2015 Chemistry

Higher

Finalised Marking Instructions

Part One: General Marking Principles for Chemistry Higher

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 Higher

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, 'It has a low melting point and is coloured grey' would **not** be treated as having a cancelling error.

4 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, …..'.

5 A half mark should be deducted in a calculation for each arithmetic slip.

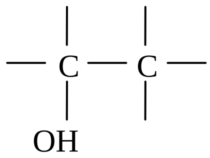
6 A half mark should be deducted for incorrect or missing units **only when stated in the marking scheme**. No marks should be deducted for incorrect or missing units at intermediate stages in a calculation.

7 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 Ignore the omission of one H atom from a full structural formula provided the bond is shown or one bond if the hydrogen is shown.

9 With structures involving an – OH or an – NH_2 group, a half mark should be deducted if the 'O' or 'N' are not bonded to a carbon, ie OH–CH_2 and NH_2–CH_2.

10 When drawing structural formulae, a half mark should be deducted if the bond points to the 'wrong' atom, eg



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

12 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.

13 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.

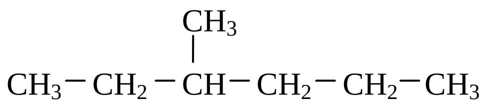
$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$$

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.

14 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 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.

15 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.

16 When it is very difficult to make a decision about a partially correct answer, a half mark can be awarded.

17 When marks have been totalled, a half mark should be rounded up.

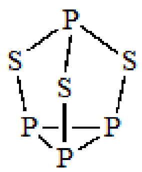
2015 Chemistry Higher

Part Two: Marking Instructions for each Question

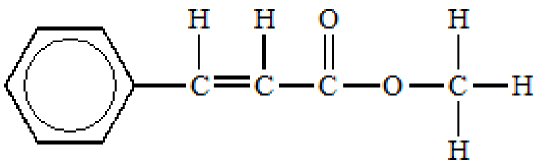
Section A

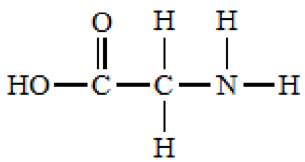
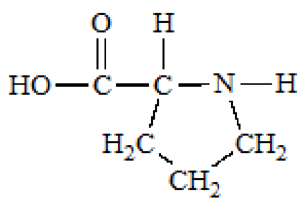
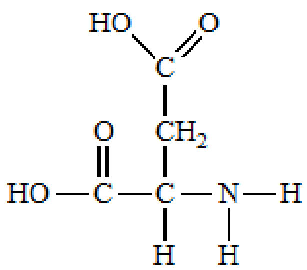
Question	Expected Answer(s)	Max Mark	Question	Expected Answer(s)	Max Mark
1.	C	**1**	**21.**	B	**1**
2.	B	**1**	**22.**	D	**1**
3.	C	**1**	**23.**	C	**1**
4.	B	**1**	**24.**	B	**1**
5.	D	**1**	**25.**	A	**1**
6.	C	**1**	**26.**	D	**1**
7.	B	**1**	**27.**	A	**1**
8.	A	**1**	**28.**	D	**1**
9.	C	**1**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

Section B

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
1	a		**Sulphur** van der Waals / intermolecular / LDF **(½)** **Silicon dioxide** (polar)Covalent (bonds)(network) **(½)**	1		Covalent molecular
1	b	i	 **or** any structure for P_4S_3 that obeys valency rules	1		Only trivalent phosphorus structures accepted.
1	b	ii	Increased nuclear attraction / increased nuclear charge / sulphur has more protons in nucleus	1		0 marks awarded for increased attraction of electrons for nucleus
1	b	iii	Correctly identify that the forces are stronger between sulphur (molecules) than between the phosphorus (molecules)/ forces are the same strength but there are more of them in sulphur than in phosphorus **(½)** Correctly identifying that there are van der Waals' forces between the molecules (of both these elements) **(½)** (These forces are stronger) due to sulphur structure being S_8 whereas phosphorus is P_4 **(1)**	2		Sulphur molecules are larger than phosphorus molecules /atoms

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
2	**a**		From graph, rate = 0·022 t = 1/rate = 45s accept answers in range 45 − 46 s **(1)** (Units not required but deduct ½ mark if incorrect units given)	**1**		
2	**b**	**i**	Second line displaced to left of original. Peak should be displaced to the left.	**1**		line doesn't start at zero
2	**b**	**ii**	A vertical line drawn at a lower kinetic energy than the original Ea shown on graph	**1**		

