



2015 Chemistry

Advanced Higher (Revised)

Finalised Marking Instructions

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Part One: General Marking Principles for Chemistry Advanced Higher Revised

This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this Paper. These principles must be read in conjunction with the specific Marking Instructions for each question.

- (a) Marks for each candidate response must always be assigned in line with these general marking principles and the specific Marking Instructions for the relevant question. If a specific candidate response does not seem to be covered by either the principles or detailed Marking Instructions, and you are uncertain how to assess it, you must seek guidance from your Team Leader/Principal Assessor.
- (b) Marking should always be positive ie, marks should be awarded for what is correct and not deducted for errors or omissions.

GENERAL MARKING ADVICE: Chemistry Advanced Higher Revised

The marking schemes are written to assist in determining the “minimal acceptable answer” rather than listing every possible correct and incorrect answer. The following notes are offered to support Markers in making judgements on candidates’ evidence, and apply to marking both end of unit assessments and course assessments.

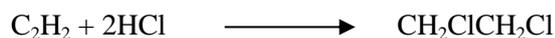
General information for markers

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:

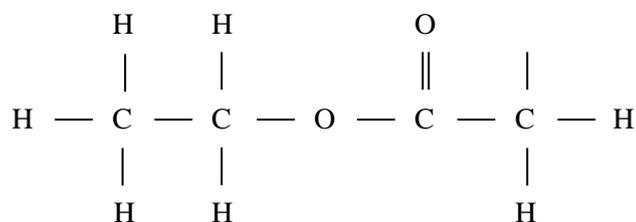


Compound	$S^\circ/\text{J K}^{-1} \text{mol}^{-1}$
C_2H_2	201
HCl	187
$\text{CH}_2\text{ClCH}_2\text{Cl}$	208

Using $\Delta S^\circ = S^\circ_{\text{reactants}} - S^\circ_{\text{products}}$ 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.

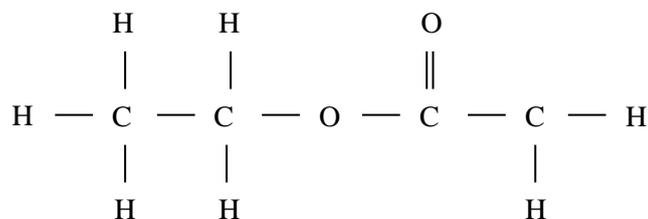
Examples:



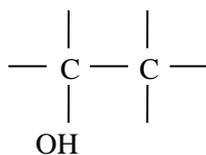
Would not be penalised as the structural formula for ethyl ethanoate.

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

Example:

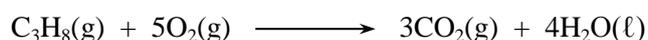


- 12 If a structural formula is asked for, CH_3- and CH_3CH_2- are acceptable as methyl and ethyl groups respectively.
- 13 With structures involving an $-\text{OH}$ or an $-\text{NH}_2$ group, no mark should be awarded if the 'O' or 'N' are not bonded to a carbon, ie $\text{OH}-\text{CH}_2$ and NH_2-CH_2 .
- 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.

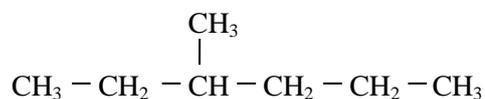


Name the kind of enthalpy change which the student measured.

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 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?

Again, although not completely correct, an answer like 'the more Cl₂, 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.

2015 Chemistry Advanced Higher Revised**Part Two: Marking Instructions for each Question****Section A**

Question	Expected Answer(s)	Max Mark
1.	C	1
2.	D	1
3.	D	1
4.	B	1
5.	B	1
6.	B	1
7.	C	1
8.	C	1
9.	A	1
10.	C	1
11.	C	1
12.	B	1
13.	A	1
14.	D	1
15.	A	1

Question	Expected Answer(s)	Max Mark
16.	B	1
17.	D	1
18.	A	1
19.	C	1
20.	C	1
21.	B	1
22.	A	1
23.	A	1
24.	B	1
25.	D	1
26.	A	1
27.	B	1
28.	D	1
29.	D	1
30.	D	1

