2010 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

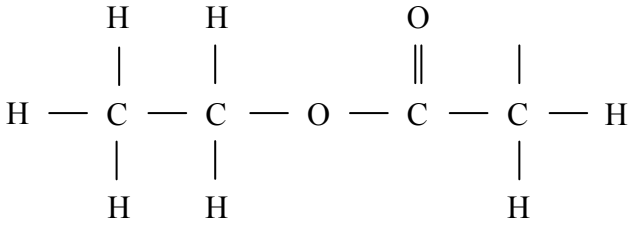
Using $\Delta S^o = S^o_{\text{reactants}} - S^o_{\text{products}}$ would gain zero marks.

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.

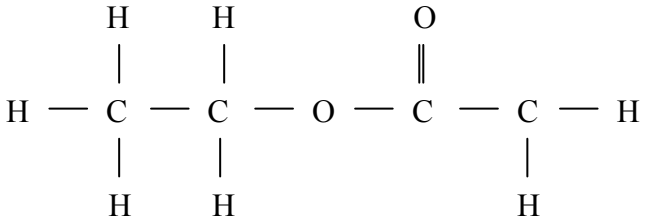
Examples:



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

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

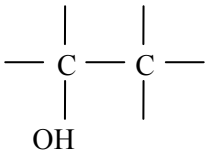
Example:



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.

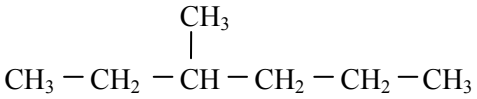
$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$$

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.

2010 Chemistry Advanced Higher

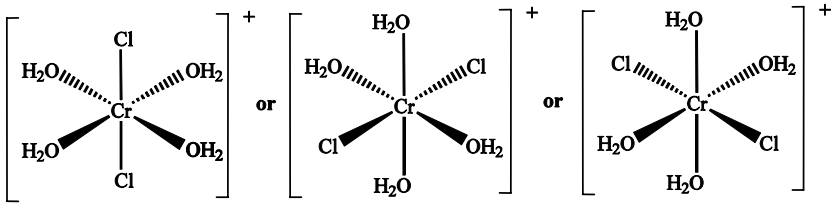
Marking scheme

Section A

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

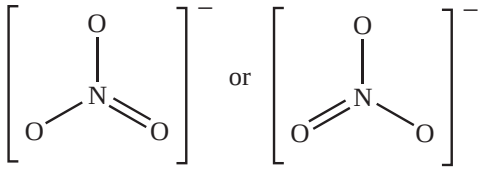
Section B

Question	Acceptable Answer	Mark	Unacceptable Answer
1 (a)	$E = \frac{Lhc}{\lambda}$ or $E = \frac{Lhc}{1000\lambda}$ $E = \frac{6.02\times10^{23}\times6.63\times10^{-34}\times3.00\times10^{8}}{160\times10^{-9}}$ E = 748 (kJ mol^{-1}) or 748361 J If L is omitted, answer is $1\cdot24\times10^{21}$ kJ 1 out of 2 If L is taken as 6×10^{23}, answer is 746 kJ OR 745875 J	**1** **1**	
(b) (i)	5 or 2 bonding and 3 non-bonding	**1**	3 bonding and 2 non-bonding
(ii)	trigonal bipyramidal or Follow through from wrong answer in b(i)	**1**	trigonal dipyramidal

Question	Acceptable Answer	Mark	Unacceptable Answer
2 (a)	+3 or III or 3	**1**	-3
(b)	tetraaquadichlorochromium(III)	**1**	
(c)		**1**	

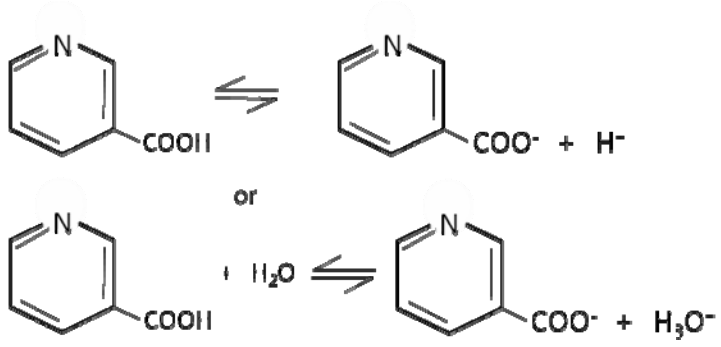
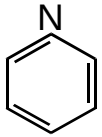
Question	Acceptable Answer	Mark	Unacceptable Answer
3 (a)	$\Delta H^o = (-1676) - (-824) = \mathbf{-852\ kJ}$	**1**	
(b)	$\Delta S^o = [2(27) + 51] - [2(28) + 87] = \mathbf{-38\ JK^{-1}}$	**1**	
(c)	$\Delta G^o = \Delta H^o - T\Delta S^o = (-852) - 298(-38/1000)$ $= -852 + 11.32 = \mathbf{-841kJ}$.	**1** **1**	

