2012 Chemistry

Higher (Revised)

Finalised Marking Instructions

Higher Chemistry (Revised)

General information for markers

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

1 There are **no half marks** awarded

2 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.

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

   Example: What colour is seen when blue Fehling's solution is warmed with an aldeyde?

   The answer 'red, green' gains no marks.

4 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.

5 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, …..'.

6 A 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 As a general rule, where a wrong numerical answer (already penalised) is carried forward to another step, no further penalty is incurred provided the result is used correctly. The exception to this rule is where the marking instructions for a numerical question assign separate "concept marks" and an "arithmetic mark". In such situations, the marking instructions will give clear guidance on the assignment of partial marks.

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

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

10 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.

11 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.

$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$$
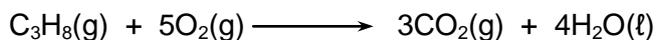
Name the kind of enthalpy change which the student measured.

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

12 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.

$$CH_3-CH_2-\overset{\overset{\displaystyle CH_3}{|}}{CH}-CH_2-CH_2-CH_3$$
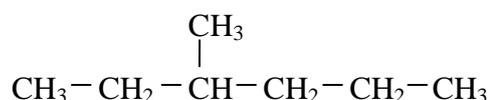
Name the hydrocarbon.

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.

13 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.

2012 Chemistry Higher

Marking Scheme

Section A

1	C	11	B	21	B
2	B	12	D	22	D
3	B	13	B	23	C
4	C	14	C	24	B
5	D	15	B	25	D
6	D	16	A	26	A
7	C	17	B	27	A
8	C	18	D	28	D
9	D	19	A	29	A
10	A	20	A	30	C

Mark Scheme		Worth 0
1 **(a)** **(i)** Boron or Carbon or B or C or graphite or diamond **1**		Silicon
(ii) Number of protons <u>increases</u> **1** **or** <u>increased</u> atomic number **or** <u>greater</u> nuclear/positive charge (pull) **or** <u>greater</u> pull on (outer) electrons		Increased number of electrons **or** larger nucleus **or** stronger nucleus **or** any answer which does not indicate an <u>increase</u> in pull/charge
(iii) Lithium or Li **1**		Li⁺
(b) Electrons are further from the nucleus or atomic size increases or extra energy level **(1)** Screening or shielding or explanation thereof **(1)** **2**		Answers <u>only</u> stating that there are more electrons

Mark Scheme	Worth 0
2 **(a)** 4 or 4.0 (mg – units not required, ignore incorrect units) **1**	
(b) 288 g or 288000 mg **2** Partial marks 288 or 288000 **(1)** Correct unit **(1)** 34.7 g (1) (awarded for correct unit) 34700 mg (1) (awarded for correct unit)	34.7 mg (0) Do not award the unit mark for any values other than those stated unless working is shown.

Mark Scheme	Worth 0

3 (a) (i) 5.75 or 5.77 (g – units not required, ignore incorrect units)   **3**

Partial marks can be awarded using a scheme of two "concept" marks, and one "arithmetic" mark

1 mark – for demonstration of <u>use</u> of the relationship between specific heat capacity, mass, temperature and heat energy/enthalpy eg $E_h = cm\Delta T$ or $\Delta H = -cm\Delta T$
This mark is for the concept, do not penalise for incorrect units or incorrect arithmetic.
The value of 171 (kJ) would automatically gain this mark.

1 mark – for demonstration of knowledge that the enthalpy of combustion of ethanol relates to the combustion of the gfm of ethanol.
This mark could be awarded if the candidate is seen to be working out the number of moles of ethanol required (0.125 or 0.13) or if the candidates working shows a proportion calculation involving use of the gfm for ethanol (46)
This mark is for demonstration of knowledge of this concept, do not penalise for incorrect units of incorrect arithmetic.

1 mark – the final mark is awarded for correct arithmetic throughout the calculation **but** cannot be awarded unless the two concept marks have both been awarded.

Worth 0 column:

Calculations involving E_h where candidates have taken m to be the mass of ethanol.

Calculations involving E_h where candidates have taken ΔT to be either 18 or $100^{\circ}C$.

Mark Scheme		Worth 0
3 **(a)** **(ii)** Heat lost to surroundings **(1)** Incomplete combustion (of alcohol) **(1)** Ethanol impure **(1)** Loss (of ethanol) through evaporation **(1)**	**3**	Evaporation of water
(b) 1 660 000 (kJ – units not required, ignore incorrect units) Partial marks 1 mark for ratio $\frac{50}{0.00145}$ or $\frac{50000}{1.45}$ or 34500 or 34.5 appearing in working	**2**	

