



2007 Chemistry

Higher

Finalised Marking Instructions

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Higher Chemistry

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?

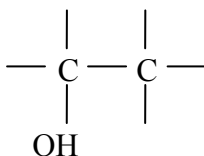
The answer 'red, blue' gains no marks.

- 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.

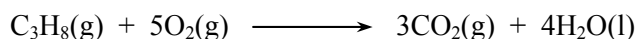
- 4 Full marks are usually awarded for the correct answer to a calculation on its own; the part marks shown in the marking scheme are for use when working is given. An exception is when candidates are asked to 'Find, by calculation,'.
5 A half mark should be deducted in a calculation for each arithmetic 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 – NH₂ group, a half mark should be deducted if the 'O' or 'N' are not bonded to a carbon, ie OH–CH₂ and NH₂–CH₂.
- 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, C₃H₈ burned to give 82.4 kJ of energy.

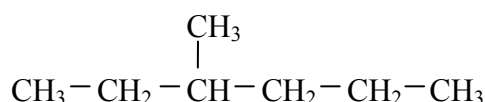


Name the kind of enthalpy change which the student measured.

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

- 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 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?

Although not completely correct, an answer such as 'the more Cl₂, 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.

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Marking Scheme

Section A

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

Mark Scheme	Worth ½	Worth 0
2 (a) Reforming 1		
(b) $ \begin{array}{ccccc} & \text{H} & & \text{H} & & \text{H} \\ & & & & & / \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} \\ & & & & & \\ & \text{H} & & \text{H} & & \text{O} \end{array} $ 1 (Accept full or shortened structural formula)		
(c) Any use for Kevlar, eg making ropes or making bullet-proof vests or making jackets for fencers or making clothing for motorcyclists or in aircraft wings or to line aircraft holds or in car tyres or body armour or kayaks, etc. 1		

Mark Scheme	Worth ½	Worth 0
3 (a) ${}^3_1\text{H} \rightarrow {}^3_2\text{He} + {}^0_{-1}\text{e}$ or e^- or e or β or ${}^3_1\text{H} \rightarrow {}^3\text{He} + {}^0_{-1}\text{e}$ or e^- or e or β (Ignore any charge on He; accept numbers on rhs)	1 ${}^0_{-1}\text{e}$ or e^- or e in an incorrect equation	
(b) (i) Rate of formation of tritium = rate of (beta) decay of tritium or tritium is being replaced as fast as it decays or tritium is in (dynamic) equilibrium or similar (ii) Clear identification of 3 half-lives (½) 3 x 12.3 = 36.9 years (½) (Deduct ½ for no or incorrect units; deduct ½ for negative sign)	1 Tritium is being formed as well as decaying (without indication that the rates are the same) 1 36 years 9 months	Tritium is always being formed or tritium has a long half-life or rate of rainfall is equal to rate of formation of tritium

Mark Scheme				Worth ½	Worth 0
4	(a)	(i)	Synthesis gas (syn gas)	1	
		(ii)	4 (mol)	1	
	(b)	(i)	Negative	1	
		(ii)	Time (½) and volume of hydrogen (gas) (½) (deduct ½ for each additional measurement; ignore current)	1	Volume alone or mass of hydrogen or amount of hydrogen

Mark Scheme		Worth ½	Worth 0
5	(a) Endothermic 1		
	(b) $E = mc\Delta T$ $45 = 0.2 \times 4.18 \times \Delta T$ (½) $\Delta T = 53.8\text{ }^{\circ}\text{C}$ (53 or 54) (½) (Units not required; deduct ½ for incorrect units; deduct ½ for negative sign)	1 $\Delta T = 0.053$ or 0.054	

Mark Scheme				Worth ½	Worth 0
6	(a)	(i)	Purple (pink) to colourless or purple (pink) disappears (goes away) 1	purple to clear or decolourises (goes colourless)	colourless to purple or any colour to colourless or purple to any colour
		(ii)	Temperature measured during heating is only roughly measured or because the temperature may continue to rise (change) when you stop heating or because the temperature at the end is measured accurately or there might be a time delay between heating and carrying out the experiment or during heating, the temperature of the solution may rise too quickly or because the temperature goes up when you add the oxalic acid or addition of the oxalic acid may cool the solution 1		
	(b)		More molecules (particles) have enough energy to collide successfully or more molecules have sufficient energy to react or more molecules with (kinetic) energy greater than the activation energy (Accept clearly labelled additions to the diagram) 1	molecules collide with greater energy (harder) or more successful collisions	more collisions or molecules collide more often or molecules move faster

Mark Scheme	Worth ½	Worth 0
7 (a) Answer to indicate that magnesium hydroxide is insoluble but calcium chloride is soluble, eg magnesium hydroxide is a solid or it precipitates out (can be filtered off) 1		Calcium chloride is a liquid
(b) Neutralisation 1		
(c) Indication in words or via arrow on diagram that the chlorine produced can be recycled (1) water from the neutralisation can be recycled (1) sea water is free or cheap or plentiful or renewable or similar (1) can sell other products or there are useful biproducts (1) (Any 2 out of 3) 2	Reactants can be recycled or reactants are cheap (easy to find)	Process is cheap or process uses raw materials or process uses sea water

Mark Scheme	Worth ½	Worth 0
(d) $Q = I \times t = 200\,000 \times 60$ $= 1.2 \times 10^7 \text{ C (½)}$ 1 mol Mg needs 2 mols of electrons (1) $2 \times 96\,500 \text{ C (½)}$ $1.2 \times 10^7 \text{ C} \rightarrow \frac{24.3 \times 1.2 \times 10^7}{2 \times 96\,500} \text{ (½)}$ $= 1.5 \text{ kg (½)}$ (no units required; deduct ½ for incorrect units; accept correct answer in g; deduct ½ for using 24 as relative atomic mass of Mg) 3	the use of 96 500 C	

