2011 Chemistry

Advanced Higher

Finalised Marking Instructions

Chemistry Advanced Higher

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, and the candidate's answer is 'It has a low melting point and is coloured grey' this would **not** be treated as a cancelling error.

4 Full marks should be awarded for the correct answer to a calculation on its own whether or not the various steps are shown **unless the question is structured or working is specifically asked for.**

5 A mark should be deducted in a calculation for each arithmetic slip **unless stated otherwise in the marking scheme.** No marks should be deducted for incorrect or missing units at intermediate stages in a calculation.

6 A mark should be deducted for incorrect or missing units **unless stated otherwise in the marking scheme**. Please note, for example, that KJ mol^{-1} is not acceptable for kJ mol^{-1} and a mark should be deducted.

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 No mark is given for the solution of an equation which is based on a wrong principle.

Example: Use the information in the table to calculate the standard entropy change for the reaction:

$$C_2H_2 + 2HCl \longrightarrow CH_2ClCH_2Cl$$

Compound	**S^o/J K^{-1} mol^{-1}**
C_2H_2	201
HCl	187
CH_2ClCH_2Cl	208

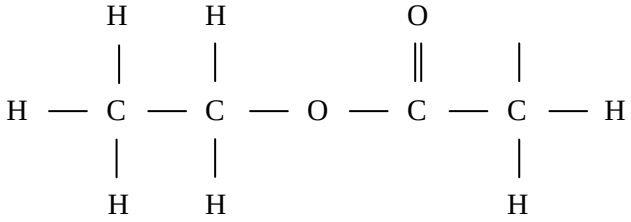
Using $\Delta S^o = S^o_{\text{reactants}} - S^o_{\text{products}}$ would gain zero marks.

9 No marks are given for the description of the wrong experiment.

10 Full marks should be given for correct information conveyed by a sketch or diagram in place of a written description or explanation.

11 In a structural formula, if one hydrogen atom is missing but the bond is shown, no marks are deducted.

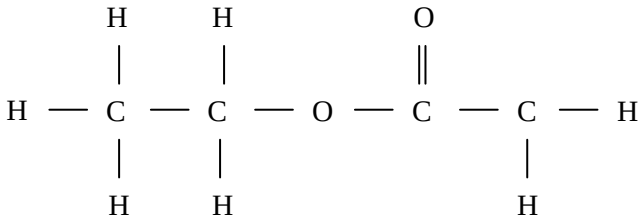
Examples:



Would not be penalised as the structural formula for ethyl ethanoate.

If the bond is also missing, then zero marks should be awarded.

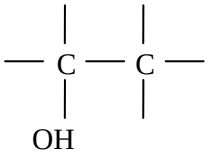
Example:



12 If a structural formula is asked for, CH_3– and CH_3CH_2 – are acceptable as methyl and ethyl groups respectively.

13 With structures involving an –OH or an $–NH_2$ group, no mark should be awarded if the 'O' or 'N' are not bonded to a carbon, ie $OH–CH_2$ and $NH_2–CH_2$.

14 When drawing structural formulae, no mark should be awarded if the bond points to the 'wrong' atom, eg



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

16 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.

17 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.

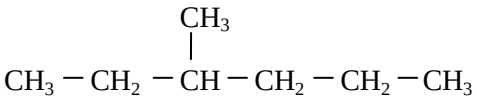
$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$$

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.

18 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 not completely correct, the answer, '3, methyl-hexane' would gain the full mark ie wrong use of commas and dashes.

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?

Again, although not completely correct, an answer like 'the more Cl_2, the stronger the acid' should gain the full mark.

Example 3: Why does the (catalytic) converter have a honeycomb structure?

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

2011 Chemistry Advanced Higher

Marking scheme

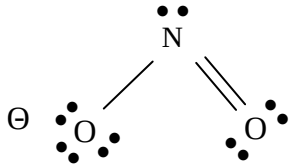
Section A

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

Section B

Question	Acceptable Answer	Mark	Unacceptable Answer
1 (a)	Superconductivity Superconducting Superconductors Superconductance	**1**	Semiconductors
(b)	Liquid nitrogen/N_2	**1**	Liquid helium or liquid oxygen N
		(2)	

