2013 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 always be assigned in line with these general marking principles and the specific Marking Instructions for the relevant question.

(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. There are **no half marks** awarded.
2. 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.

3. A right answer followed by a wrong answer should be treated as a cancelling error and no marks should be given.

   Example: What colour is seen when blue Fehling's solution is warmed with an aldehyde?

   The answer 'red, green' gains no marks.

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

5. 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, '.

6. A 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. As a general rule, where a wrong numerical answer (already penalised) is carried forward to another step, no further penalty is incurred provided the result is used correctly. The exception to this rule is where the marking instructions for a numerical question assign separate "concept marks" and an "arithmetic mark". In such situations, the marking instructions will give clear guidance on the assignment of partial marks.

8. Ignore the omission of one H atom from a full structural formula provided the bond is shown.

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

10. 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.

11. 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.

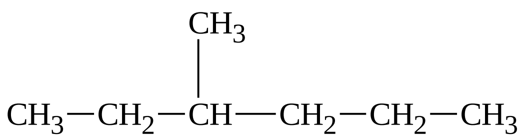
$$C_3H_8(g) + 50_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$$

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.

12. A guiding principle in marking is to give credit for 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.

Structural formula	**pH**
CH_3COOH	1·65
$CH_2ClCOOH$	1·27
$CHCl_2COOH$	0·90
CCl_3COOH	0·51

The results are shown.

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.

13. 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.

Part Two: Marking Instructions for each Question

Section A

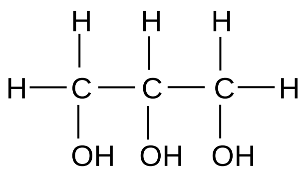
Question			Acceptable Answer
1			B
2			D
3			C
4			C
5			D
6			D
7			A
8			C
9			D
10			B
11			A
12			C
13			D
14			C
15			A

Question			Acceptable Answer
16			C
17			B
18			C
19			B
20			A
21			A
22			D
23			C
24			B
25			A
26			B
27			A
28			A
29			B
30			D

Question			Acceptable Answer/s	Max Mark	Unacceptable
1	**a**	**i**	$K(g) \rightarrow K^+(g) + e^-$ **(1)** $K(g) \rightarrow K^+(g) + e$ **(1)**	**1**	Missing or incorrect state symbols
1	**a**	**ii**	Answers can be given either in terms of potassium or of chlorine Answers starting with "it" are assumed to refer to Potassium **Either** K has more shells/levels **or** electron further from nucleus or diagram showing this **(1)** Correct and clear use of <u>greater</u> shielding/screening (or clear explanation thereof) **(1)** So less energy required to remove electron/ weaker attraction for the electron **(1)** **or** Cl has fewer shells **or** electron closer to nucleus **(1)** Correct and clear use of <u>less</u> shielding/screening (or clear explanation thereof) **(1)** So more energy required <u>to remove electron</u>/stronger attraction for the electron **(1)**	**3**	
1	**b**		8	**1**	Circling OH groups but not stating the number

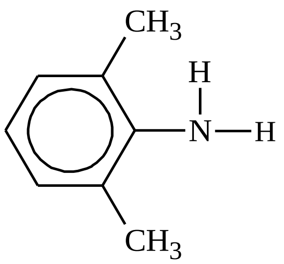
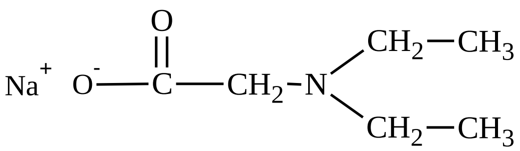
Question			Acceptable Answer/s	Max Mark	Unacceptable
2	**a**		It can react with radicals to form stable molecules **(1)** **or** It can terminate radical (reactions) **(1)** **or** It reacts with radicals to stop further radical reactions **(1)** **or** It mops-up (free) radicals **(1)** **or** It has an unpaired/free electron **(1)**	**1**	Provides electrons (0)
2	**b**		$C_6H_8O_6 \rightarrow C_6H_6O_6 + \mathbf{2H^+ + 2e^-}$ (state symbols not required, negative sign on electron not required)	**1**	

