2015 Chemistry

Higher (Revised)

Finalised Marking Instructions

Part One: General Marking Principles for: Chemistry 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 <u>always</u> 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 (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, '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 No marks should be deducted for incorrect or missing units at intermediate stages in a calculation.

6 Where a wrong numerical answer (already penalised) is carried forward to another step, no further penalty is incurred provided the result is used correctly.

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

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

9   When structures involving an –OH group or an –NH_2 are asked for, a mark should only be
    deducted when a bond is drawn to the wrong atom, if understanding of the functional group
    structure is required.

$$ \begin{array}{ccc} & | & | \\ - & C & - & C & - \\ & | & | \\ & OH & \end{array} $$
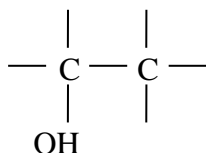
10 A symbol or correct formula should be accepted in place of a name **unless stated otherwise
    in the marking scheme**.

11 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.

12 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.

    $$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$$
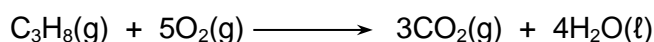
    Name the kind of enthalpy change which the student measured.

    No marks should be given for 'burning' since the word 'burned' appears in the text.

13 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.

    $$ \begin{array}{c} CH_3 \\ | \\ CH_3 - CH_2 - CH - CH_2 - CH_2 - CH_3 \end{array} $$
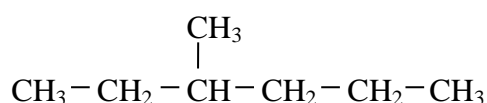
    Name the hydrocarbon.

    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.

14   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?
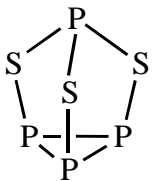
            A response such as 'to make it work' may be correct but it is not a chemical answer and the mark should not be given.
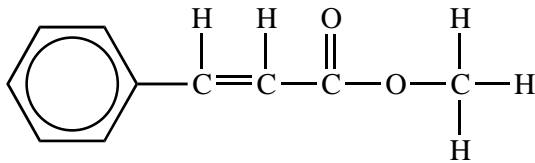
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Part Two: Marking Instructions for each Question

Section A
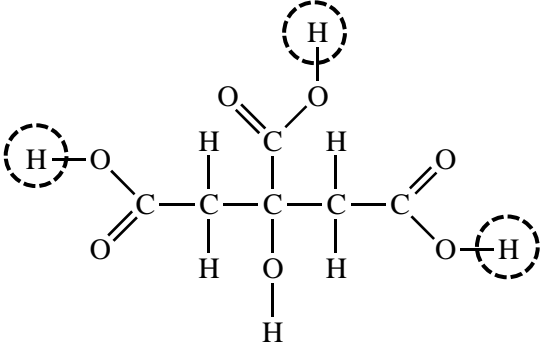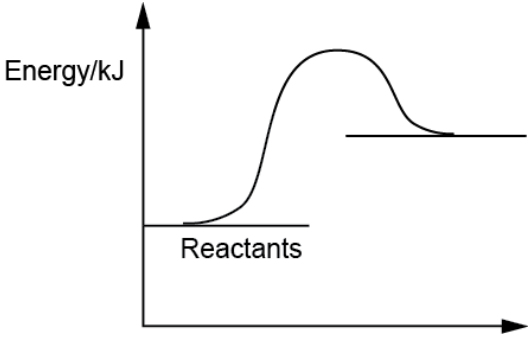
Question	Expected Answer(s)	Max Mark	Question	Expected Answer(s)	Max Mark
1.	D	1	16.	B	1
2.	A	1	17.	A	1
3.	C	1	18.	B	1
4.	B	1	19.	A	1
5.	A	1	20.	C	1
6.	C	1	21.	A	1
7.	C	1	22.	D	1
8.	D	1	23.	A	1
9.	A	1	24.	B	1
10.	D	1	25.	C	1
11.	C	1	26.	D	1
12.	B	1	27.	B	1
13.	C	1	28.	C	1
14.	D	1	29.	B	1
15.	A	1	30.	D	1