Question	Acceptable Answer	Mark	Unacceptable Answer
2 (a)	The line at $4{\cdot}6 \times 10^{14}$ Hz	**1**	
(b) (i)	$H(g) \rightarrow H^+(g) + e^-$ $H(g) - e^- \rightarrow H^+(g)$	**1**	
(b) (ii)	$E = \frac{Lhc}{\lambda}$ or $E = \frac{Lhc}{1000\lambda}$	**1**	
	Wavelength, $\lambda = \frac{6{\cdot}02\times10^{23}\times6{\cdot}63\times10^{-34}\times3{\cdot}00\times10^{8}}{1311000}$	**1**	
	$= 91{\cdot}3 \times 10^{-9}$ m or 91·3 nm or $9{\cdot}13 \times 10^{-8}$m 91nm	**1**	
		(5)	

Question	Acceptable Answer	Mark	Unacceptable Answer
3 (a)	In NO, oxidation state is 2 or +2 or II 2+ In NO_2, oxidation state is 4 or +4 or IV 4+ (Both must be correct for the mark)	**1**	
(b)		**1**	Wrong number of electrons shown
(c)	$NO_2^-(aq) + H_2O(\ell) \rightarrow NO_3^-(aq) + 2H^+(aq) + 2e^-$ (state symbols not required but correct charges must be shown)	**1**	
		(3)	

Question	Acceptable Answer	Mark	Unacceptable Answer
4 (a) (i)	Fe^{3+} $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$	**1**	$[Ar]3d^5$
(ii)	Mn^{3+} $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4$	**1**	$[Ar]3d^4$
(iii)	Fe^{3+} has half filled d-subshell All d-orbitals half filled	**1**	Half filled orbitals/half filled subshell Half filled d-orbitals/half filled d shell more unpaired electrons
(b)	Moles of $FeTiO_3$ = 3250/151·7 = **21·42** Mass of TiO_2 = n × FM = 21·42 × 79·9 = 1711 g = **1·71 kg**	**1** **1**	
(c)	$(NH_4)_2[Cu(Cl)_4]$	**1**	
		(6)	

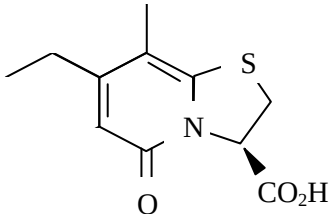
Question	Acceptable Answer	Mark	Unacceptable Answer
5 (a)	Step 4: Rinse beaker with deionised water, add washings to standard flask. Step 5: add deionised water up to mark on standard flask.	 **1**	
(b) (i)	Murexide or ammonium purpurate	**1**	
(ii)	Octahedral	**1**	
(iii)	Average titre = 23·55 cm^3 No of moles of Ni in 100 cm^3 solution = 0·02355 × 0·110 × 4 = 0·0104 % mass of Ni = $\frac{0 \cdot 0104 \times 58 \cdot 7}{2 \cdot 656} \times 100 = \mathbf{22 \cdot 98\%}$	**1** **1** **1**	
		(6)	

Question	Acceptable Answer	Mark	Unacceptable Answer
6 (a)	T = 300 K → 310 K	**1**	300 °K 300 °C
(b)	$\Delta H°$ = (+) 380 → 420 (kJ mol^{-1})	**1**	- 400
(c)	Gradient of line = -1·3 (kJ K^{-1} mol^{-1}) or $\Delta S°$ = 1·22 to 1·40 kJ K^{-1} mol^{-1}	**1**	
	$\Delta S°$ = (+) 1220 to 1400 (J K^{-1} mol^{-1})	**1**	
		(4)	

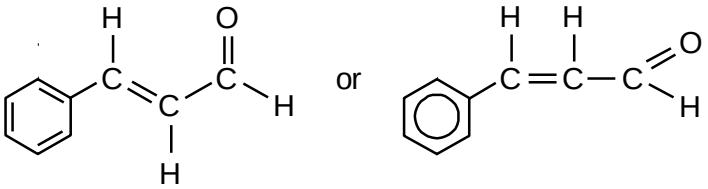
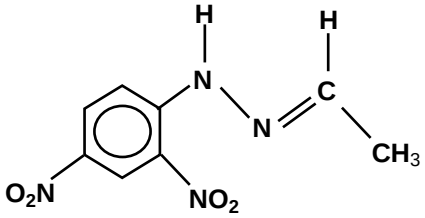
Question	Acceptable Answer	Mark	Unacceptable Answer
7 (a)	Third order/3rd/3	**1**	
(b)	Reaction 3 Rate is independent of concentration of reactants Or rate is independent of concentration of ammonia Concentration of reactant has no effect on rate	**1**	
(c)	$k = \frac{\text{Rate}}{[NO]^2[Cl_2]} = \frac{1{\cdot}43 \times 10^{-6}}{(0{\cdot}250)^2(0{\cdot}250)}$ **$= 9{\cdot}15 \times 10^{-5}$ l^2 mol^{-2} s^{-1}** **(1 mark for correct value, 1 mark for correct units)**	**2**	
		(4)	