Question			Acceptable Answer/s	Max Mark	Unacceptable
3	**a**		Stating that one ($CHCl_3$) is polar **and/or** the other (CCl_4) is non-polar **(1)** Identifying that $CHCl_3$ has permanent dipole/permanent dipole attractions **and** identifying that CCl_4 has London dispersion forces **(1)** Other mark is for a statement linking intermolecular forces/polarity to the solubility in water. Statements such as the following would be acceptable • Water is polar **(1)** • Water has permanent dipole/ permanent dipole attractions **(1)** • Water is a good solvent for polar molecules **(1)** • Like dissolves like **(1)**	**3**	
3	**b**		-97 (2) A single mark is available if either of the following operations is correctly executed **Either** the four relevant values for the bond enthalpies of the C–H, Cl–Cl, C–Cl and H–Cl bonds (or multiples thereof) are retrieved from the databook; 243, 414, 326, 428 (ignore signs) **(1)** **or** the enthalpy values for bond formation are taken away from the enthalpy values for bond breaking without arithmetic error **(1)** (units not required)	**2**	

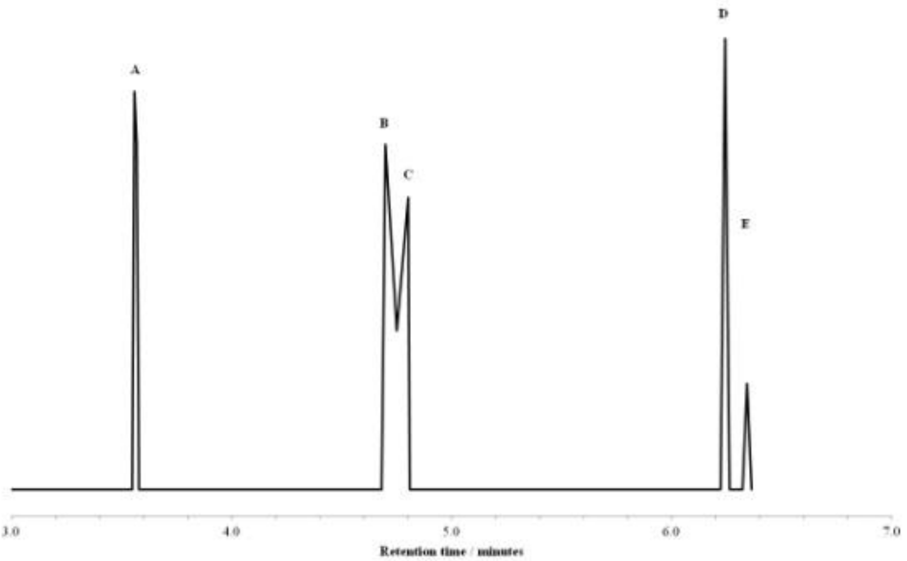
Question			Acceptable Answer/s	Max Mark	**Unacceptable**
4	**a**	**i**	Tollen's or acidified dichromate or Fehling's or Benedict's (please note – although Benedict's reagent would not work in practice, because it appears in Higher textbooks, revision guides and the PPA materials for the traditional Higher, it can be accepted) (accept other spellings if phonetically correct)	1	
4	**a**	**ii**	Carboxylic acid	1	
4	**b**	**i**	It keeps oil & water soluble materials mixed or Allow immiscible substances to mix or To allow fat and water to mix or To form a suspension	1	to stop it separating (with no mention of water & oil soluble components) to stop layers forming
4	**b**	**ii**	 Any structural formula for glycerol	1	
4	**c**		6·7 (mg) – units not required A single mark is available if either of the following manipulations is correctly executed. Correct use of percentage eg *mass of chocolate* = $\frac{28}{100} \times 17$ g = 4·76 g Correct use of proportion theobromine eg *mass of theobromine* = 1·4 × *a mass*	2	

Question			Acceptable Answer/s	Max Mark	Unacceptable
4	d		This is an open ended question **1 mark:** The student has demonstrated 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 a reasonable understanding of the chemistry involved. The student makes 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 a good understanding of the chemistry involved. The student shows a good comprehension of the chemistry of the situation 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	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.