Section B

Question			Acceptable Answer/s	Max Mark	Additional Guidance
1	**a**		Sulfur – London Dispersion forces – London dispersion forces /van der Waals / intermolecular forces **(1)** Silicon dioxide – Covalent bond (polar)covalent (network) bonds **(1)**	**2**	LDF is acceptable for London dispersion forces
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 for electrons / increased nuclear charge / sulfur has more protons in nucleus	**1**	Increased attraction of electrons **for** nucleus is not an acceptable answer
1	**b**	**iii**	**1 mark** Correctly identify that the forces are stronger between sulfur (molecules) than between the phosphorus (molecules) **1 mark** Correctly identifying that there are London dispersion forces between the molecules of both these elements **1 mark** These forces are stronger due to sulfur structure being S_8 whereas phosphorus is P_4	**3**	This mark can only be awarded if no other forces are mentioned Candidate answers should mention S_8 and P_4 structures

Question			Acceptable Answer/s	Max Mark	Unacceptable
2	**a**	**i**	Workable apparatus for passing the steam **through** strawberry gum leaves **(1)** Workable apparatus for condensing the steam and essential oil **(1)**	**2**	Both marks should be treated separately "Through" not "over" A closed system would not allow candidates to gain mark for condensation.
2	**a**	**ii**	(Fractional) distillation **or** chromatography	**1**	
2	**b**		 A correct structural formula for methyl cinnamate	**1**	
2	**c**	**i**	**1 mark** awarded for correct arithmetical calculation of moles of acid = 0·044 **and** moles alcohol = 0·063 (no penalty for candidates who round to 0·04 and 0·06 etc) **or** working out that 9·25 g cinnamic acid would be needed to react with 2 g methanol or 6·5 g cinnamic acid would react with 1·41 g methanol **1 mark** awarded for statement demonstrating understanding of limiting reactant. eg there are less moles of cinnamic acid therefore it is the limiting reactant **or** 0·0625 moles methanol would require 0·0625 moles cinnamic acid **or** methanol is in excess therefore cinnamic acid is the limiting reactant.	**2**	

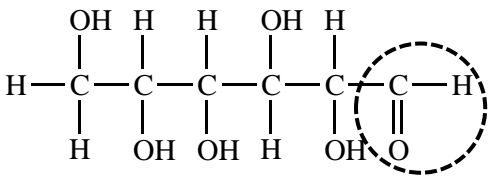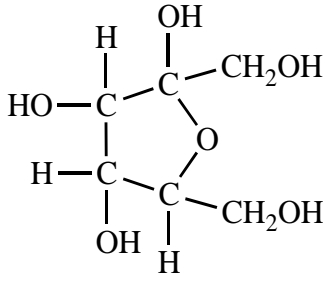| Question			Acceptable Answer/s	Max Mark	Unacceptable
2	c	ii	**A.** 52% (2) Partial Marking **1 mark** is given for working out the theoretical yield ie 7·1 g or for working out **both** the moles of reactant and product formed ie **both** 0·044moles and 0·023 moles **1 mark** is given for calculating the % yield; either using the actual and theoretical masses, or using the actual number of moles of products and actual number of moles of reactant	2	**0 marks awarded for –** 3·7/6·5 × 100 or 56·9%
2	c	ii	**B.** £24·59 (2) Partial marking for **1 mark** Evidence for costing of 3·7 g $\dfrac{6·5}{250} \times 35 \rightarrow £0·91$ **or** evidence of a calculated mass of cinnamic acid × 14p **or** evidence that 176 g of cinnamic acid required £12·80 would be using 100% yield	2	It should be assumed that units are £ unless otherwise stated Follow through from (b) (ii) (A) should be applied