Mark Scheme	Worth ½	Worth 0
9 (a) (i) One we need to get in the food we eat (from our diet) or one that the body cannot manufacture (make) 1 (ii) 11 1		Essential for life or needed for the body to function or vital to make protein
(b) Peptide link correctly identified 1		
(c) $ \begin{array}{ccccccc} & & & & \text{CH}_2 & & \\ & & & & & & \\ & & & & \text{C}_6\text{H}_5 & & \\ & & & & & & \\ \text{H}_2\text{N} & -\text{C}- & \text{C}- & \text{N}- & \text{C}- & \text{C}- & \text{OH} \\ & & & & & & \\ \text{CH}_3 & & \text{O} & \text{H} & \text{H} & \text{O} & \\ & & & & & & \\ \text{H} & & & & & & \end{array} $ (Accept full or shortened structural formula) 1		

Mark Scheme	Worth $\frac{1}{2}$	Worth 0
10 (a) experiment 2 curve initial gradient steeper than experiment 1 ($\frac{1}{2}$) curve levels off at approximately same volume as experiment 1 ($\frac{1}{2}$) experiment 3 curve initial gradient less steep than experiment 1 ($\frac{1}{2}$) levels off at approximately half final volume of experiment 1 ($\frac{1}{2}$) 2		
(b) 0.01 mol acid used ($\frac{1}{2}$) 1: 1 mole ratio ($\frac{1}{2}$) 0.01 x 24.3 g Mg required = 0.24 g ($\frac{1}{2}$) 0.5 – 0.24 = 0.26 g Mg unreacted ($\frac{1}{2}$) 2 or 0.01 mol acid used ($\frac{1}{2}$) no. of moles of Mg = $\frac{0.50}{24.3}$ = 0.02 mol ($\frac{1}{2}$) 0.02 – 0.01 mol = 0.01 mol unreacted ($\frac{1}{2}$) 2 = 0.01 x 24.3 = 0.24 g Mg unreacted ($\frac{1}{2}$) (No units required; deduct $\frac{1}{2}$ for incorrect units)		

Mark Scheme					Worth ½	Worth 0
11	(a)	(i)	$2\text{NH}_3 + 5/2\text{O}_2 \rightarrow 2\text{NO} + 3\text{H}_2\text{O}$ (accept multiples)	1	Equilibrium shifts to right	Catalyst is different from reactants
		(ii)	In different state from reactants	1		
		(iii)	Increases	1		
	(b)	(i)	$1 \text{ mol Cu(NO}_3)_2 \rightarrow 2 \text{ mol NO}_2 \text{ (½)}$ $187.5 \text{ g (½)} \rightarrow 48 \text{ l}$ $2.0 \text{ g} \rightarrow \frac{2.0 \times 48}{187.5} \text{ (½)} = 0.51 \text{ litres (½)}$ or $1 \text{ mol Cu(NO}_3)_2 \rightarrow 2 \text{ mol NO}_2 \text{ (½)}$ $\text{no. of moles of Cu(NO}_3)_2 = \frac{2.0}{187.5} = 0.107 \text{ mol}$ $0.107 \text{ mol} \rightarrow 0.107 \times 48 \text{ (½)} = 0.51 \text{ litres (½)}$ (Deduct ½ for no or incorrect units)	2		Diagram showing gas bubbling through water
		(ii)	Diagram showing any method of condensing the nitrogen dioxide (½) and workable way of collection (½) eg U tube in ice	1		

Mark Scheme				Worth ½	Worth 0
12	(a)	(i)	Structural formula (full or shortened) for 1,1-dichloroethane	1	
		(ii)	Reagent A hydrogen Reagent B chlorine Reagent C hydrogen chloride or hydrochloric acid (Accept formulae)	1	H for hydrogen, Cl for chlorine
	(b)		$\Delta H_c \text{ carbon} \times 2 = -394 \text{ kJ} \times 2 = -788 \text{ kJ} \text{ (}\frac{1}{2}\text{)}$ $\Delta H_c \text{ hydrogen} = -286 \text{ kJ} \text{ (}\frac{1}{2}\text{)}$ reverse $\Delta H_c \text{ ethyne} = +1300 \text{ kJ} \text{ (}\frac{1}{2}\text{)}$ addition = +226 kJ (½) (3 'sensible' numbers required for ½ mark for addition based on following through; no units required; deduct ½ for incorrect units)	2	

Mark Scheme	Worth ½	Worth 0
15 (a) $\text{H}_2\text{O}_2(\text{aq}) + 2\text{H}^+(\text{aq}) + 2\text{I}^-(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\ell) + \text{I}_2(\text{aq})$ 1 (State symbols not required; accept $\text{I}_2(\text{s})$ on right hand side of equation; deduct ½ if 2e^- shown on each side)		
(b) no. of moles of thiosulphate = $0.0050 \times 0.0149 = 7.45 \times 10^{-5}$ (½) 2 mol thiosulphate : 1 mol I_2 (1) no. of moles of $\text{I}_2 = \frac{1}{2} \times 7.45 \times 10^{-5} = 3.725 \times 10^{-5}$ (½) 1 mol $\text{I}_2 = 2 \times 126.9 = 253.8 \text{ g}$ (½) mass of $\text{I}_2 = 3.725 \times 10^{-5} \times 253.8 = 0.00945 \text{ g}$ ($9.45 \times 10^{-3} \text{ g}$) (½) (Deduct ½ for no or incorrect units) 3		

[END OF MARKING INSTRUCTIONS]