Mark Scheme	Worth 0
4 **(a)** (Geraniol has) hydrogen bonding (between its molecules) **(1)** **1** or there are stronger intermolecular bonds (in geraniol) **(1)** or stronger van der Waals' (in geraniol) **(1)** or limonene only has London dispersion forces **(1)**	Geraniol contains –OH group (with no further mention of intermolecular forces)
(b) **(i)** aldehydes or alkanals **1** **(ii)** $H_3C — (CH_2)_8 — \overset{\displaystyle CH_3}{\underset{\displaystyle H}{\overset{\displaystyle |}{\underset{\displaystyle |}{C}}}} — \overset{\displaystyle O}{\overset{\displaystyle \|}{C}} — OH$ **1** (Accept full or shortened structural formula)	Structures where connectivity is clearly incorrect

Mark Scheme	Worth 0
3	
(c) This is an open ended question **1 mark:** The student has demonstrated a limited understanding of the chemistry involved. The candidate has made some statement(s) which is/are relevant to the situation, showing that at least a little of the chemistry within the problem is understood. **2 marks:** The student has demonstrated a reasonable understanding of the chemistry involved. The student makes some statement(s) which is/are relevant to the situation, showing that the problem is understood. **3 marks:** The maximum available mark would be awarded to a student who has demonstrated a good understanding of the chemistry involved. The student shows a good comprehension of the chemistry of the situation and has provided a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. This does not mean the answer has to be what might be termed an "excellent" answer or a "complete" one.	The student has demonstrated no understanding of the chemistry involved. There is no evidence that the student has recognized the area of chemistry involved or has given any statement of a relevant chemistry principle. This mark would also be given when the student merely restates the chemistry given in the question.

Mark Scheme			Worth 0
5 **(a)** 0.21 (g – units not required)		**3**	
Reading volume ethanol from graph, 110 (cm^3) **(1)**			
EITHER			
Calculation of (no of moles) $\dfrac{0.11}{24}$ or 4.58 x 10^{-3} **(1)**			
Calculation of mass 46 x 4.58 x 10^{-3} = <u>0.21</u> g **(1)**			
OR			
Calculating (the mass of 1l) = $\dfrac{46}{24}$ or 1.92 **(1)**			
Calculating (the mass of 0.11l) = 0.11 x 1.92 = <u>0.21</u> g **(1)**			
(b) $CH_3CH_2OH + O_2 \longrightarrow CH_3COOH + H_2O$		**1**	Equations showing electrons
or			
$CH_3CH_2OH + O_2 + 4H^+ + H_2O \longrightarrow 2H_2O + CH_3COOH + 4H^+$			
or any balanced equation <u>not</u> showing electrons			

Mark Scheme		Worth 0

6 **(a)**

Or any structure for an expansion of the shortened structural formula $CH_3S_2CH_3$ containing
- 6 hydrogen atoms, valency 1
- 2 carbon atoms, valency 4
- 2 sulphur atoms, valency 2 or 4 or 6

All Bonds must be shown

1

Shortened structural formulae

Mark Scheme			Worth 0
(b)	First mark for naming the strongest type of intermolecular forces in H_2S	**2**	Mention of Hydrogen bonding results in mark of 0 for whole question
	Permanent dipole - permanent dipole attractions (accept dipole/dipole) **(1)**		Polar bonding
	Second Mark for explaining how the intermolecular forces they have named arise.		If van der Waals' named as the strongest intermolecular force, do not award any mark for explanation as this could be any one of several different types of intermolecular force.
	If permanent dipole-permanent dipole named, award mark for mention of electronegativities of S and H or diagram showing correct partial changes **(1)**		
	If London dispersion forces named, award mark for mention of instantaneous/induced/temporary dipoles/electron cloud wobbles or similar **(1)**		

Mark Scheme		Worth 0
(c) (i) pipette or burette	**1**	Measuring cylinder syringe
(ii) a solution of exactly/accurately known concentration or exact concentration or precise concentration	**1**	

Mark Scheme	Worth 0

(iii) 1.5×10^{-3} or 0.0015 (mol l^{-1} – units not required) **3**

Partial marks can be awarded using a scheme of two "concept" marks, and one "arithmetic" mark.

1 mark for knowledge of the relationship between moles, concentration and volume. This could be shown by any <u>one</u> of the following steps:

- Calculation of moles $Cl_2(aq)$ eg
  $0.010 \times 0.0294 = 2.94 \times 10^{-4}$
- Calculation of conc^n H_2S eg
  $7.35 \times 10^{-5}/0.05 = 1.47 \times 10^{-3}$
- Insertion of correct pairings of values for conc^n and volume in a valid titration formula such as
  $$\frac{C_1V_1}{b_1} = \frac{C_2V_2}{b_2} \quad \text{eg} \quad \frac{29\cdot4\times0\cdot010}{b_1} = \frac{C_2\times50\cdot0}{b_2}$$

1 mark for knowledge of the relationship between the number of moles of chlorine and H_2S

- 4:1 ratio
- Insertion of values for balancing numbers in a valid titration formula such as
  $$\frac{c_1v_1}{b_1} = \frac{c_2v_2}{b_2} \quad \text{eg} \quad \frac{c_1v_1}{4} = \frac{c_2v_2}{1}$$

1 mark is awarded for correct arithmetic throughout the calculation. This mark can only be awarded if both concept marks have been awarded.