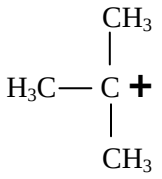
Question	Acceptable Answer	Mark	Unacceptable Answer
8 (a)	$H_2O_2(aq) + 2H^+(aq) + 2Br^-(aq) \rightarrow Br_2(\ell) + 2H_2O(\ell)$	**1**	
(b)	$\Delta G° = -nFE°$ $= -2 \times 96500 \times 0{\cdot}70$ $= -135{\cdot}1 \text{ kJ mol}^{-1}$ (If 0·70 given as answer (and nothing else) then award 1 mark only)	**1** **1** **1**	
		(4)	

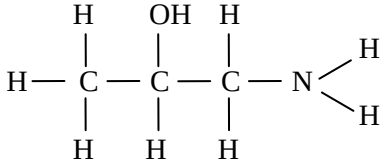
Question	Acceptable Answer	Mark	Unacceptable Answer
9 (a)	A solution in which the pH remains (approximately) constant when small amounts of acid, alkali or water are added Resists p H changes when acid/alkali added	**1**	
(b)	Sodium propanoate or potassium propanoate	**1**	
(c)	$[\text{salt}] = \frac{0 \cdot 15/80 \cdot 0}{0 \cdot 1} = 0 \cdot 131 \text{ mol } l^{-1}$ $pH = 14 - 4 \cdot 76 + \log \frac{0 \cdot 15}{0 \cdot 131}$ $pH = 14 - 4 \cdot 76 + 0 \cdot 059 =$ **9·30**	**1** **1** **1**	
		(5)	

Question	Acceptable Answer	Mark	Unacceptable Answer
10 (a)	Pharmacaphore	**1**	
(b)		**1**	
		(2)	

Question	Acceptable Answer	Mark	Unacceptable Answer
11 (a)	C H O 50 / 12 = 4·16 : 5·6 / 1 = 5·6 : 44·4 / 16 = 2·77 1·50 : 2·02 : 1 giving **$C_3H_4O_2$**	**1**	Empirical formula without any working shown
(b) (i)	$C_6H_8O_4$	**1**	
(b) (ii)	2500 – 3500 (cm^{-1}) or 1700 – 1725 cm^{-1}	**1**	
		(3)	

Question	Acceptable Answer	Mark	Unacceptable Answer
12 (a)	Condensation	**1**	elimination
(b)	 or Accept either cis/trans isomer	**1**	
(c) (i)		**1**	
(ii)	Crystallisation/recrystallisation	**1**	
(iii)	Measure melting point and compare to known data/value	**1**	Measure melting point (on its own)
(iv)	Accept yellow/orange/gold	**1**	
		(6)	

Question	Acceptable Answer	Mark	Unacceptable Answer
13 (a) (i)	Nucleophilic substitution/replacement by a nucleophile First order unimolecular	**1** **1**	
(ii)	 $(CH_3)_3C+$		
(b) (i)	Na in ethanol	**1**	
(ii)	Methoxyethane Accept methyl ethyl ether or ethylmethylether	**1**	
		(5)	

Question	Acceptable Answer	Mark	Unacceptable Answer
14 (a)	2-hydroxypropanoic acid (spelling must be correct)	**1**	
(b)	Carbon atom ② because it has 4 different groups attached	**1**	Carbon atom ② with no explanation
(c) (i)	KCN or NaCN or HCN or any cyanide compound that would work or correct names	**1**	
(ii)	Hydrolysis/acid hydrolysis	**1**	
(iii)	or $CH_3CHOHCH_2NH_2$ 	**1**	
		(5)	

[END OF MARKING INSTRUCTIONS]