2012 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.

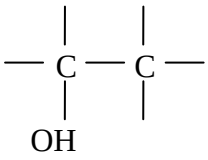
6 A half mark should be deducted for incorrect or missing units **only when stated in the marking scheme**. No marks should be deducted for incorrect or missing units at intermediate stages in a calculation.

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.

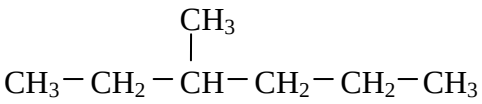
$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$$

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.

2012 Chemistry Higher

Marking Scheme

Section A

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

Mark Scheme				Worth ½	Worth 0
1	**(a)**	Boron or Carbon or B or C or graphite or diamond	**1**		Silicon
	(b)	Number of protons <u>increases</u> **or** <u>increased</u> atomic number **or** <u>greater</u> nuclear/positive charge (pull) **or** <u>greater</u> pull on (outer) electrons	**1**		Increased number of electrons **or** larger nucleus **or** stronger nucleus **or** any answer which does not indicate an <u>increase</u> in pull/charge

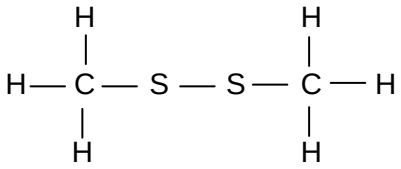
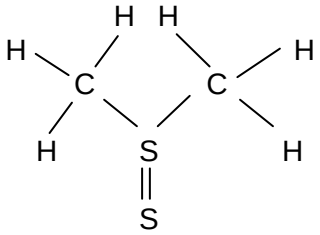
Mark Scheme					Worth ½	Worth 0
2	**(a)**	To prevent loss of any solution/spray/acid from flask or To allow gas to escape Or Spurting Or To stop any <u>solids/liquids</u> getting in/out		**1**		To prevent anything from escaping from the flask Answers given only in terms of preventing evaporation / condensers
	(b)	**(i)** 0.017 Units not required Deduct ½ mark for incorrect units	1 mark	**1**	Change in mass = 0.17 ½ mark Allow follow through from incorrect change in mass for ½ mark (165.00-164.83)/10 but with incorrect arith ½ mark	
		(ii) Answer between 0.37and 0.4 Units not required No penalty for incorrect units in this question	1 mark	**1**		

Mark Scheme				Worth ½	Worth 0
3	**(a)**	$E_h = cm\Delta T$ Correct substitution of data $= 4.18 \times 0.5 \times 82$ ½ mark $= \pm 171$ kJ (no units required) ½ mark (Deduct ½ mark if incorrect units are given here only if this is the end of the candidate's answer) Or $4.18 \times 500 \times 82$ ½ mark $= \pm 171000$ J (no units required) ½ mark (Deduct ½ mark if incorrect units are given here only if this is the end of the candidate's answer) Number of moles required = $\frac{171}{1367}$ ½ mark Answer 0.12 or 0.125 or 0.13 moles ½ mark (Candidates can work consistently work in J rather than kJ) (5.75 g – 1 ½ marks)	**2**		

Mark Scheme				Worth ½	Worth 0
(b)	Heat lost to surroundings	1 mark	**2**		Evaporation of water
	Incomplete combustion (of alcohol)	1 mark			
	Ethanol impure	1 mark			
	Loss (of ethanol) through evaporation	1 mark			

Mark Scheme				Worth ½	Worth 0
4	**(a)**	$^{89}Sr \rightarrow {}^{89}Y + \beta$ or $^{89}_{38}Sr \rightarrow {}^{89}_{39}Y + {}^{0}_{-1}e$ Atomic numbers not required- if shown, they must be correct Mass numbers shown top left as in question paper	**1 or 0**		
	(b)	**(i)** No effect/no change	**1 or 0**		
		(ii) $\frac{89}{160} \times 10 = 5.56\text{g or } 5.6\text{g}$ (No units required; deduct ½ for incorrect units) Please check any working provided for this question as 5.6 can be the product of incorrect calculations.	**1 or 0**	Correct formula mass of $SrCl_2$ = 160	Answers calculated using ram of 87.6 for Sr Answers calculated using 158.6 as gfm for $SrCl_2$
	(c)	¼ or 0.25 or 25%	**1**	For identifying 2 half-lives ½	