Mark Scheme	Worth 0
7 **(a)** 2.9 **1**	
(b) covalent **1**	
(c) Cross at (2.6, 0.8) on graph **2** For calculation of <u>both</u> average electroneg. = 2.6 and diff. electroneg. = 0.8 **(1)** For correctly plotting the point for the values candidate has calculated **(1)**	A point other than (2.6, 0.8) plotted with no statement of the values is worth 0 marks

Mark Scheme			Worth 0
8	**(a)**	$CH_3CH_2CH_2CH_2CH_2CH_2OH$ Or hexan-1-ol or hexanol Also accept structural formulae or names for hexan-2-ol or hexan-3-ol	**1**	
	(b)	The further away from the end of the chain the O atom is, the lower the flash point or similar	**1**	

Mark Scheme		Worth 0

9 **(a)** **(i)**   ester link or carboxylate or ester   **1**

(ii) Correctly drawn amino acid structure   **1**   Structures where connectivity is clearly wrong

(iii) Essential   **1**

(b) **(i)**   69 – 70 (mg l^{-1} – no units required. Ignore incorrect units)   **1**

(ii) Sample of Y should be diluted
or less of sample Y should be used
or smaller sample of Y   **1**

			Mark Scheme		Worth 0
10	**(a)**	**(i)**	It is polar/has hydrogen bonding	**1**	
	(b)	**(i)**	Methyl methanoate	**1**	
		(ii)	58(%)	**1**	
	(c)		70(%) 1 mark is given for either calculating the theoretical yield, or for working out the numbers of moles of reactant and product formed. eg 1·35(g) or both 0·03 and 0·021 1 mark is given for calculating the % yield; either using the actual and theoretical masses, or using the actual number of moles of products and actual number of moles of reactant.	**2**	percentage yield $=\dfrac{0\cdot945}{1\cdot38}$ x 100 $= 68.5\%$

Mark Scheme		Worth 0

11	**(a)**	**(i)**	3-methyl-butan-2-ol (with or without the hyphens)	**1**	3-methyl but-2-ol
		(ii)		**1**	Structures when connectivity is clearly wrong

Any correct structural formula for
2-methylpentant-1-ol

	(b)	**(i)**	$4BF_3 + 3NaBH_4 \longrightarrow 2B_2H_6 + 3NaBF_4$ (or multiples)	**1**	
		(ii)	-2168 (kJ mol^{-1})	**2**	+2168 without any working is worth 0

1 mark for two from the three correct enthalpy
change values:
-36 kJ
-1274 kJ
3 x -286 (= -858) kJ

Mark Scheme		Worth 0
12 **(a)** Diagram completed to show a suitable means of collecting and <u>measuring</u> volume of gas	**1**	Method drawn would not allow **volume** to be measured
(b) **(i)** Water bath or heating mantle	**1**	Heating directly with bunsen
(ii) The protein is denatured/intermolecular bonds broken/changes shape	**1**	Structure changes

Mark Scheme		Worth 0
13 **(a)** MnO_4^-/H^+ is not a strong enough oxidising agent. or F_2 would react with Mn^{2+} or F_2 is below MnO_4^- in the electrochemical series	**1**	Fluorine is very reactive
(b) **(i)** initiation	**1**	
(ii) $\bullet CH_3 + \bullet CH_3 \longrightarrow CH_3CH_3$ Or $\quad F\bullet + F\bullet \longrightarrow F_2$	**1**	

Mark Scheme	Worth 0
(c) **(i)** exothermic **1** Heat given out $\Delta H < 0$ or negative **(ii)** Graph shows as pressure increases/conc^n **1** C_2F_4 decreases Line sloping <u>downward</u>	

Mark Scheme				Worth 0
14	**(a)**		Octadec-9,12,15-trienoic acid Octadeca-9,12,15-trienoic acid (allow the interchange of hyphens and commas)	**1**	Ortadec-9,12,15-trinoic acid
	(b)	**(i)**	neutralisation	**1**	hydrolysis
		(ii)	any mention that soaps have both hydrophobic/oil-soluble and hydrophilic/water-soluble parts (or alternative wording showing knowledge of these parts of the soap) Correct identification of the parts of this soap which dissolve in water and oil, COO^-/COONa/ O^-Na^+ and the hydrophobic part of the molecule, the hydrocarbon chain Describe how this results in a 'ball-like' structure/globule (with the oil/grease held inside the ball) or micelle or mention of an emulsion.	**1**	Simply repeating the word "suspension" from the stem

Mark Scheme		**Worth 0**
15 This is an open ended question	**3**	The student has demonstrated no understanding of the chemistry involved. There is no evidence that the student has recognized the area of chemistry involved or has given any statement of a relevant chemistry principle. This mark would also be given when the student merely restates the chemistry given in the question.
1 mark: The student has demonstrated a limited understanding of the chemistry involved. The candidate has made some statement(s) which is/are relevant to the situation, showing that at least a little of the chemistry within the problem is understood.		
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[END OF MARKING INSTRUCTIONS]