Section B

Question			Acceptable Answer	Max Mark	Unacceptable
1	a	i	Equal energy/same energy/contains the same energy/	1	Same energy level/same energy subshell/similar energy
1	a	ii	Correct statement of Hund's Rule. Each orbital should be filled singly before spin pairing takes place The 2p should be filled singly (before spin pairing takes place) The 2p should be filled singly (before they double up) Orbital box diagram showing correct representation	1	" They " should be filled singly Each orbital should be filled singly Breaks Hund's rule
1	a	iii	3,0,0,+1/2 or 3,0,0,-1/2 or 3,0,0, 1/2,	1	
1	b	i	$E = Lhc / \lambda$ (1) $\lambda = 6.02 \times 10^{23} \times 6.63 \times 10^{-34} \times 3 \times 10^8 / 502000$ (1) $\lambda = 238.5 \text{ nm} = 239 \text{ nm}$ or $2.39 \times 10^{-7} \text{ m}$ or $2.385 \times 10^{-7} \text{ m}$ (1) Correct = 3 sig figs – accept 2 sig figs to 5 sig figs (240nm and 238.52 nm are also acceptable) 238nm = (2) Not using L = (2) if units correct So $3.96 \times 10^{-31} \text{ m}$ or $3.9622 \times 10^{-31} \text{ m}$ or $3.962 \times 10^{-31} \text{ m}$ or $3.96 \times 10^{-22} \text{ nm}$ or $4.0 \times 10^{-31} \text{ m}$ would all get (2) marks If don't convert J to kJ and get $2.39 \times 10^{-4} \text{ m}$ / $2.385 \times 10^{-4} \text{ m}$ / 23852 nm / 24000 nm then (2) Correct answer with no working = (3)	3	$E = Lhf$ (and nothing else) (0) or $f = c/\lambda$ (and nothing else) (0) No units = -1 Mistake in a number = -1 Two errors in one line = -1 Wrong answer with no working = 0 (unless the answers are one of those mentioned)

Question			Acceptable Answer	Max Mark	Unacceptable
1	b	ii	<p>No – wavelength required is too short. Wavelength required is outside visible range.</p> <p>UV light required / visible light too long wavelength / frequency of visible light too low / visible light is between 400-700nm / 239nm is not in the visible region</p> <p>If calculated wavelength in part (i) is in the range 400-700nm then follow through answer “yes” with correct explanation = (1)</p>	1	<p>No with no explanation.</p> <p>Visible light (energy) not enough</p> <p>No with wrong range of visible light = (0)</p> <p>No because visible light is not correct wavelength / energy.</p> <p>Any mention of energy with no explanation = (0)</p>
				(7)	
2	a		$\Delta H^\circ = 194$	1	-194
2	b		$\Delta S^\circ = 133$	1	-133 / 0·133
2	c		$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ = 0 \text{ or } T = \frac{\Delta H^\circ}{\Delta S^\circ} \quad (1)$ $= \frac{194000}{133} = 1458.6\text{K or } 1459\text{K}$ <p>Or 1460 K / 1186 °C / 1185.6 °C Allow 3 to 5 sig figs Follow through from incorrect (a) and (b) 194/133 = (1) Standard symbols not needed for first mark</p>	2	<p>Deduct 1 mark for °K or for –ve value for temp</p> <p>1458 K, 1458, 1500 K, 1458.65 K are only worth 1 mark if correct relationship given</p>
				(4)	