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
3	a		Workable apparatus for passing the steam **through** strawberry gum leaves (Steam must pass "through" not "over" strawberry gum leaves.) **(1)** Workable apparatus for condensing the steam and essential oil. **(1)**	2		A closed system would not allow candidates to gain mark for condensation.
3	b		 A correct structural formula for methyl cinnamate	1		
3	c		Two common methods 148g $\rightarrow$ 162g 6·5g $\rightarrow$ 162/148 × 6·5 **(½)** Theoretical yield = 7·1g **(½)** % yield = 3·7/7·1 × 100 **(½)** = 52% **(½)** **or** moles cinnamic acid = 6·5 / 148 = 0·044 **(½)** moles methyl cinnamate = 3·7/162 = 0·023 **(½)** % yield = 0·023/0·044 ×100 **(½)** = 52% **(½)**	2		3·7/6·5 × 100 **or** 57%

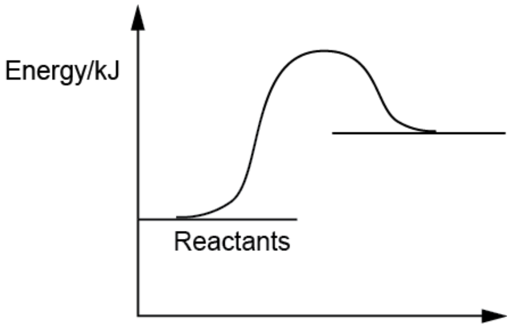
Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
4	**a**		(Source of) energy / vitamins	**1**		Source of fatty acids.
4	**b**		Esters	**1**		triglycerides
4	**c**		Hydrolysis	**1**		
5	**a**		Four	**1**		
5	**b**		Any one of the three possible amino acids drawn as a shortened or full structural formula   	**1**		

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
6	a	i	The arrangement of the atoms in the molecules are altered or words to that effect / changes the structure Molecule is changed to branched, aromatic, cyclic structure / shape Answer must indicate changing or rearranging the structure or shape	1		
6	a	ii	C_8H_{10}	1		

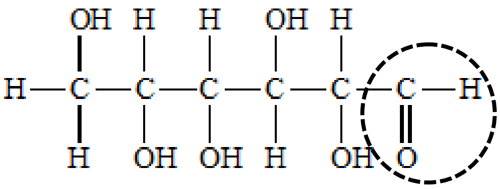
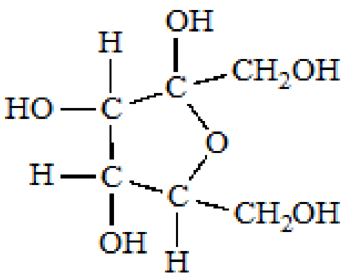
Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
6	b	i	So alcohol (spirit) is not lost by evaporation Prevent loss by evaporation. (answer must include idea of evaporation)	1		
6	b	ii	$E_h = cm\Delta T$ Correct substitution of data = 4·18 × 0·1 × 21 **(½)** = 8·78 kJ (no units required) **(½)** If candidate uses 0·64 answer should be 56·18 J. Ignore unit at this stage. Follow through will give an answer of −6495 Again ignore incorrect energy units **or** = 4·18 × 100 × 21 **(½)** = 8778 J **(½)** (Deduct ½ mark if incorrect units are given here **only** if this is the end of the candidates answer) Then 0·64 g → 8·78 kJ **(½)** 74 g → 8·78/ 0·64 × 74 = −1015 $kJmol^{-1}$ **(½)** (units not required deduct ½ mark for incorrect units) **or** Moles = $\frac{0 \cdot 64}{74}$ = 0·0086 mole **(½)** Energy released for 1 mole = 8·78/ 0·0086 = −1021 $kJmol^{-1}$ **(½)** (Deduct ½ mark if no negative sign in answer No units required, deduct ½ mark for incorrect units)	2		
6	c		Answer within the range 3325 − 3340 Units not required (negative sign not required)	1		

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
7	a	ii	Keeps current constant/steady/ to control / alter / the current	1		
7	b		I = 0·030 × 24 = 0·72 **(½)** I mole requires 2 × 96 500 C **(½)** 4·5 g = (4·5 / 63·5) mol or 0·071mol **(½)** 0·071 mol requires 2 × 96500 × 0·071 C = 13677 C **(½)** t = Q/I = 13677/0·72 **(½)** = 18996 (19000) (s) **(½)** (no units required, deduct a ½ for incorrect units)	3		
8	a		$^{60}_{27}\mathbf{Co} \rightarrow ^{60}_{28}\mathbf{Ni} + ^{0}_{-1}\beta$ **(1)** **or** $^{60}_{27}\mathbf{Co} \rightarrow ^{60}_{28}\mathbf{Ni} + ^{0}_{-1}\mathbf{e}$ **(1)** **or** $^{60}\mathbf{Co} \rightarrow ^{60}\mathbf{Ni} + ^{0}_{-1}\beta$ **(1)** **or** $^{60}\mathbf{Co} \rightarrow ^{60}\mathbf{Ni} + ^{0}_{-1}\mathbf{e}$ **(1)**	1		
8	b		Very high energy/ionising radiation/very penetrative	1		
8	c	i	Four half lives **(½)** = 4 × 5·27 = 21 years (21·08) **(½)** (no units required, deduct a ½ for incorrect units)	1		
8	c	ii	No change	1		