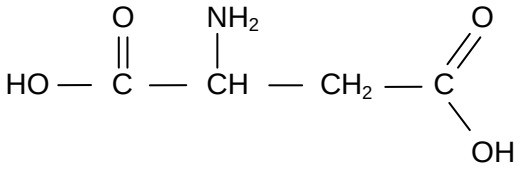
Mark Scheme				Worth ½	Worth 0
5	**(a)**	110 (cm^3) ½	**2**		
		For the value 6.02×10^{23} ½			
		(24 litres) 24,000 $cm^3 \rightarrow 6{\cdot}02 \times 10^{23}$			
		For the ratio $\frac{110}{24000}$ or 4.58×10^{-3} ½			
		(0·110 litres) 110 $cm^3 \rightarrow 110/24000 \times 6{\cdot}02 \times 10^{23}$			
		$= 2.76 \times 10^{21}$ ½			
	(b)	$CH_3CH_2OH + O_2 \rightarrow CH_3COOH + H_2O$	**1 or 0**		Equations showing electrons
		or			
		$CH_3CH_2OH+O_2 + 4H^+ + H_2O \rightarrow 2H_2O+CH_3COOH + 4H^+$			
		or any balanced equation <u>not</u> showing electrons			
	(c)	Catalyst/reactants different state	**1 or 0**		Any mention of products
		They are in different (chemical) states			

Mark Scheme		Worth ½	Worth 0
6 **(a)**   Or any structure for an expansion of the shortened structural formula $CH_3S_2CH_3$ containing • 6 hydrogen atoms, valency 1 • 2 carbon atoms, valency 4 • 2 sulphur atoms, valency 2 or 4 or 6 All Bonds must be shown	**1**		Shortened structural formulae

Mark Scheme	Worth ½	Worth 0
(b) (i) Either moles Cl_2 $0{\cdot}010 \times 0{\cdot}0294 = 2{\cdot}94 \times 10^{-4}$ (½) moles H_2S $2{\cdot}94 \times 10^{-4}/4 = 7{\cdot}35 \times 10^{-5}$ (½) conc^n H_2S $\frac{7.35\times10^{-5}}{0.05}$ (½) $= \underline{1{\cdot}47 \times 10^{-3}}$ (½) OR Candidates may use a "titration" formula of which an example is shown below. $\frac{c_1 v_1}{b_1} = \frac{c_2 v_2}{b_2}$ For inserting the correct "stoichiometric" values in this equation award (½) [eg $b_1 = 4$ and $b_2 = 1$ if the student had decided to make substance "one" the chlorine] $\frac{29.4 \times 0.01}{4} = \frac{c_2 \times 50.0}{1}$ For inserting the correct pairings of concentrations of volumes (can be in litres or in cm^3) (½) $c_2 = \frac{29.4 \times 0.01}{4 \times 50.0}$ For correct rearrangement (½) Concentration of $H_2S = 1.47 \times 10^{-3}$ (½) **2** (Units not required, deduct ½ mark for incorrect unit)		

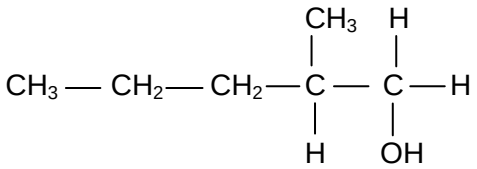
Mark Scheme			Worth ½	Worth 0
(ii)	This question is divided into two separate marks, each subdivided <u>First Mark</u> Permanent dipole-permanent dipole attractions or polar-polar attractions/forces ½ weak intermolecular bonds/forces ½ <u>Second Mark</u> *If they have named pd-pd then*<u>:</u> Mention of difference in electronegativities or indication of polar bonds or indication of permanent dipole 1 mark *If they have named VdW/LDF* instantaneous dipoles or temporary dipoles or uneven distribution of electrons or electron wobbles 1	**2**		

	Mark Scheme		Worth ½	Worth 0
7	**(a)** w=9 x=6 y=2 z=2 or $C_9H_6N_2O_2$. Accept atoms in any order	**1**		
	(b) no elimination of a small molecule (such as water) or the monomers have <u>added across</u> the (N=C) double bond or only one product molecule formed or joined across the (N=C) double bond	**1**		Molecules add together Answers only mention the <u>breaking</u> of a double bond Answers only mentioning changes in saturation
	(c) Dotted lines between H/N or H/O on adjacent polymer chains	**1**		Dotted lines drawn to H-C atoms

		Mark Scheme		Worth ½	Worth 0
8	**(a)**	Amide link or peptide link or peptide bond	**1**		Amine or amino or cabonyl
	(b)	Correctly drawn amino acid structure  (Suspend General Marking Instructions 9 & 10- in the case of ambiguity)	**1**		Structures where connectivity is clearly wrong
	(c)	Essential	**1 or 0**		
	(d)	Wet paper towel (condenser) or cold finger test tube (1) Use a condenser (1) Raise the test-tube so that a greater length of the test-tube is above the hot water, but with the reaction mix still immersed or lower the level of the water (1)			Bung Lower the temperature of the water bath Add/change the catalyst Change in temperature

