2008 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.

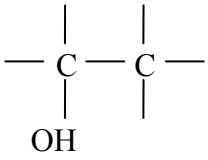
6 A half mark should be deducted for incorrect or missing units **only when stated in the marking scheme**. No marks should be deducted for incorrect or missing units at intermediate stages in a calculation.

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.

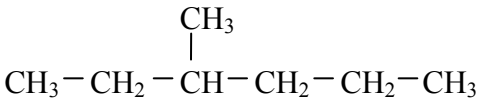
$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$$

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.

2008 Chemistry Higher

Marking Scheme

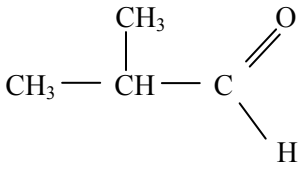
Section A

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

Mark Scheme			Worth ½	Worth 0
1	**(a)**	**CO_2** covalent molecular (or molecules) **or** discrete covalent (molecular or molecules) **1**	covalent only (discrete) molecular (or molecules) only	mention of sharing electrons **or** polar
		SiO_2 covalent network **or** covalent lattice **1**	covalent only (molecular) network **or** (molecular) lattice only **or** giant molecule	giant structure

		Mark Scheme		Worth ½	Worth 0
2	**(a)**	esters	**1**		fats (or oils)
	(b)	they react with hydrogen (or are hydrogenated) **or** they become (more) saturated (or less unsaturated) **or** they have fewer double bonds (or more single bonds) **or** the double bonds are broken	**1**	pack more closely together	become solid (or have higher melting points)
	(c)	as an energy source (or more concentrated energy source than carbohydrates) **or** provide essential fatty acids **or** carry oil soluble vitamins **or** good for health with reason given, eg lowers cholesterol	**1**		good for health without reason given **or** provide a layer of tissue for insulation **or** protect vital organs, eg kidneys

Mark Scheme			Worth ½	Worth 0
3	**(a)**	a certain volume of KI solution was measured out and the volume made up to 25 cm^3 with water (and this was repeated) **or** 20 cm^3 KI solution added to 5 cm^3 of water; 15 cm^3 KI solution to 10 cm^3 of water etc. **1**		KI solution is diluted **or** water is added **or** volume of KI is varied (or changed)
	(b)	$\text{rate} = \frac{1}{\text{time}}$ $\text{time} = \frac{1}{\text{rate}} = \frac{1}{0.043}\ (½) = 23.3\ \text{s}$ (½) **1** (no units required; deduct ½ mark for incorrect units)		

Mark Scheme				Worth ½	Worth 0
4	**(a)**	synthesis gas (syn gas)	**1**		synthetic gas
	(b)	 **or** $CH_3CH(CH_3)CHO$	**1**		structure of a ketone
	(c)	**(i)** any mention of silver being formed (deposited), eg silver mirror	**1**		precipitate forms
		(ii) in a water bath **or** no naked flames **or** use water heated in a kettle	**1**		
	(d)	primary	**1**		giving the name of an alcohol, eg butan-1-ol

Mark Scheme	Worth ½	Worth 0
5 **(a)** β **or** $^{0}_{-1}e$ **or** e^{-} **or** e **or** beta (particle) **1** **(b)** **(i)** curve down through points: Time/hours 0 6 **(½)** 12 18 24 **(½)** Mass/g 0.5 0.25 0.125 0.06 0.03 **1** **(ii)** short half-life (**or** little will remain in the body after a short time) **or** not as ionising (as other radiation) **or** can pass right through the body (**or** can escape from the body) **1**		not damaging **or** not enough of it

Mark Scheme				Worth ½	Worth 0
6	**(a)**	**(i)**	benzene does not (rapidly) decolourise bromine (solution or water) **1**	the bromine test **or** using bromine (solution or water)	
		(ii)	mention of delocalised electrons (in ring of C atoms) **or** C to C bonds are all of equal length **or** planar molecule **or** bond angles of 120º **1** (any 2 points; ½ mark each)	correct structure of benzene without mention of delocalised electrons	no C to C double bonds
	(b)		reforming (or reformation) **or** dehydrogenation **1**		
	(c)		increases efficiency of burning (or fuel performance or octane number) **or** cuts down auto ignition (or knocking) **1**		to improve the blend **or** makes petrol more useful **or** makes petrol more volatile **or** makes petrol easier to ignite