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
9	a	i	Hydroxyl **(½)** Carboxyl / carboxylic / carboxylic acid **(½)**	1		
9	a	ii	Each citric acid molecule can make (many) hydrogen bonds to water **or** other similar answer which includes formation of hydrogen bonds	1		
9	b		H^+ ions are not produced unless water is present / mention of dissociation (or ionisation) of reactant(s) (presence of water) **or** Solid /solid reactions very slow or very few collisions occurring (between the solid reactant particles)	1		

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
9	c		Product energy shown on diagram at higher energy level than reactants  	1		
9	d		84g → 24 litres (½) **or** 3 × 84g → 3 × 24 litres 15g → 24/84 × 15 (½) = 4·29 litres or 4290cm^3 (½) supplying correct units (½) *this is the one question in the paper where candidates are required to supply the units* **or** Moles method 15/84 =0·18 mole (½) **or** 0·18mole → 0·18 mole 0·18 × 24 (½) = 4·32 litres or 4290cm^3 (½) supplying correct units (½)	2		

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
10	**a**		(Acid that is) only partially ionised/ dissociated or words to that effect	**1**		
10	**b**		Any pH > 7	**1**		alkaline
10	**c**	**i**	4: 8: 1: 2: → 4: 4 Multiples of the answer are acceptable	**1**		
10	**c**	**ii**	$[H^+] = 10^{-10}$ (mol l^{-1}) **(½)** $[H^+] \times [OH^-] = 10^{-14}$ $[OH^-] = 10^{-4}$ (mol l^{-1}) **(½)** (units not required, deduct ½ for incorrect units)	**1**		

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
11	**a**	**i**	Aldehyde group correctly identified 	**1**		
11	**a**	**ii**	Answer must describe the glucose/ Fehling's mixture being heated	**1**		
11	**a**	**iii**	Blue to orange/(brick) red/yellow/brown/green (not brown-black)	**1**		
11	**b**		Ring form correctly drawn 	**1**		
11	**c**		Condensation	**1**		
11	**d**		(Because of its more open structure) amylopectin molecules are unable to pack closely together (so easy to separate) **or** amylose molecules can pack closely together (so is difficult to separate) **or** an answer that indicates that in amylopectin, more of the OH groups are available to make hydrogen bonds to water molecules	**1**		

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
12	**a**	**i**	Calcium carbonate/carbon dioxide/ ammonia/calcium oxide **all** correctly identified in flow diagram **(1)** ammonium chloride/sodium hydrogen carbonate/sodium carbonate/water **all** correctly identified in flow diagram **(1)**	**2**		
12	**a**	**ii**	Calcium chloride / by-products can be sold	**1**		
12	**b**		(Adding brine) increases sodium ion concentration hence equilibrium shifts to right	**1**		
12	**c**		**+ 20** kJ mol^{-1} **(2)** **partial marking** All five enthalpy values used **(½)** Enthalpy three multiplied by × 2 **(½)** Remaining enthalpies values used unchanged **(½)** Correct addition of the enthalpy values they have used **(½)** (A minimum of two enthalpy values must be used to get this addition ½ mark)	**2**		−20 with no working

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
13	a		1 mark Ammonia is polar and trichloramine is non-polar. 1 mark Explanation of this in terms of polarities of bonds or electronegativity differences of atoms in bonds	2		
13	b	i	$2I^- \rightarrow I_2 + 2e^-$ (state symbols ignored)	1		
13	b	ii	Starch acts as indicator **or** So the end point can be detected more accurately or words to that effect. Ignore any colour change.	1		

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
13	b	iii	**EITHER** moles thiosulphate =0·0010 × 0·0124 = 0·0000124 **(½)** moles hypochlorite = 0·0000124/2 **(½)** concentration of hypochlorite $= \frac{0 \cdot 0000062}{0 \cdot 10}$ **(½)** = 0·000062 (mol l^{-1}) or $6 \cdot 2 \times 10^{-5}$ **(½)** Accept appropriate answers if there is evidence of rounding at intermediate stages No units required but penalise ½ mark if wrong units shown in final answer **OR** Candidates may use a "titration" formula of which an example is shown below. $\frac{C1 \times V1}{b1} = \frac{C2 \times V2}{b2}$ For inserting the correct pairings of concentrations and volumes (volumes can be in litres or in cm^3) **(½)** $\frac{C1 \times 0 \cdot 1}{1} = \frac{0 \cdot 001 \times 0 \cdot 0124}{2}$ For inserting the correct "stoichiometric" values in this equation award **(½)** rearrangement: $C1 = \frac{0 \cdot 001 \times 0 \cdot 0124}{0 \cdot 2}$ **(½)** = 0·000062 (mol l^{-1}) $6 \cdot 2 \times 10^{-5}$ **(½)**	**2**		

[END OF MARKING INSTRUCTIONS]