Question			Acceptable Answer/s	Max Mark	Unacceptable
3	a		Each citric acid molecule can make (many) <u>hydrogen bonds</u> to water **or** other similar answer which <u>names hydrogen bonds</u>	1	
3	b	i	Correctly identifies a hydrogen that is replaced	1	
3	b	ii	H^+ ions are not produced unless water is present / mention of dissociation (or ionisation) of reactant(s) (in presence of water) **or** Solid /solid reactions very slow or very few collisions occurring (between the solid reactant particles)	1	
3	c	i	Product energy shown on diagram at higher energy level than reactants	1	
3	c	ii	Volume/mass of water used **(1)** Change in temp or initial and final/ lowest temperature (of water) **(1)**	2	

Question			Acceptable Answer/s	Max Mark	Unacceptable
3	**d**		4·29 litres or 4290cm^3 **(3)** partial marking **1 mark** can be awarded for 84 g gives 24litres **or** 3 × 84 g gives 3 × 24 litres **or** any calculated moles value × 24 litres **or** calculation of 0·18 moles correct units are required; this is the one question in the paper where candidates are required to supply the units. the mark is not awarded if units not given or incorrect units given.	**3**	

	Question		Acceptable Answer/s	Max Mark	Unacceptable
4	a		Any one of the common compounds correctly identified ie citronellol/geraniol/anisyl alcohol	1	
4	b		The concentration / volume of compounds (that are common to both/present in the counterfeit) is different/are present in lower concentration in the counterfeit	1	Answer must relate to the perfume and not to the chromatogram.
4	c	i	Inert/ will not react with the molecules (being carried through the column)	1	
4	c	ii	Size (mass) of molecules / temperature of column.	1	
4	d	i	Terpenes	1	
4	d	ii	3,7-dimethylocta-1,6-dien-3-ol	1	
4	e		1·7 g (units not required) **(2)** partial marking **for 1 mark** for evidence within candidate answer of calculating that 1 mg coumarin is obtained from 0·227 g cinnamon **or** tolerable daily intake = 7·5mg for 75kg individual **or** evidence of multiplying DTI by 227 (multiplying by 1000 and dividing by 4·4)	2	

Question			Acceptable Answer/s	Max Mark	Unacceptable
5			This is an open ended question – **1 mark:** The student has demonstrated, at an appropriate level, a limited understanding of the chemistry involved. The candidate has made some statement(s) which is/are relevant to the situation, showing that at least a little of the chemistry within the problem is understood. **2 marks:** The student has demonstrated, at an appropriate level, a reasonable understanding of the chemistry involved. The candidate has made some statement(s) which is/are relevant to the situation, showing that the problem is understood. **3 marks:** The maximum available mark would be awarded to a student who has demonstrated, at an appropriate level, a good understanding of the chemistry involved and has provided a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. This does not mean the answer has to be what might be termed an "excellent" answer or a "complete" one	**3**	Zero marks should be awarded if: The student has demonstrated, at an appropriate level, 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.

Question			Acceptable Answer/s	Max Mark	Unacceptable
6	a		Any mention that sodium lauryl sulfate has both hydrophobic/oil-soluble and hydrophilic/water-soluble parts (or alternative wording showing knowledge of these parts of the molecule) **(1)** Correct identification of the parts of this molecule which dissolve in water and oil, SO_3^-/ SO_3^- Na/ O^-Na^+ and the hydrophobic part of the molecule, the hydrocarbon chain **(1)** Describe how this results in a 'ball-like' structure/ globule (with the oil/grease held inside the ball) or micelle or mention of an emulsion. **(1)**	3	
6	b	i	24·8 g (units not required) **(2)** partial marking candidate appreciates that graph should be best fit and correctly calculates from graph that % NaCl required is 2·25% **(1)** **or** candidate incorrectly reads the % NaCl from the data on the graph but correctly (using this) calculates a mass of sodium chloride	2	
6	b	ii	**Either –** If the mass of sodium chloride becomes too high the viscosity will decrease **or** (Once the required viscosity is achieved) the further addition of sodium chloride is wasting/costing money	1	
6	c		Green	1	