Question			Acceptable Answer	Max Mark	Unacceptable
3	a		<p>Correct answers along the lines of: When excess reagent is added (to analyte). Then the excess reagent is titrated with 2nd reagent.</p> <p>or</p> <p>Tablet added to excess NaOH. The titration shows the volume of NaOH left unreacted by the tablet.</p> <p>or</p> <p>A known quantity of either an acid or base is reacted with an unknown quantity of some chemical. How much leftover acid or base remaining can be determined via titration and so how much of it reacted with the other chemical can be worked out to determine the chemical's concentration.</p> <p>or</p> <p>It is when a substance is not titrated itself but instead a compound is reacted with the substance and then the remaining compound is titrated to see how much did not react ie how much was left over.</p>	1	Back titration is used when one of the substances used is insoluble in water. In this case the aspirin tablet is insoluble therefore back titration is used.
3	b	i	$\text{mol H}_2\text{SO}_4 = 8.65/1000 \times 0.050$ $= 4.325 \times 10^{-4}$ <p>4.3×10^{-4} or 4.33×10^{-4} ($8.6 / 1000 \times 0.050 = (1)$)</p>	1	4.0×10^{-4} 4.35×10^{-4}
3	b	ii	<p>Mol NaOH in 25 cm³ sample = 8.65×10^{-4} mol</p> <p>mol NaOH in 250 cm³ standard flask = 8.65×10^{-3} (0.00865 mol) / 8.7×10^{-3}</p> <p>Follow on = 20 × answer to part (i)</p>	1	
3	b	iii	<p>Initial moles of NaOH = $25/1000 \times 1 = 0.025$ mol</p> <p>Moles of NaOH reacting with ASA = $0.025 - 0.00865 = 0.01635$ = $0.01635 / 0.016 / 0.0164$ Accept 0.0163 as follow on from 8.7</p>	1	

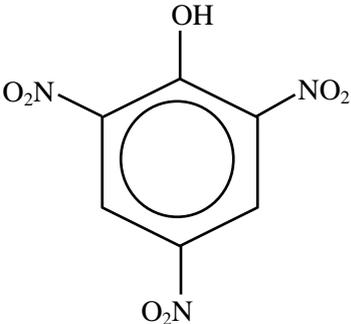
Question			Acceptable Answer	Max Mark	Unacceptable
3	b	iv	<p>Moles of ASA = $0.01635/2 = 0.008175$</p> <p>Mass of ASA $0.008175 \times 180 = 1.4715$ g (1)</p> <p>Mass of ASA in one tablet = 0.2943 g (1)</p> <p>0.29 / 0.294 / 0.2952 / 0.295 / 0.3 or converted to mg</p> <p>Allow follow through from any answer in (iii)</p> <p>1 mark for $90 \times$ answer to part (iii)</p> <p>2 marks for 18 x answer to part (iii)</p>	2	
3	c		<p>Repeat the experiment with pure / analar ASA</p> <p>Use known quantity of aspirin / ASA</p>	1	Answer in terms of a 'blank' (no aspirin) or standardisation of NaOH or H ₂ SO ₄
				(7)	

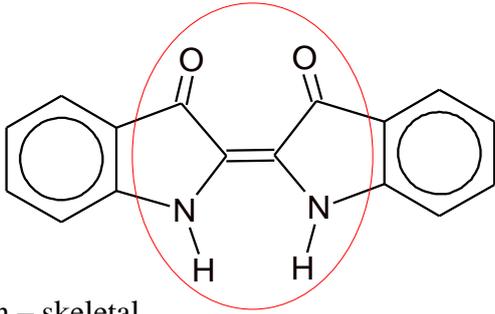
Question		Acceptable Answer	Max Mark	Unacceptable
4	a	Hydrolysis /Acid hydrolysis	1	alkaline
4	b	To purify (the sulfanilamide) To get rid of impurities To make purer	1	To improve the % yield
4	c	GFM reactant 214.1, GFM product 172.1 Both GFM calculated correctly (1) $4.282/214.1 \times 172.1 = 3.442$ (1) $2.237/3.442 \times 100 = 65\%$ (1) Acceptable – 64.9913, 64.991, 64.99, 65.0 or $4.282/214.1 = 0.02$ moles $\times 172.1 = 3.442$ (2) Then $2.237/3.442 \times 100 = 65\%$ (1)	3	64.9 (wrong rounding)
4	d	The sample is mixed with pure sulfanilimide / substance (1) The melting point of the mixture will be the same (as pure sulfanilimide if the sample is pure) (1)	2	
4	e	(Thin layer) chromatography/IR/NMR/TLC	1	
			(8)	