Question			Acceptable Answer/s	Max Mark	Unacceptable
5	**a**		75 % (2) Total mass of reactants/products = 240 g **(1)** *Atom Economy* = $\frac{180}{240}$ × 100 % = 75 % **(1)** (Accept 0·75 also, this would be atom economy as a fraction)	**2**	
5	**b**		40 % (2) 1 mark is given for either calculating the theoretical yield, or for working out the numbers of moles of reactant and product formed. eg 6•55(g) or both 0•0364 and 0•0146 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**	*%yield* = $\frac{2 \cdot 62}{5 \cdot 02}$ × 100 = 52·2 %

Question			Acceptable Answer/s	Max Mark	Unacceptable
6	**a**	**i**	Carboxyl (group) **(1)** **or** Carboxylic (acid) **(1)**	**1**	
6	**a**	**ii**		**1**	
6	**a**	**iii**	 **or** shortened formula. Charges not required but if shown, both +ve and –ve charges must be correct(1).	**1**	Covalent bond shown between Na-O
6	**b**		25 (minutes) **or** 8.0 to 8.4 (minutes) (units not required. Ignore incorrect units)	**1**	

Question			Acceptable Answer/s	Max Mark	Unacceptable
6	c		Volume = 31·5 cm^3 or 31·5 ml or 0·0315 l or equivalent **(3)** **One mark is allocated to the correct statement of units of volume.** **This is the mark in the paper earmarked to reward a candidate's knowledge of chemical units.** So volume = 31·5 or 0·0315 **(2)** One mark is available if either of the following steps is correct Calculation of mass of lidocaine eg 4·5 × 70 = 315 (mg) Calculation of a volume of solution required eg *a mass* × $\frac{1}{10}$ = *a volume*	3	
6	d	i	Benzocaine is a smaller/Tetracaine is bigger **(1)** **or** weaker London Dispersion Forces with Benzocaine **(1)** **or** weaker Van der Waal's forces for Benzocaine **(1)** **or** Benzocaine has lower b.pt **(1)** **or** Benzocaine more soluble/attracted in/ to mobile phase **(1)** **or** Benzocaine less strongly attracted to stationary phase **(1)** **or** Benzocaine is more polar **(1)**	1	Benzocaine takes less time to travel through the apparatus
6	d	ii	The peaks for lidocaine and caffeine overlap **or** Candidate wording for idea of masking	1	The retention times are similar

Question			Acceptable Answer/s	Max Mark	Unacceptable
6	d	iii	Peak for tetracaine at correct RT with approximately half original height 	1	

Question			Acceptable Answer/s	Max Mark	Unacceptable
7	a	i	For successful generation of gas; must have iron sulfide, hydrochloric acid and appropriate glassware to transfer the gas to the gas collection/ measurement apparatus without loss of gas **(1)** For the successful collection and measurement of the gas; must have a syringe or collect the gas in a measuring cylinder over a non-aqueous liquid **(1)**	**2**	
7	a	ii	0·29 (g) (units not required) 1 mark is awarded for a correct strategy to work out number of moles of hydrogen sulfide (a volume of hydrogen sulfide in whatever unit is shown being divided by a molar volume in whatever unit). 1 mark is awarded for correct strategy to work out the mass of the iron(II) sulfide (eg a number of moles of FeS is multiplied by something clearly intended to be the GFM of FeS). 1 mark is awarded for correct arithmetic in both of these steps. (This includes the correct value for the GFM of FeS). This arithmetic mark can only be awarded if both of the concept marks are awarded.	**3**	
7	b	i	Covalent molecular **or** discrete covalent	**1**	
7	b	ii	$Al_2S_3 + 6H_2O \rightarrow 2Al(OH)_3 + 3H_2S$ Correct formulae for all but one substance, whether balanced or not – 1 mark	**2**	

Question			Acceptable Answer/s	Max Mark	Unacceptable
8	**a**		–803, 726, 283 (any two values from this list) **(1)** +206 kJ mol^{-1} (for value, no follow through, units not required) **(1)**	**2**	
8	**b**		<table><tr><td>temperature</td><td>decrease/keep the same/increase</td></tr><tr><td>pressure</td><td>decrease/keep the same/increase</td></tr></table>	**1**	
9	**a**		9·0	**1**	
9	**b**		4	**1**	
10	**a**		$I_2 + 2e^- \rightarrow 2I^-$ **(1)** **or** $I_2 + 2e \rightarrow 2I^-$ **(1)** Ignore state symbols Allowing reversible arrows providing the equation is written the correct way round.	**1**	
10	**b**	**i**	first titre is a rough (or approximate) result/practice **or** first titre is not accurate/not reliable/rogue **or** first titre is too far away from the others **or** you take average of concordant/close results **(1)**	**1**	