Question			Acceptable Answer/s	Max Mark	Unacceptable
7	a		Aldehyde group correctly identified	1	
7	b		Ring form correctly drawn	1	
7	c		Condensation	1	
7	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	Unacceptable
8			This is an open ended question – **1 mark**: The student has demonstrated, at an appropriate level, a limited understanding of the chemistry involved. The candidate has made some statement(s) which is/are relevant to the situation, showing that at least a little of the chemistry within the problem is understood. **2 marks**: The student has demonstrated, at an appropriate level, a reasonable understanding of the chemistry involved. The candidate has made some statement(s) which is/are relevant to the situation, showing that the problem is understood. **3 marks**: The maximum available mark would be awarded to a student who has demonstrated, at an appropriate level, a good understanding of the chemistry involved and has provided a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. This does not mean the answer has to be what might be termed an "excellent" answer or a "complete" one.	**3**	Zero marks should be awarded if: The student has demonstrated, at an appropriate level, 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.
9	**a**	**i**	Calcium carbonate/carbon dioxide/ ammonia/ calcium oxide **all** correctly identified in flow diagram **(1)** **and** ammonium chloride/sodium hydrogen carbonate/ sodium carbonate/water **all** correctly identified in flow diagram **(1)**	**2**	
9	**a**	**ii**	Calcium chloride / by-products can be sold	**1**	
9	**b**		(Adding brine) increases sodium ion concentration hence equilibrium shifts to right	**1**	
9	**c**		**+ 20** kJmol^{-1} **(2)** (no units required) partial marking **1 mark** is awarded for use of **all** the correct bond enthalpies. +178, −20, +85, −158, −65	**2**	Positive sign does not need to be given in answer

Question			Acceptable Answer/s	Max Mark	Unacceptable
10	**a**		Kill bacteria/fungi/inactivate viruses	**1**	
10	**b**	**i**	3 points (**1 mark each**) from − **1 mark** for preparation of burette – rinse the burette with the thiosulfate solution rinse the burette with the solution to be put in it / with the solution **2 marks (1 mark each)** for any 2 of the following points • fill burette above the scale with thiosulfate solution • filter funnel used should be removed • tap opened/some solution drained to ensure no air bubbles • (thiosulfate) solution run into scale • reading should be made from bottom of meniscus	**3**	
10	**b**	**ii**	$2I^-$(aq) $\rightarrow$ I_2(aq) +2e	**1**	Ignore state symbols

Question			Acceptable Answer/s	Max Mark	Unacceptable
10	b	iii	0·000062 (mol l^{-1}) Partial marks can be awarded using a scheme of two "concept" marks, and one "arithmetic" mark **1 mark** for knowledge of the relationship between moles, concentration and volume. This could be shown by one of the following steps: Calculation of moles thiosulfate solution eg 0·001 × 0·0124 = 0·0000124 **or** calculation of concentration of iodine solution eg 0·0000062/ 0·1 **or** Insertion of correct pairings of values for concentration and volume in a valid titration formula **1 mark** for knowledge of relationship between moles of thiosulfate and hypochlorite. This could be shown by one of the following steps: Calculation of moles hypochlorite from moles thiosulfate – eg 0·0000124/2 = 0·0000062 **or** Insertion of correct stoichiometric values in a valid titration formula **1 mark** is awarded for correct arithmetic through the calculation. This mark can only be awarded if both concept marks have been awarded.	3	
10	c		44·4 (litres) or 44400 (cm^3)	1	

Question			Acceptable Answer/s	Max Mark	Unacceptable
10	**d**	**i**	**1 mark** Ammonia is polar molecule and trichloramine is non-polar molecule. **1 mark** Explanation of this in terms of polarities of bonds or electronegativity differences of atoms in bonds	**2**	
10	**d**	**ii**	Substances that have unpaired electrons	**1**	
10	**d**	**iii**	Propagation	**1**	

[END OF MARKING INSTRUCTIONS]