2014 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.

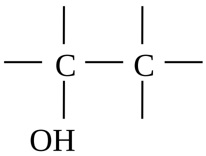
6 A half mark should be deducted for incorrect or missing units **only when stated in the marking scheme**. No marks should be deducted for incorrect or missing units at intermediate stages in a calculation.

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.

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.

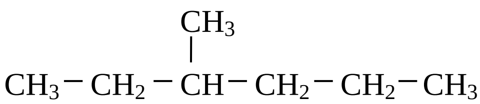
$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$$

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.

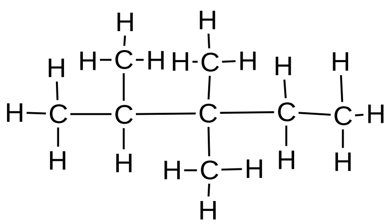
Part Two: Marking Instructions for each Question

Section A

Question	Acceptable Answer(s)
1	A
2	D
3	D
4	B
5	C
6	A
7	C
8	C
9	A
10	A
11	C
12	D
13	B
14	A
15	B
16	C
17	C
18	B
19	B
20	A

Question	Acceptable Answer(s)
21	B
22	D
23	C
24	D
25	B
26	D
27	D
28	A
29	A
30	B
31	C
32	B
33	A
34	C
35	D
36	B
37	A
38	B
39	D
40	D

Section B

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
1	**a**		**Completed table in order:** Metallic (metal) Network (lattice) Covalent Molecular (discrete) 2/3 pieces of info **(1 mark)** 4 pieces of info **(2 marks)**	**2**		
1	**b**		Delocalised / free electrons	**1**		Free charge carriers; dissociated electrons
1	**c**		Increasing nuclear charge / increasing number of protons (pulls electrons closer)	**1**		Increased atomic number/ number of electrons
2	**a**		Naphtha (Naptha misspelling OK)	**1**		Gasoline
2	**b**	**i**	 Any correct structural formula but if full shown general MI no 8 applies or one missing bond to a hydrogen missing with H shown. Suspend MI 10, accept CH_3	**1**		A missing bond between two carbons
2	**b**	**ii**	Aromatic (hydrocarbons) **OR** cycloalkanes or cyclic (hydrocarbons)	**1**		Specific compounds

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
2	**c**	**i**	Two factors are: Not too high as to denature enzyme **(½ mark)** High enough to give fast reaction optimum / most efficient temperature **(½ mark)** (Focus of answer must be the enzyme)	**1**		Not too high to kill the enzyme. Boiling point of compounds flammability pH / cost Increased yield
2	**c**	**ii**	Oxygen to hydrogen ratio has decreased **OR** hydrogen to oxygen has increased **OR** hydrogen has been gained (accept gain of hydrogen ions)	**1**		It is reverse of oxidation; gain of electrons

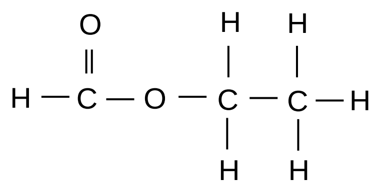
Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
2	c	iii	**Either** **Glucose** **Ethanol** 1 mole 2 moles 180 g 92 g **(½ mark)** 1000 g $\frac{92 \times 1000}{180}$ = 511·11 g **(½ mark)** % Yield = $\frac{445 \times 100}{511 \cdot 11}$ **(½ mark)** = 87(·1) % **(½ mark)** **OR** Moles glucose = $\frac{1000}{180}$ = 5·56 **(½ mark)** Moles ethanol = $\frac{445}{46}$ = 9·67 **(½ mark)** **Glucose** **Ethanol** 5·56 mole 11·12 moles % Yield = $\frac{9 \cdot 67}{11 \cdot 12} \times 100$ **(½ mark)** = 87% **(½ mark)** If candidate rounds figures for no of moles check working. If error in mole etc work through. (Ignore rounding)	2		$\frac{445 \times 100}{1000}$ = 44·5

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
3	a	i	Example eg 20 cm^3 KI solution plus 5 cm^3 water or description to explain dilution with water keeping (total) volume constant.	1		
3	a	ii	Any 2 from: • Start timing as hydrogen peroxide is added • Use more accurate measuring equipment such as syringes pipettes, burettes, smaller measuring cylinder) to measure the solutions • Use a white tile under beaker • Stirring / swirling • Repeat the experiment **(2 x ½ mark)**	1		Use a dropper Temperature constant Use a more accurate container
3	b		Collision must occur with sufficient energy / force to break bonds (Answer must have implied understanding of activation energy) **OR** Collision must occur with suitable geometry	1		High energy Use catalyst