Question	Acceptable Answer	Mark	Unacceptable Answer
4 (a) (i)	Brown fumes, fizzing, solution turning yellow, NO_2 forming	**1**	H_2 forming Cl_2 forming Colour change
(ii)	Oxidising agent	**1**	
(iii)	Max absorbance of permanganate/Green is the complementary colour of purple Max reading on meter	**1**	520 nm is the optimum wavelength
(b)	moles of Mn = $1.4 \times 10^{-4} \times 0.1$ = **1.4×10^{-5}** $1.4 \times 10^{-5} \times 54.9$ = **7.686×10^{-4} g** of Mn $(7.686 \times 10^{-4} / 0.19) \times 100$ = **0.40%** Mn	**1** **1** **1**	

Question	Acceptable Answer	Mark	Unacceptable Answer
5 (a)	 or	**1**	Original rotated by 90º or 180º
(b)	b = 0	**1**	
	c = -1 and d = -1	**1**	

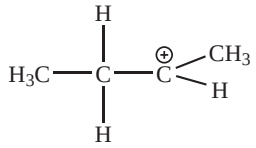
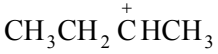
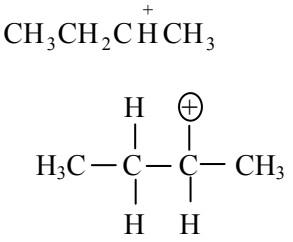
Question	Acceptable Answer	Mark	Unacceptable Answer
6 (a) (i)	colourless to pink/colourless to purple	**1**	clear to pink/purple
(ii)	(16.5/1000) x 0.02 x 5/2 = **0.000825 moles** ($8{\cdot}25 \times 10^{-4}$)	**1**	
(iii)	0.000825 x (1000/20) x 88 = **3.63 g**	**1**	3·63 (Units must be shown)
(iv)	4.49 – 3.63 – 0.06 = **0.8 g**	**1**	0·8 (Units must be shown)
(b)	K H C_2O_4 0.8/39 0.06/1 3.63/88 } or for 1st mark 0.020 0.060 0.041 **X** = 1 **Y** = 3 **Z** = 2	**1** **1**	Using 2 as RAM for H

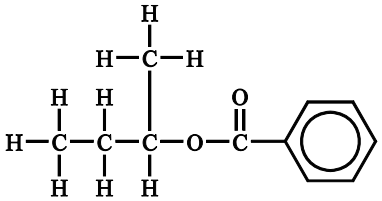
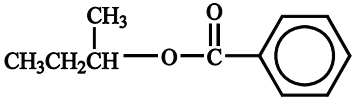
Question	Acceptable Answer	Mark	Unacceptable Answer
7 (a)	$CH_3CH_2OH + CH_3COOH \rightleftharpoons CH_3COOCH_2CH_3 + H_2O$	1	→ in place of ⇌
(b) (i)	No equilibrium in open system/System will not reach equilibrium	1	Value of K will be changed
(ii)	At equilibrium: moles water and ester = 0.70 - 0.24 = **0.46** moles of ethanoic acid = 0.24 moles of ethanol = 0.68 – 0.46 = **0.22** K = [0.46][0.46]/[0.24][0.22] = **4.0**	1 1 1	Units in final answer, 1 mark deducted

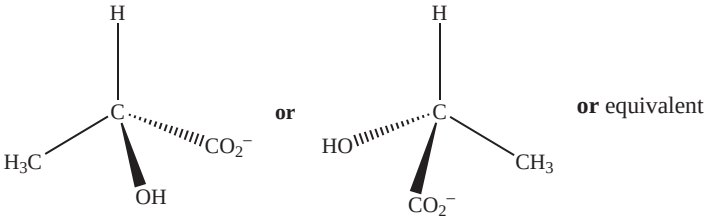
Question	Acceptable Answer	Mark	Unacceptable Answer
8 (a)		**1**	→ in place of ⇌ 
(b)	$pKa = -\log Ka = -\log 1.4 \times 10^{-5} = 4.85$	**1**	
	$pH = ½\ pKa - ½ \log c$		
	Substitute values $3.77 = 2.43 - ½ \log c$	**1**	
	$c = 0.0020$ mol l^{-1}	**1**	
	Or		
	$pH = -\log [H^+]$		
	$[H^+] = 10^{-3.77} = 1.7 \times 10^{-4}$		
	$[H^+] = \sqrt{Ka \times c}$	**1**	
	$1.7 \times 10^{-4} = \sqrt{1.4 \times 10^{-5} \times c}$ Substitute values		
	Or	**1**	
	$c = (1.7 \times 10^{-4})^2 / 1.4 \times 10^{-5}$ Substitute values		
	$= 0.0020$ mol l^{-1}	**1**	

