2007 Chemistry

Higher

Finalised Marking Instructions

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.

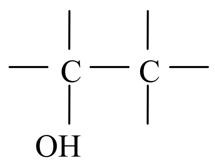
6 A half mark should be deducted for incorrect or missing units **only when stated in the marking scheme**. No marks should be deducted for incorrect or missing units at intermediate stages in a calculation.

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 – 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.

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

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.

$$\begin{array}{c} \qquad\qquad\quad CH_3 \\ \qquad\qquad\quad | \\ CH_3-CH_2-CH-CH_2-CH_2-CH_3 \end{array}$$

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.

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.

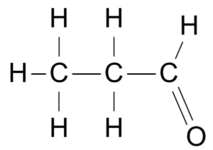
2007 Chemistry Higher

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
1	**(a)**	Electronegativity	**1**		
	(b)	Decreases **or** gets smaller	**1**		
	(c)	Bigger atom **or** larger size **or** more electron shells **or** outer electron is further from the nucleus (**or** protons) **(1)** Second mark for a further **clear** explanation, eg inner electrons (electron shells) reduce the attraction between the nucleus and the outer electron **or** Inner electrons (electron shells) shield (screen) the outer electron from the attraction of the nucleus **(1)**	**2**	With regard to second mark Less attraction **or** outer electron not attracted so much **or** because of the shielding (screening)	

Mark Scheme				Worth ½	Worth 0
2	**(a)**	Reforming	**1**		
	(b)	 (Accept full or shortened structural formula)	**1**		
	(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)**		$^{3}_{1}H \rightarrow ^{3}_{2}He + ^{0}_{-1}e$ **or** e^{-} **or** e **or** β **or** $^{3}_{1}H \rightarrow ^{3}He + ^{0}_{-1}e$ **or** e^{-} **or** e **or** β (Ignore any charge on He; accept numbers on rhs)	**1**	$^{0}_{-1}e$ **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	**1**	Tritium is being formed as well as decaying (without indication that the rates are the same)	Tritium is always being formed **or** tritium has a long half-life **or** rate of rainfall is equal to rate of formation of tritium
		(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**	36 years 9 months	

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

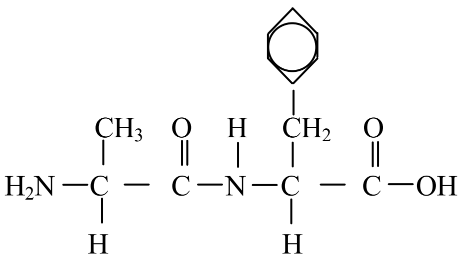
Mark Scheme				Worth ½	Worth 0
5	**(a)**	Endothermic	**1**		
	(b)	E = mcΔT 45 = 0·2 × 4·18 × ΔT (½) ΔT = 53.8 ^{o}C (53 or 54) (½) (Units not required; deduct ½ for incorrect units; deduct ½ for negative sign)	**1**	ΔT = 0.053 **or** 0.054	

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) $Q = I \times t = 200\,000 \times 60$ $= 1.2 \times 10^7$ C **(½)** 1 mol Mg needs 2 mols of electrons **(1)** 2 x 96 500 C **(½)** $1.2 \times 10^7 \text{ C} \rightarrow \dfrac{24.3 \times 1.2 \times 10^7}{2 \times 96\,500}$ **(½)** = 1.5 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
8 **(a)** Ethanoic (acetic) acid **1**		
(b) **(i)** Concentrated sulphuric acid **1** (accept $H_2\,SO_4$ with correct state symbol) **(ii)** answer to indicate use of condenser, eg paper towel soaked in cold water wrapped around (mouth of) test tube **or** cold finger inserted inside test tube **or** similar **or** use of cotton wool plug **1**	(dilute) sulphuric acid **or** H_2SO_4(aq) **or** H_2SO_4	Use of a paper towel alone **or** stopper (plug) the tube
(c) 1 mol alcohol → 1 mol ester 88 g → 130 g (½) 4·0 g → $\frac{4{\cdot}0 \times 130}{88}$ g = 5.9 g (½) 65 % yield = $\frac{65 \times 5.9}{100}$ (½) = 3.8 g (½) (No units required; deduct ½ for incorrect units) **2**		

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)  **1** (Accept full or shortened structural formula)		