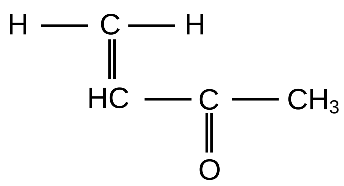
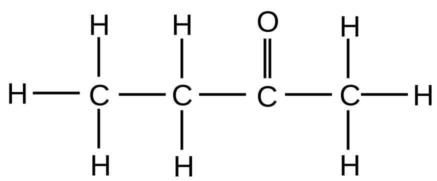
Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
4	**a**		H-F has hydrogen bonds and F-F has van der Waals' / London dispersion forces **(½ mark)** Hydrogen bonds stronger **(than van der Waals' forces)** **(½ mark)** Then: Hydrogen bonds caused by: (large) difference in electronegativity Or indication of polar bonds Or indication of permanent dipole **(½ mark)** Van der Waals' forces caused by: Temporary dipoles Or uneven distribution of electrons Or electron cloud wobble / Movement of electrons **(½ mark)**	**2**		
4	**b**		Any pH greater than 7 If range given it must not include 7	**1**		alkaline
5	**a**	**i**	Condensation	**1**		Condensing
5	**a**	**ii**	Any answer that indicates that ethanoic acid has only one functional group (so the chain cannot continue) A monomer must contain 2 functional groups It is not a diacid	**1**		
5	**b**		Conducts (electricity)	**1**		Photoconductive; Any use

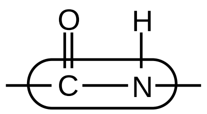
Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
6			OH^- ions react with H^+ ions H^+ concentration decreases Equilibrium shifts to right More $C_{14}H_{14}N_3SO_3$ **or** less $C_{14}H_{15}N_3SO_3$ Any 3 from the above list for 1 ½ marks (3 x ½) Then becomes (more) yellow or less red (must be linked to a valid reason from above.) **(½ mark)**	2		
7	a		$^{1}_{1}H$ or $^{1}_{1}p$	1		
7	b		Proton is produced **Or** neutron splits to give proton (and electron) **Or** nucleus contains one more proton	1		
7	c	i	From graph, half-lives = $4{\cdot}3 \pm 0{\cdot}1$ **(½ mark)** Age = $4{\cdot}3 \times 5700 = 24510$ (23940 – 25080) **(½ mark)** (no units required, deduct ½ for wrong units) Follow through applies	1		
7	c	ii	Radioactivity / Amount of C-14 too low. Too short a half-life; Too little C-14 remains; Too many half-lives have passed; too little change in activity	1		It will run out of half-lives. C-14 fully decayed.

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
8	a		$E_h = cm\Delta T$ Correct substitution of data $= 4{\cdot}18 \times 0{\cdot}21 \times 50$ **(½ mark)** $= \pm\ 43{\cdot}89$ kJ (no units required) **(½ mark)** (Accept use of 4.2 → 44.1) (Deduct ½ mark if incorrect units are given here only if this is the end of the candidates answer) **OR** $= 4{\cdot}18 \times 210 \times 50$ **(½ mark)** $= 43890$ J (no units required) **(½ mark)** (Deduct ½ mark if incorrect units are given here only if this is the end of the candidates answer) **Then** 65 kJ → 56 g **(½ mark)** $43{\cdot}89 \text{ kJ } (44) \rightarrow \frac{56}{65} \times 43{\cdot}89\ (44)$ $= 37{\cdot}81\text{ g}\ \ (38\text{ g})$ **(½ mark)** **OR** Moles required $= \frac{43{\cdot}89}{65} = 0{\cdot}67$ **(½ mark)** Mass $= 0{\cdot}67 \times 56$ $= 37{\cdot}52\text{ g}$ **(½ mark)** (No units required, deduct ½ mark if wrong units) Follow through applies	2		

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
8	b		$Ca(s) + ½O_2(g) \rightarrow CaO(s)$ (reversed) $\Delta H = +635$ kJ mol^{-1} **(½ mark)** $H_2(g) + ½O_2(g) \rightarrow H_2O(\ell)$ (reversed) $\Delta H = +286$ kJ mol^{-1} **(½ mark)** $Ca(s) + O_2(g) + H_2(g) \rightarrow Ca(OH)_2(s)$ $\Delta H = -986$ kJ mol^{-1} **(½ mark)** $Ca(OH)_2(s) \rightarrow Ca(OH)_2(aq)$ $\Delta H = -82$ kJ mol^{-1} **(½ mark)** Add together = −147 (kJ mol^{-1}) Deduct ½ mark for incorrect or no addition of numbers No units required (deduct ½ mark for incorrect units)	**2**		
9	a	i	Concentrated sulphuric acid/cH_2SO_4	**1**		Sulphuric acid
9	a	ii	Reaction mixture and/or ester produced is flammable Any mention of flammable/burning KEY flammability	**1**		Explosive for safety reasons
9	a	iii	 **OR** $HCOOCH_2CH_3$ **OR** partially shortened structural formula GMI 8 apply only to C_2H_5	**1**		
9	b		$CHCl_3 + \mathbf{4}NaOH \rightarrow HCOONa + \mathbf{3}NaCl + \mathbf{2}H_2O$ Or multiples including ½	**1 or 0**		