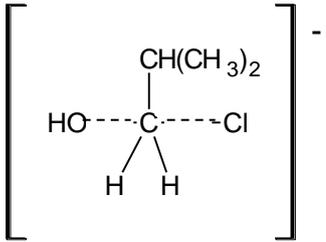
Question			Acceptable Answer	Max Mark	Unacceptable
5	a		(IV), 4, +4, IV, 4+, four	1	4 / 4-
5	b		Both the blue / VO^{2+} and yellow / VO_2^+ coloured (ions) are present (and will produce the green colour) / yellow and blue gives green	1	Green is an intermediate colour between blue and yellow.
5	c		3 / three	1	
5	d		(Oxygen) oxidises the vanadium ions / reacts with oxygen / oxygen turns it back / oxygen effects the mixture / oxidation of V^{2+} ion / reacts with air to oxidised form / it has been oxidised	1	Reacts with the air / oxygen reduces the vanadium ions / oxide ions / oxygen reacts with zinc / due to something escaping
				(4)	

Question			Acceptable Answer	Max Mark	Unacceptable
6	a	i	<p>At equilibrium $[\text{NO}_2] = 0.24 \text{ mol l}^{-1}$ N_2O_4 reacted $\rightarrow 0.24/2 = 0.12$</p> <p>$[\text{N}_2\text{O}_4]$ at equilibrium $\rightarrow 0.28 - 0.12 = 0.16$ (1)</p> <p>$K = [\text{NO}_2]^2/[\text{N}_2\text{O}_4]$ or $= (0.24)^2/(0.16)$ (1) $= 0.36$ (1)</p> <p>Correct FT from incorrect (or missing 0.16)</p> <p>For example $0.24^2 / 0.28 = 0.206 / 0.21 / 0.2$ (2) $0.24^2 / 0.12 = 0.48$ (2)</p>	3	<p>$0.24^2/0.28 \times 127 = 0$ marks 1 mark deducted if units given</p>
6	a	ii	<p>The forward reaction is endothermic since decreasing the temp has favoured the reverse reaction. The forward reaction is endothermic with an acceptable reason that shows an understanding of degree of dissociation (eg more product forms at higher temperatures / as temp decreases the yield decreases).</p> <p>or</p> <p>There is bond breaking taking place therefore the reaction is endothermic.</p> <p>Correct FT from (i)</p>	1	Reaction is endothermic because as temperature decreases K decreases
6	b	i	<p>$x = 7.40 \times 10^{-4} / 7.4 \times 10^{-4}$ (1) $y = 2.96 \times 10^{-3} / 3.0 \times 10^{-3}$ (1)</p>	2	3×10^{-3}
6	b	ii	<p>Rate = $k [\text{NO}]^2$</p> <p>$k = \frac{7.40 \times 10^{-4}}{(2.00 \times 10^{-3})^2} = 185$ (1) $1 \text{ mol}^{-1} \text{ s}^{-1}$ (1)</p> <p>(units in any order eg $\text{mol}^{-1} \text{ s}^{-1}$) if unit is incorrect lose one mark</p>	2	
				(8)	

Question	Acceptable Answer	Max Mark	Unacceptable
7	<p>This is an open ended question</p> <p>1 mark: The student has demonstrated a limited understanding of the chemistry involved. The student has made some statement(s) which is/are relevant, showing that at least a little of the relevant chemistry is understood.</p> <p>2 marks: The student has demonstrated a reasonable understanding of the chemistry involved. The student makes some statements which are relevant showing understanding of the problem.</p> <p>3 marks: The maximum available mark would be awarded to a student who has demonstrated a good understanding of the chemistry involved. The student has shown a good understanding of the chemistry involved and has provided a logically correct answer to the question asked. This type of response might include a statement of the principles involved, a relationship or an equation and an application of these to answer the question. This does not mean that the answer has to be what might be termed an 'excellent' or 'complete' answer.</p>	<p>3</p> <p>(3)</p>	<p>The student has demonstrated no understanding of the chemistry involved. There is no evidence that the student has recognised 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.</p>