Mark Scheme			Worth ½	Worth 0
7	**(a)**	depletion of the ozone layer (or similar) **1**		they break down (to release chlorine) **or** mention of pollution
	(b)	1 mol CaF_2 → 2 mol HF (½) 78 g (½) → 48 l 1000 g → $\frac{1000 \times 48}{78}$ (½) = 615 litres (½) **2** **or** 1 mol CaF_2 → 2 mol HF (½) no. of moles of CaF_2 = $\frac{1000}{78}$ (½) = 12.82 mol 12.82 mol → 25.6 × 24 (½) = 615 litres (½) **2** (deduct ½ mark for no or incorrect units)		

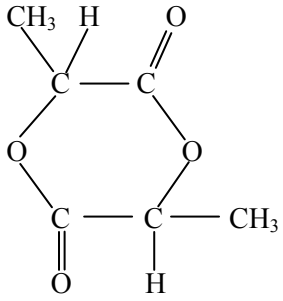
Mark Scheme				Worth ½	Worth 0
8	**(a)**	$2B_2O_3 + 7C \rightarrow B_4C + 6CO$	**1**		
	(b)	diagram showing any workable method of producing CO_2 (½) with calcium carbonate and dilute hydrochloric acid labelled (½) and removing CO_2 (½) with chemical labelled, eg sodium hydroxide solution, lime water, alkali (½) (accept correct formulae for labelled chemicals)	**2**		
	(c)	incomplete (or inefficient) combustion (of fuel) **or** similar eg not enough oxygen	**1**		

Mark Scheme				Worth ½	Worth 0
9	**(a)**	weak (½) van der Waals' forces (½) second mark for further **clear** explanation of origins of van der Waals' forces along the lines of instantaneous (or momentary or non-permanent) dipoles (or attractions) (½) caused by movement of electrons (½) **2**		molecules are non-polar	
	(b)	**(i)** to saturate the (porous) carbon rods with (hydrogen) gas **or** the gas trapped in the carbon rods leads to an error **or** to steady the current **1**			to ensure no impurities **or** to ensure the circuit (or apparatus) is working **or** to purify the gas
		(ii) $Q = I \times t = 10 \times 60 \times 0.30 = 180$ C (½) 1 mol H_2 needs 2 moles of electrons (½) = $2 \times 96\,500$ C (½) 180 C $\rightarrow$ $\frac{2 \times 180}{2 \times 96\,500} = 0.00187$ g (½) **2** (no units required; deduct ½ mark for incorrect units)		the use of 96 500 C	
	(c)	$[H^+] \times [OH^-] = 10^{-14}$ (½) $[OH^-] = 10^{-13}$ mol l^{-1} (½) **1** (no units required; deduct ½ mark for incorrect units)			

Mark Scheme				Worth ½	Worth 0
10	**(a)**	any suitable indication of point at which curves start to level off on concentration axis, eg by a vertical line or arrow	**1**		
	(b)	the ratio of moles of reactant (gas): moles of product (gas) is 1:1 **or** the number of (gaseous) molecules is the same on both sides of the equation	**1**		equal quantities of gas
	(c)	propene and cyclopropane curves both level off at the same concentrations as in graph on left hand page; ignore time axis	**1**		

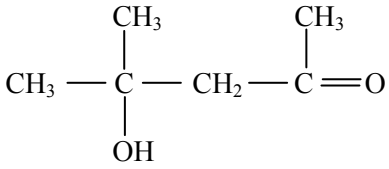
		Mark Scheme		Worth ½	Worth 0
11	**(a)**	alcohols do not contain OH^- (hydroxide) ions (or the OH in alcohols is not ionic) **or** alkalis contain OH^- (hydroxide) ions (or the OH is an ion in alkalis)	**1**	alcohols do not ionise in water	alcohols are neutral **or** alkalis ionise water
	(b)	potassium iodide contains iodide ions (or potassium iodide is ionic) (½) iodine molecules (or iodine the element) forms the blue/black colour with starch (½)	**1**	potassium iodide is a compound **or** iodine is an element	the iodine in a compound is different

