2009 Chemistry

Advanced Higher

Finalised Marking Instructions

Advanced 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, 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

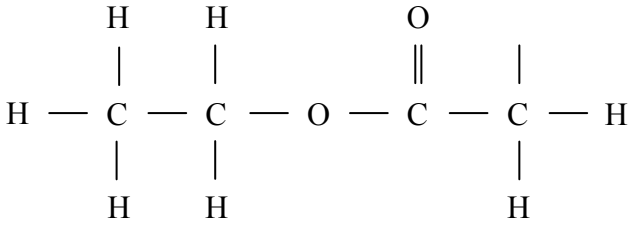
Using $\Delta S^o = S^o_{\text{reactants}} - S^o_{\text{products}}$ would gain zero marks.

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.

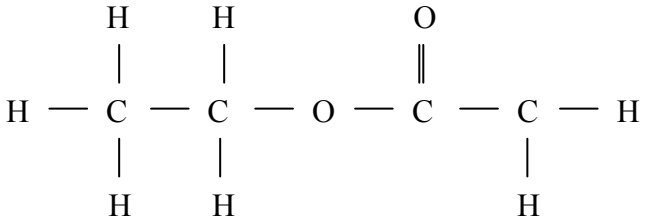
Examples:



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

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

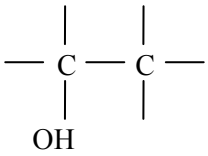
Example:



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.

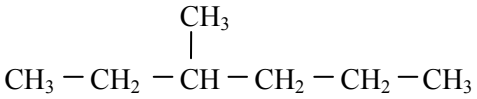
$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$$

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.

2009 Chemistry Advanced Higher

Marking scheme

Section A

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

Section B

Question	Acceptable Answer	Mark	Unacceptable Answer
1 (a)	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$ or $[Ne]\ 3s^2\ 3p^6$	**1**	
(b) (i)	$E = \frac{Lhc}{\lambda}$ **OR** $\lambda = \frac{Lhc}{E}$ $\lambda = \frac{6 \cdot 02 \times 10^{23} \times 6 \cdot 63 \times 10^{-34} \times 3 \cdot 00 \times 10^{8}}{1530 \times 1000}$ $= 78 \cdot 3$ (nm)	**1** **1** **1**	
(ii)	$Ar(g) \rightarrow Ar^{+}(g) + e^{-}$	**1**	

Question	Acceptable Answer	Mark	Unacceptable Answer
2 (a)	138 J K^{-1} mol^{-1}	**1**	
(b)	96 kJ mol^{-1}	**1**	
(c)	$T = \frac{\Delta H°}{\Delta S°}$ **OR** $\Delta G^o = \Delta H^o - T\Delta S^o$ (and $\Delta G^o = 0$) $= \frac{96}{0 \cdot 138} = 696$ K (Note only total of -1 mark for units)	**1** **1**	

Question	Acceptable Answer	Mark	Unacceptable Answer
3 **(a)**	$Mg^{2+}(aq)$	**1**	Using wrong state symbol
(b)	Lattice (breaking) enthalpy	**1**	Enthalpy of lattice formation
(c)	-728 kJ **OR** -728 kJ mol^{-1}	**1**	
(d)	-322 kJ mol^{-1}	**1**	

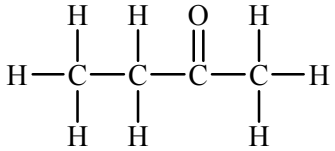
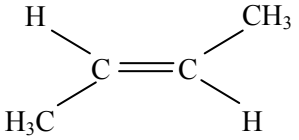
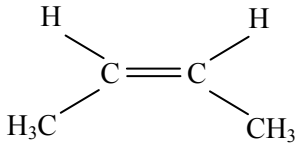
Question	Acceptable Answer	Mark	Unacceptable Answer
4 (a)	Bond breaking H-H + ½ O=O = 432 + 248·5 = 680·5 Bond making 2 O-H = -916 ΔH = (680·5 -916) = -235·5 (kJ mol^{-1})	**1** **1** **1**	
(b)	The above reaction has formed $H_2O(g)$ and more energy will be given out as it changes to $H_2O(\ell)$ **OR** Enthalpy of combustion forms $H_2O(\ell)$ at standard conditions but the above reaction has formed $H_2O(g)$ **OR** Realisation that $H_2O(g)$ formed and that the value in the Data Booklet is for the formation of $H_2O(\ell)$	**1**	

Question	Acceptable Answer	Mark	Unacceptable Answer
5 (a)	1 mol l^{-1} H^+ ions **OR** 1 mol l^{-1} HCl **OR** HNO_3, 298 K (25 ^oC), 1 atmosphere pressure	**1**	1 mol l^{-1} H_2SO_4
(b)	$2IO_3^- + 12H^+ + 10e^- \rightarrow I_2 + 6H_2O$ (**OR** multiple and sub-multiples)	**1**	
(c)	$\Delta G^o = -nFE^o$ $= - 5 \times 96500 \times 1{\cdot}19$ $= -574{\cdot}2$ (kJ mol^{-1})	**1** **1** **1**	

Question	Acceptable Answer	Mark	Unacceptable Answer
6 (a) (i)	$HCOO^-$ **OR** methanoate ion	**1**	
(ii)	$K_a = \frac{[HCOO^-][H_3O^+]}{[HCOOH]}$	**1**	$K_a = \frac{[HCOO^-][H_3O^+]}{[HCOOH][H_2O]}$
(b) (i)	moles of HCOOH $= \frac{3\cdot6\times10^{-3}}{46} = 7\cdot83\times10^{-5}$ mol Conc. of HCOOH $= \frac{7\cdot83\times10^{-5}}{0\cdot0010} = 0\cdot0783$ (mol l^{-1})	**1** **1**	
(ii)	pH $= ½\ pK_a - ½ \log c$ $= ½\ (3\cdot75) - ½ \log(0\cdot0783)$ $= 2\cdot43$ **OR** $[H^+] = \sqrt{K_a \times c}$ $= \sqrt{1\cdot8\times10^{-4}\times0\cdot0783} = 3\cdot75\times10^{-3}$ pH $= 2\cdot43$	**1** **1** **1** **1**	