Question			Acceptable Answer	Max Mark	Unacceptable
8	a		sp ²	1	
8	b		Chloromethane / methylchloride bromomethane / methylbromide and FeCl ₃ / FeBr ₃ / AlCl ₃ / AlBr ₃ / iron chloride / iron bromide Reagent and catalyst needed for mark	1	CCl ₄ / FeCl / FeCl ₂ / iron(ii) chloride
8	b	ii	Electrophilic substitution / alkylation / Friedel Crafts	1	Nucleophilic substitution
8	c	i	 <p>Kekule structure is fine Must have correct placing of bonds to nitro groups</p>	1	Bonds from benzene ring going to O of the nitro group
8	c	ii	NO ₂ ⁺	1	NO ²⁺ H ₂ SO ₄ / HNO ₃
				(5)	

Question			Acceptable Answer	Max Mark	Unacceptable
9	a		Alternating single double bonds/conjugated system	1	Delocalised electrons chromophore
9	b		An answer such as red and green being absorbed (and blue being transmitted) / absorbs all colours except blue / orange absorbed / red and yellow absorbed	1	Reflects – cancelling Blue light emitted - cancelling General answer in terms of absorption and transmittance
9	c		 <p>Non – skeletal Circled part most important – NH on same side with C = O on opposite.</p>	1	
9	d	i	$C_{10}H_{11}NO_4$ – any order of atoms but must be molecular	1	
9	d	ii	Addition Ignore electrophilic and nucleophilic	1	
9	e		Suction / vacuum filtration / fluted filter paper / using Büchner / Hirsch / sintered glass / water pump / aspirator	1	
				(6)	

Question			Acceptable Answer	Max Mark	Unacceptable
10	a		2-chloro-2-methylpropane 2-chloromethylpropane	1	2,2 methylchloropropane methyl-2-chloropropane 2-methylchloropropane
10	b		CH ₃ CH = CHCH ₃ (1) and CH ₂ = CHCH ₂ CH ₃ (1) Or full structural formulae Ignore incorrect names	2	Names only
10	c	i	2-methylpropan-1-ol Methylpropan-1-ol 1-hydroxy-2-methylpropane Methyl-1-propanol	1	2-methylprop-1-ol
10	c	ii	Five membered transition state with negative charge  Needs dotted bonds as above Wedges and dotted 3D bonds are OK.	1	OH---- (dotted bond going – to H of OH)
10	d		CH ₃ CH ₂ CH ₂ CH ₂ Cl Or full structural / skeletal	1	
10	e		3 / three	1	
10	f		A= (has an asymmetric carbon and so) must be a racemic mix (1) B = no chiral (carbon) / no carbon with four different groups around it (1)	2	Carbon does not have four molecules around it Carbon does not have four atoms around it B does not have an optical isomer
				(9)	

Question			Acceptable Answer	Max Mark	Unacceptable
11	a	i	<p>Must mention “lone pair of electrons on the N” / non-bonded pair of electrons on N / lone pair of electrons on the amine / nitrogen donates electrons to reactant A / the NH₂ has a lone pair of electrons</p> <p>nitrogen or amine must be mentioned</p>	1	Nitrogen is a nucleophile N–H bond is polar which causes the N to be slightly negative causing it to act as a nucleophile
11	a	ii	3570 – 3200	1	Ignore units
11	b		<p>This is an open ended question</p> <p>1 mark: The student has demonstrated a limited understanding of the chemistry involved. The student has made some statement(s) which is/are relevant, showing that at least a little of the relevant chemistry is understood.</p> <p>2 marks: The student has demonstrated a reasonable understanding of the chemistry involved. The student makes some statements which are relevant showing understanding of the problem.</p> <p>3 marks: The maximum available mark would be awarded to a student who has demonstrated a good understanding of the chemistry involved. The student has shown a good understanding of the chemistry involved and has provided a logically correct answer to the question asked. This type of response might include a statement of the principles involved, a relationship or an equation and an application of these to answer the question. This does not mean that the answer has to be what might be termed an ‘excellent’ or ‘complete’ answer</p>	3	The student has demonstrated no understanding of the chemistry involved. There is no evidence that the student has recognised 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.
				(5)	

