0
15	(a) $\text{Al}_4\text{C}_3 + 12\text{H}_2\text{O} \rightarrow 4\text{Al}(\text{OH})_3 + 3\text{CH}_4$ 1 (b) $\text{SiO}_2(\text{s}) + 2\text{H}_2\text{O}(\ell) \rightarrow \text{SiH}_4(\text{g}) + 2\text{O}_2(\text{g}) + 1517 \text{ kJ}$ (½) $\text{Si}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{SiO}_2(\text{s}) - 911 \text{ kJ}$ (½) $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g}) - 572 \text{ kJ}$ (½) addition = 34 kJ mol^{-1} (½) (3 ‘sensible’ numbers required for ½ mark for addition based on following through; no units required; deduct ½ mark for incorrect units)	2	

Mark Scheme		Worth ½	Worth 0
16	(a) $^{227}\text{Th} \rightarrow ^{223}\text{Ra} + \alpha$ (or alpha or He) (atomic numbers not required)	1	
	(b) alpha is low penetrating or range of travel is short or does not pass through wood	1	non-ionising or weak radiation or too small a dose
	(c) idea of 3 half-lives (½) initial mass = 0.48 g (½) (no units required; deduct ½ mark for incorrect units)	3.36g	1.68g

Mark Scheme				Worth ½	Worth 0
17	(a)	1.17 (or 7:6)	1	p:n = 6:7	
	(b)	(i) left to right 3, 2, 1	1	butene or butan-2-ene	
		(ii) but-2-ene	1		

Mark Scheme	Worth ½	Worth 0
18 (a) $2\text{S}_2\text{O}_3^{2-}(\text{aq}) \rightarrow \text{S}_4\text{O}_6^{2-}(\text{aq}) + 2\text{e}^-$ (state symbols not required) 1		
(b) starch (solution) 1		
(c) no. of moles of $\text{S}_2\text{O}_3^{2-}(\text{aq}) = 0.0504 \times 0.10 = 0.00504$ (½) mole ratio 2:5 (1) no. of moles of CO = 0.0125 (½) or no. of moles of $\text{S}_2\text{O}_3^{2-}(\text{aq}) = 0.504 \times 0.10 = 0.00504$ (½) moles of iodine : thiosulphate is 1:2 moles of iodine = 0.0025 (½) moles of CO : iodine is 5:1 (½) moles of CO = 0.0125 (½) 2		

[END OF MARKING INSTRUCTIONS]