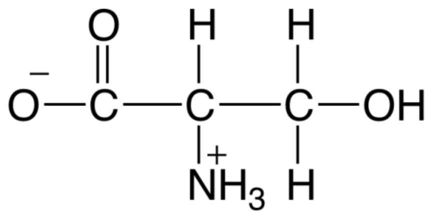
Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
10	**a**		Heterogeneous	**1**		Heterozygous
10	**b**		$CH_4 + 2H_2O \rightarrow CO_2 + 4H_2$	**1**		CO still in the equation
10	**c**	**i**	$Q = It = 200 \times 60 \times 30$ $= 360\,000\,C$ **(½ mark)** 1 mol H_2 needs 2 moles electrons $= 2 \times 96\,500 = 193\,000\,C$ **(½ mark)** 193 000 24 litres **(½ mark)** 360 000 $\frac{360\,000}{193\,000} \times 24$ $=$ 44·77 litres **(½ mark)** (no units required, deduct ½ mark for incorrect units) Follow through applies	**2**		
10	**c**	**ii**	Doesn't produce CO_2 **Or** CO_2 is bad for the environment **Or** no polluting by-product **Or** no by-product to separate **Or** getting pure hydrogen O_2 produced by electrolysis If global warming given must be linked to CO_2	**1**		Better for environment CO_2 is poisonous Only product is hydrogen

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
11	**a**		w = 10, x = 5, y = 2, z = 1	**1 or 0**		
11	**b**		4-methylpentan-2-one (ignore hyphen usage and/or comma usage space between methyl and pent)	**1**		2-methylpentan-4-one 4-methylpentanone 4-methylpentane-2-one 4-methylpent-2-one
11	**c**		(CFCs) destroy/deplete/damage ozone (layer)/ makes holes in ozone layer	**1**		Harmful to atmosphere
11	**d**	**i**	Hydrogenation	**1**		reduction
11	**d**	**ii**	 Or other correct drawing of this structure Accept the final product of the reaction, ie 	**1**		

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
12	**a**		Fibrous	**1**		Fibre
12	**b**		Peptide link correctly identified including just  OK to simply identify correct bond	**1**		
12	**c**		Hydroxyl(e)	**1**		Hydroxide/hydroxy
12	**d**	**i**	Glycerol Or propan(e)−1,2,3-triol Or glycerin(e)	**1**		Soap Propan−1,2,3-ol
12	**d**	**ii**	From a hydrogen connected to an oxygen or nitrogen to another oxygen (includes the carbonyl oxygen) or nitrogen. Hydrogen bond correctly drawn	**1**		

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
13	**a**		Top of meniscus /curve was read Use a bright light behind burette	**1**		White paper; eye level, white scale
13	**b**		Blue/black or to purple colour Ignore starting colour	**1**		
13	**c**		It was the rough titre Or wasn't done accurately Or words to that effect (Must refer to why volume too high, not why value rejected)	**1**		It is not concordant It is incorrect
13	**d**		**EITHER** moles I_2 = moles Vit C $= 0{\cdot}00125 \times 0{\cdot}0254 = 0{\cdot}0000317$ (0·00003)(0·000032) **(½ mark)** Scale up to 1litre: $0{\cdot}0000317 \times 50 = 0{\cdot}00159$ (0·0015)(0·0016) **(½ mark)** Calculation of mass = moles × 176 **(½ mark)** $= 0{\cdot}00159 \times 176 = 0{\cdot}279\,g$ (0·264)(0·282) **(½ mark)** 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	**2**		

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
13	**d**		**(cont)** **OR** Candidates may use a "titration" formula of which an example is shown below $\dfrac{C1 \times V1}{b1} = \dfrac{C2 \times V2}{b2}$ For inserting the correct pairings of concentrations and volumes (volumes can be in litres or in cm^3) **(½ mark)** $\dfrac{C1 \times 20}{1} = \dfrac{0{\cdot}00125 \times 25{\cdot}4}{1}$ Rearrangement: $C1 = \dfrac{0{\cdot}00125 \times 25{\cdot}4}{20} = 0{\cdot}00159$ **(½ mark)** Calculation of mass = moles × 176 **(½ mark)** $= 0{\cdot}00159 \times 176 = 0{\cdot}279\,g$ **(½ mark)**			

Question			Acceptable Answer/s	Max Mark	½ mark	Unacceptable
14	a		222 g **(½ mark)** gives 9×24 **(½ mark)** 1 g gives $\frac{9\times24}{222}$ = 0·973 litres **(½ mark)** Or 973 cm^3 Correct units **(½ mark)**	**2**		
14	b		$2CO + 3CO_2 + 4H_2O + 2N_2$	**1 or 0**		
15	a		 GMI 8 applies but ignore GMI10	**1**		
15	b		OH^- concentration = 1×10^{-5} mol l^{-1} H^+ concentration = 1×10^{-9} mol l^{-1} **(½ mark)** pH = 9 **(½ mark)** Positive zwitterion forms **(½ mark)** Moves to negative electrode **(½ mark)** (second mark must be related to pH and correct to stated pH)	**2**		Negative electrode with no explanation

[END OF MARKING INSTRUCTIONS]