Question	Acceptable Answer	Mark	Unacceptable Answer
9 (a)	Step two $NO_2 + F \rightarrow NO_2F$	**1**	
(b)	$2NO_2 + F_2 \rightarrow 2NO_2F$ $NO_2 + \frac{1}{2}F_2 \rightarrow NO_2F$	**1**	
(c)	2^{nd} order **or** 2	**1**	
(d)	k = Initial rate/$[NO_2][F_2]$ = **40 l mol $^{-1}$s^{-1}** 1 mark for value/1 mark for unit	**2**	

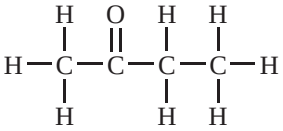
Question	Acceptable Answer	Mark	Unacceptable Answer
10 (a)	to give a higher yield **or** to reduce side reactions **or** to prevent charring	**1**	H_3PO_4 is a better dehydrating agent Faster reaction
(b)	sodium chloride (solution)/brine/salt water	**1**	
(c)	to dry the cyclohexene/dry the organic layer/drying agent/ absorbs water/removes water	**1**	removes impurities dehydrating agent
(d)	Theoretical mass of cyclohexene = $\frac{82 \times 22.56}{100}$ = 18.5 g % yield = $\frac{6.52 \times 100}{18.5}$ = 35 % **or** Moles cyclohexanol = 22.56/100 = 0.2256 mol Moles cyclohexane = 6.52/82 = 0.0795 mol % yield = $\frac{0.0795}{0.2256}$ x 100 = 35.2 % **or** 35%	**1** **1** **1** **1**	

Question	Acceptable Answer	Mark	Unacceptable Answer
11 (a)	because but-2-ene has two different groups attached to each of the carbon atoms of the double bond **or** because in but-1-ene one of the carbon atoms of the double bond has identical groups (H) attached 3 H atoms around the C=C in but-1-ene Structures with explanation	**1**	But-1-ene, double bond at end of chain But-2-ene, double bond in middle of chain But-2-ene, symmetrical 3 H atoms at end of chain
(b)	 	**1**	
(c)	aqueous potassium (or sodium) hydroxide $KOH_{(aq)}$ or $NaOH_{(aq)}$ or $LiOH_{(aq)}$ **or** potassium (or sodium) hydroxide solution **or** aqueous alkali **or** alkali solution **or** water/H_2O	**1**	OH^- or $OH^-_{(aq)}$ LiOH NaOH KOH ethanolic KOH

Question	Acceptable Answer	Mark	Unacceptable Answer
(d)	aluminium chloride or $AlCl_3$ **or** iron(III) chloride or $FeCl_3$ **or** iron(III) bromide or $FeBr_3$ **or** aluminium bromide or $AlBr_3$	**1**	$FeCl_2$ or iron(II) chloride
(e)	 **or**  Use of C_6H_5 in place of 	**1**	

Question	Acceptable Answer	Mark	Unacceptable Answer
12 (a)	ethanal/acetaldehyde/correct structural formula	**1**	C_2H_4O
(b)	cyanohydrin **or** hydroxynitrile **or** cyanoalcohol	**1**	nitrile
(c)	hydrolysis/acid hydrolysis	**1**	alkaline hydrolysis
(d) (i)	van der Waals'/London (dispersion) forces	**1**	
(ii)	 **or** equivalent Must be tetrahedral but dots and wedges can be replaced by solid lines	**1**	

Question	Acceptable Answer	Mark	Unacceptable Answer
(iii)	while one group would be able to bind to the appropriate region, the other two would not **or** the 3 'functional' groups fail to match the binding regions of the active site **or** only 1 group or 2 groups could bind (or match) the binding regions **or** The groups on the lactate ion no longer match the binding regions on the active site of the enzyme **or** The lactate ion no longer complements the binding region (of the active site) **or** The groups now fail to match the binding region (of the active site)	**1**	Molecule is wrong shape

Question	Acceptable Answer	Mark	Unacceptable Answer
13 (a)	Alcohols or alkanols **and** ethers	**1** **1**	
(b) (i)	 **or** $CH_3COCH_2CH_3$	**1**	
(ii)	butan-2-ol	**1**	

[END OF MARKING INSTRUCTIONS]