Mark Scheme				Worth ½	Worth 0
12	**(a)**	the idea that the **shape** of the reactant (substrate) molecule must fit the enzyme **or** lock and key diagram(s) **1**		the active sites on the enzyme only accepts certain reactant (substrate) molecules	enzymes are specific
	(b)	$C_6H_4(OH)_2(aq) \rightarrow C_6H_4O_2(aq) + H_2(g)$	+177.4 kJ mol^{-1} (½)		
		$H_2O_2(aq) \rightarrow H_2(g) + O_2(g)$ reverse	+191.2 kJ mol^{-1} (½)		
		$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$ × 2	-438.6 kJ mol^{-1} (½)		
		$2H_2O(g) \rightarrow 2H_2O(\ell)$ × 2	-87.6 kJ mol^{-1} (½)		
		answer = -202.6 kJ mol^{-1} **2**			
		(deduct ½ mark for incorrect addition based on numbers used; no units required; deduct ½ mark for incorrect units)			

Mark Scheme				Worth ½	Worth 0
13	**(a)**	hydroxyl	**1**		
	(b)	**(i)** biopol or other biodegradable polymer eg starch, cellulose, protein, poly(ethenol)	**1**		carbohydrate
		(ii) idea of all the reactants being allowed to be used up (or reaction goes until it stops) (and then products are removed) before fresh reactants are added (or the process is restarted)	**1**	products made some at a time **or** used to make small amounts	not continuous **or** made in batches **or** an example of a batch process eg making aspirin
		(iii)  **or** $CH_3CH(CH_3)CHO$	**1**		

Mark Scheme				Worth ½	Worth 0
14	**(a)**	homogeneous	**1**		
	(b)	**(i)** no effect	**1**		
		(ii) E = m c ΔT = 0·1 (½) × 4·18 × 16 = 6.69 kJ (½) 1000 cm^3 of H_2O_2(aq) ↔ 0.88 mol 50 cm^3 of H_2O_2(aq) ↔ $\frac{0.88 \times 50}{1000}$ (½) = 0.044 mol (½) 0.044 mol ↔ 6.69 kJ 1 mol ↔ $\frac{6.69 \times 1}{0.044}$ = 152 kJ (½) include negative sign in final answer -152 kJ (½) (units not required; deduct ½ mark for incorrect units)	**3**		

Mark Scheme				Worth ½	Worth 0
15	**(a)**	**(i)**	$HO - CH_2 - CH_2 - OH$ **1**		
		(ii)	sodium chloride will cause rusting **1**		damages the engine (or paintwork)
	(b)		butane **1**		

Mark Scheme			Worth ½	Worth 0
16	**(a)**	 **1**		
	(b)	methanal **or** 2, 2-demethylpropanal **or** formaldehyde **1**		
	(c)	water is not a product of the reaction **or** no small molecule produced **or** it is an addition reaction **1**		water is not involved in the reaction

Mark Scheme				Worth ½	Worth 0
17	**(a)**	$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(\ell)$ (state symbols not required)	**1**		
	(b)	there is a colour change from colourless to purple (or purple to colourless) **or** the reaction is self-indicating (or a colour change shows the end of the reaction)	**1**	there is a colour change	
	(c)	**(i)** first titre is a rough (or approximate) result **or** not accurate **or** an estimate **or** too far away from the others	**1**		
		(ii) no. of moles of $MnO_4^-(aq) = 0.040 \times 0.0269 = 0.001$ (½) ratio of $(COOH)_2(aq) : MnO_4^-(aq) = 5 : 2$ (½) no. of moles of $(COOH)_2(aq)$ in 25 $cm^3 = 2.5 \times 0.001 = 0.0025$ (½) no. of moles of $(COOH)_2(aq)$ in 500 $cm^3 = 0.0025 \times \frac{500}{50} = 0.05$ (½) (no units required; deduct ½ mark for incorrect units)	**2**		

[END OF MARKING INSTRUCTIONS]