Question			Acceptable Answer/s	Max Mark	Unacceptable
10	b	ii	0·045 ($mol\,l^{-1}$ – units not required) 3 marks **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 any <u>one</u> of the following steps: • Calculation of moles thiosulfate(aq) eg 0·1 × 0·01815 = 0·001815 • Calculation of conc^{n} I_2 eg (0·000908) ÷ 0·02 = 0·045 • Insertion of correct pairings of values for conc^{n} and volume in a valid titration formula such as $\frac{C_1V_1}{b_1} = \frac{C_2V_2}{b_2}$ eg $\frac{18{\cdot}15 \times 0{\cdot}10}{b_1} = \frac{C_2 \times 20{\cdot}0}{b_2}$ 1 mark for knowledge of relationship between moles of $S_2O_3^{2-}$ and I_2. This could be shown by any <u>one</u> of the following steps: • Calculation of moles I_2 from moles $S_2O_3^{2-}$ eg 0·001815/2 = 0·000908 • Insertion of correct stoichiometric values in a valid titration formula such as $\frac{C_1V_1}{b_1} = \frac{C_2V_2}{b_2}$ eg $\frac{18{\cdot}15 \times 0{\cdot}10}{2} = \frac{C_2 \times 20{\cdot}0}{1}$ 1 mark is awarded for correct arithmetic throughout the calculation. This mark can only be awarded if both concept marks have been awarded.	3	
10	b	iii	Mass of sodium thiosulfate = 3·96 g **(1)** Mention of rinsings **(1)** Mention of make up to the mark **(1)**	3	

Question			Acceptable Answer/s	Max Mark	Unacceptable
11	**a**	**i**	(anaerobic) fermentation **or** Anaerobic respiration	**1**	
11	**a**	**ii**	10·1 to 10·3 (% abv)	**1**	11
11	**b**	**i**	114 or 113·75	**1**	
11	**b**	**ii**	£3·30 (do not penalise for rounding at intermediate stages) One mark is available if the candidate has either Carried out a calculation to take into account the dilution of the whisky e.g. used a scaling factor of $\frac{46}{65}$ **or** Has correctly calculated the cost for a given volume of alcohol by use of the e.g. used the scaling factor of 1300/195	**2**	
11	**b**	**iii**	5-butyl-4-ethyltetrahydrofuran-2-ol **or** 4-ethyl-5-butyltetrahydrofuran-2-ol	**1**	
11	**c**	**i**	addition or hydration	**1**	
11	**c**	**ii**	no change	**1**	

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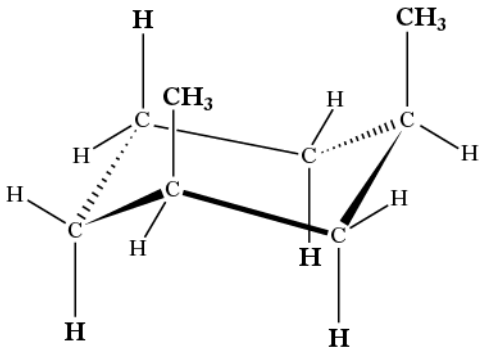
Question			Acceptable Answer/s	Max Mark	Unacceptable
13	a		 or equivalent 1,3-dimethylcyclohexane structure with both methyl groups in axial positions	1	Structures with missing H-atoms Any structure with a methyl group in the equatorial position.
13	b	i	The bigger the group the greater the strain **or** The larger the (halogen) atom the greater the strain **or** The more atoms in a group, the greater the strain **or** Any other statement which is consistent with the values presented	1	Incorrect reference to a group as a “molecule”
13	b	ii	7·6 (kJ mol^{-1}) (Units not required, ignore incorrect units)	1	

[END OF MARKING INSTRUCTIONS]