Mark Scheme	Worth ½	Worth 0
10 **(a)** experiment 2 curve initial gradient steeper than experiment 1 **(**½**)** curve levels off at approximately same volume as experiment 1 **(**½**)** experiment 3 curve initial gradient less steep than experiment 1 **(**½**)** levels off at approximately half final volume of experiment 1 **(**½**)** **2**		
(b) 0.01 mol acid used (½) 1: 1 mole ratio (½) 0.01 x 24.3 g Mg required = 0.24 g (½) 0.5 – 0.24 = 0.26 g Mg unreacted (½) **2** **or** 0.01 mol acid used (½) no. of moles of Mg = $\frac{0.50}{24.3}$ = 0.02 mol (½) 0.02 – 0.01 mol = 0.01 mol unreacted (½) = 0.01 x 24.3 = 0.24 g Mg unreacted (½) **2** (No units required; deduct ½ for incorrect units)		

Mark Scheme					Worth ½	Worth 0
11	**(a)**	**(i)**	**2**NH_3 + **5/2**O_2 → **2**NO + **3**H_2O (accept multiples)	**1**		
		(ii)	In different state from reactants	**1**		Catalyst is different from reactants
		(iii)	Increases	**1**	Equilibrium shifts to right	
	(b)	**(i)**	1 mol $Cu(NO_3)_2$ → 2 mol NO_2 **(½)** 187.5 g **(½)** → 48 l 2·0 g → $\frac{2\cdot0 \times 48}{187.5}$ **(½)** = 0.51 litres **(½)**	**2**		
			or 1 mol $Cu(NO_3)_2$ → 2 mol NO_2 **(½)** no. of moles of $Cu(NO_3)_2$ = $\frac{2\cdot0}{187.5}$ **(½)** **=** 0.107 mol 0.107 mol → 0.107 × 48 **(½)** = 0.51 litres **(½)** (Deduct ½ for no or incorrect units)	**2**		
		(ii)	Diagram showing any method of condensing the nitrogen dioxide **(½)** and workable way of collection **(½)** eg U tube in ice	**1**		Diagram showing gas bubbling through water

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) ΔH_c carbon x 2 = -394 kJ x 2 = -788 kJ **(½)** ΔH_c hydrogen -286 kJ **(½)** reverse ΔH_c ethyne = +1300 kJ **(½)** 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
13	**(a)**	hydrogen bonds **(½)** which are strong **or** strong bonds between ammonia molecules **or** strong intermolecular bonding **(½)** second mark for further **clear** explanation of origins of hydrogen bonding along the lines of big difference in electronegativity between N and H **(½)** N to H covalent bonds very polar **(½)** (Accept diagram showing above points)	**2**		
	(b)	**(i)** Hydrogenation **or** addition	**1**		
		(ii) $CH_3 - CH_2 - CH_2 - CH_2 - NH_2$ (Accept full or shortened structural formula)	**1**		

Mark Scheme				Worth ½	Worth 0
14	**(a)**	To increase melting point **or** to harden the spread **or** to turn an oil into a spreadable margarine **or** to prolong shelf-life	**1**	vegetable oils have low melting points **or** are runny **or** to make them more saturated	
	(b)	It is a weak acid	**1**		
	(c)	1 mol Na ↔ 1 mol NaCl 23 g ↔ 58.5 g **(½)** 0·70 g ↔ $\frac{0.70 \times 58.5}{23}$ = 1.78 g **(½)** (No units required; deduct ½ for incorrect units)	**1**	no. of moles of Na = 0.03	

Mark Scheme	Worth ½	Worth 0
15 **(a)** $H_2O_2(aq) + 2H^+(aq) + 2I^-(aq) \rightarrow 2H_2O(\ell) + I_2(aq)$ **1** (State symbols not required; accept $I_2(s)$ on right hand side of equation; deduct ½ if $2e^-$ shown on each side)		
(b) no. of moles of thiosulphate = 0.0050 x 0.0149 = 7.45 x 10^{-5} **(½)** 2 mol thiosulphate : 1 mol I_2 **(1)** no. of moles of I_2 = ½ x 7.45 x 10^{-5} = 3.725 x 10^{-5} **(½)** 1 mol I_2 = 2 x 126.9 = 253.8 g **(½)** mass of I_2 = 3.725 x 10^{-5} x 253.8 = 0.00945 g (9.45 x 10^{-3} g) **(½)** (Deduct ½ for no or incorrect units) **3**		

[END OF MARKING INSTRUCTIONS]