Question	Acceptable Answer	Mark	Unacceptable Answer
7 (a)	Rate = $k[CH_3COCH_3]\,[H_3O^+]$	1	
(b)	The H_3O^+ (**OR** H^+) is present at the **start** and the **end** of the reaction H^+ ion regenerated (**OR** similar)	1	Presence of H^+ ions
(c) (i)	To quench/stop the reaction. To neutralise the acid.	1	
(ii)	Starch solution **and** blue/black **OR** purple to colourless Iotec indicator **and** blue/black **OR** purple to colourless	1	Clear instead of colourless

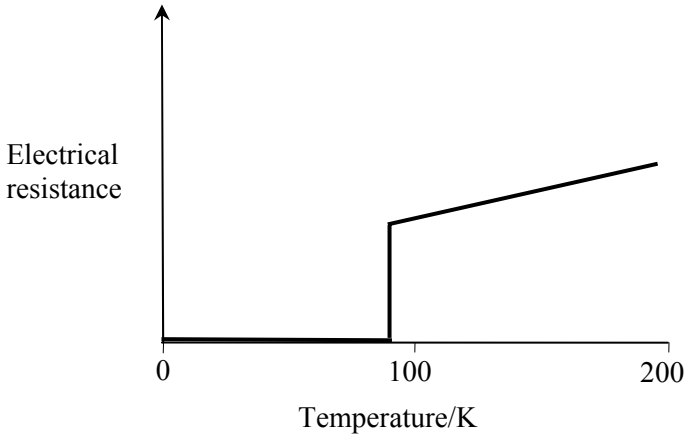
Question	Acceptable Answer	Mark	Unacceptable Answer
8 (a)	EDTA	**1**	
(b)	nickel(II) ions are green **OR** green/blue **OR** coloured $Ni^{2+}(aq)$ absorb visible light	**1**	
(c) (i)	it has lone pairs of electrons/non-bonding pairs of electrons It forms dative **OR** co-ordinate bonds	**1**	
(ii)	4	**1**	
(iii)	gravimetric	**1**	
(iv)	to prevent the complex from absorbing moisture **OR** to allow the complex to cool in a dry atmosphere **OR** to keep it dry/to stop water getting in	**1**	Any reference to dehydration/hydration **OR** it removes water from the complex

Question	Acceptable Answer	Mark	Unacceptable Answer
9 (a)	 **OR** $CH_3CH_2COCH_3$ **OR** butanone	**1**	
(b)	(nucleophilic) substitution	**1**	not electrophilic
(c)	Find its melting point and check with literature values	**1**	Boiling point **OR** Melting point and compare with melting point of **Y**
(d)	 *trans*-but-2-ene  *cis*-but-2-ene	**2**	

Question	Acceptable Answer	Mark	Unacceptable Answer
10 (a)	H_2SO_4 and HNO_3 **or** H_2SO_4 and $NaNO_3$	**1**	Acids in dilute form
(b)	reduction	**1**	
(c)	Ethanoic acid/CH_3COOH or Ethanoyl chloride/CH_3COCl or Ethanoic anhydride/$(CH_3CO)_2O$	**1**	

Question	Acceptable Answer	Mark	Unacceptable Answer
11 (a)	$C_4H_8O_2$ **OR** $(C_2H_4O)_2$	**1**	$2(C_2H_4O)$
(b) (i)	carbonyl **OR** C=O	**1**	
(ii)	ester	**1**	
(c)	$[CH_3CH_2CO]^+$ $C_2H_5CO^+$	**1**	Negative charge on ion
(d)	methyl propanoate	**1**	

Question	Acceptable Answer	Mark	Unacceptable Answer
12 (a)	+5 and +7	**1**	
(b)	trigonal bipyramidal	**1**	
(c)	sp^3d **OR** sp^2d^2 **OR** spd^3	**1**	
(d)	Cl atom too small to accommodate 7 F atoms around it **OR** Radius of chlorine not big enough	**1**	Mention of ions in answer

Question	Acceptable Answer	Mark	Unacceptable Answer
13 (a)	 (Could be a curve after 95 K, but must increase)	**1**	
(b) (i)	**Y** Ba Cu O mass/g 13·4 41·2 28·6 16·8 moles $\frac{13\cdot4}{88\cdot9}$ $\frac{41\cdot2}{137\cdot3}$ $\frac{28\cdot6}{63\cdot5}$ $\frac{16\cdot8}{16\cdot0}$ = 0·151 = 0·300 = 0·450 = 1·05 mole ratio 1 2 3 7 **OR** Empirical mass = 88·9 + 2(137·3) + 3(64·5) + 7(16·0) = 666·0 % Y $\frac{88\cdot9\times100}{666\cdot0}$ = 13·3 % Ba $\frac{2\times137\cdot3\times100}{666\cdot0}$ = 41·2 % Cu $\frac{3\times63\cdot5\times100}{666\cdot0}$ = 28·6 % O $\frac{7\times16\cdot0\times100}{666\cdot0}$ = 16·8	**1** **1** **1** **1**	

Question	Acceptable Answer	Mark	Unacceptable Answer
(ii)	+2·33	**1**	
(iii)	$Y_2Ba_4Cu_6O_{13}$ **OR** $YBa_2Cu_3O_6$	**1**	

[END OF MARKING INSTRUCTIONS]