		Mark Scheme		Worth ½	Worth 0
9	**(a)**	Bromine (water)/iodine (solution) ½ Either Oleic decolourises ½ or stearic does not decolourise / decolourises slowly ½ Do not award the second half mark if colour change given is incorrect. Do not award the second half mark if the fatty acids are not named.	**1**		"Goes clear" used in place of decolourises forfeits second half mark
	(b)	Octadec -9, 12, 15 –trienoic acid Octadeca-9, 12, 15 – trienoic acid (allow the interchange of hyphens and commas)	**1**		Octadec-9,12,15-trinoic acid
	(c)	Circle either O^-Na^+ or CO^-Na^+ or COO^-Na^+ or O^- or $C\text{-}O^-$ or COO^-	**1**		Any structure containing CH C=O on its own Na^+ on its own

Mark Scheme				Worth ½	Worth 0
10	**(a)**	Air	**1 or 0**		
	(b)	Methyl methanoate	**1 or 0**		
	(c)	**70% 2 marks** Either $HCOOH \rightarrow HCONH_2$ 1 mole 1 mole 46g 45g ½ 1·38g <u>1·35</u>g ½ % yield = $\frac{0{\cdot}945g}{1{\cdot}35g} \times 100$ ½ = 70% ½ **OR** moles $HCOOH \rightarrow 1{\cdot}38/46 = 0{\cdot}03$ ½ moles $HCONH_2 \rightarrow 0{\cdot}945/45 = 0{\cdot}021$ ½ $HCOOH \rightarrow HCONH_2$ 0·03 moles → 0·03 moles % yield = 0·021/0·03 × 100 ½ = 70% ½	**2**		0·945/1·38 × 100 → 68·5%

Mark Scheme					Worth ½	Worth 0
11	**(a)**	**(i)**	3-methyl butan-2-ol (with or without the hyphens)	**1 or 0**		3-methyl but-2-ol
		(ii)	 Any correct structural formula for 2-methylpentan-1-ol (Suspend General Marking Instructions 9 & 10- in case of ambiguity)	**1**		Structures when connectivity is clearly wrong
	(b)	**(i)**	$4BF_3 + 3\ NaBH_4 \longrightarrow 2B_2H_6 + 3\ NaBF_4$ (Or multiples)	**1**		
		(ii)	-36 kJ -1274 kJ 3 × -286 = -858 kJ ½ mark for each correct enthalpy change plus ½ mark for addition of 3 sensible numbers -2168 kJ mol^{-1} (2) Omission of units or incorrect units -½ (although permit kJ)	**2**		

Mark Scheme	Worth ½	Worth 0
(c) 143444 OR -143444 OR 143000 OR -143000 OR 145000 or -145000 (1) Units not required, if incorrect units -½ (Accept kJ mol^{-1} in place of kJ) or 143 MJ (1) (Do not penalise rounding or for sign)		

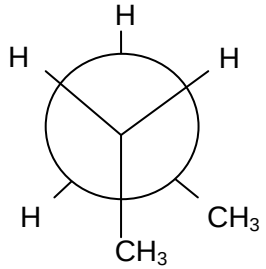
		Mark Scheme		Worth ½	Worth 0
12	**(a)**	To allow the potato discs/catalase to reach the pH of the buffer or To allow buffer to soak/diffuse into the potato disc or A statement to the effect- to allow the enzyme/potato to reach the same pH as the surrounding solution or To allow the enzyme/potato to acclimatise	**1**		To neutralise with the buffer To allow it time to react To let it mix To let it settle
	(b)	hydrogen peroxide/H_2O_2	**1**	peroxide	
	(c)	The enzyme is denatured Or The enzyme changes its shape Or Enzymes work best at an optimum pH Or Too acidic for enzyme to function Or Enzyme is destroyed Or Enzyme has stopped working	**1**		Enzyme is inhibited Enzyme is killed

Mark Scheme				Worth ½	Worth 0
13	**(a)**	$Q = I \times t = 5{\cdot}0 \times 60 \times 32 = 9600$ C (½) 1 mol F_2 needs 2 moles of electrons = <u>2 × 96 500 C</u> (½ for 2F) 193000 C → 38g (½ for 38g) 9600 C → 1.89g (½) (no units required; deduct ½ mark for incorrect units) Candidates who use 1F and 19g will get 1.89 g which should then only be awarded 1 mark	**2**		
	(b)	**(i)** exothermic or heat given out or ΔH is –ve or ΔH<0	**1**		
		(ii) Graph shows as pressure increases/conc^n C_2F_4 decreases. Line sloping <u>downward</u>	**1**		
	(c)	depletion/break down etc of the ozone layer	**1**		Any answer including <u>any mention</u> of • Global warming • Acid Rain • Pollute atmosphere • Greenhouse gases

Mark Scheme					Worth ½	Worth 0
14	**(a)**	**(i)**	$[H^+(aq)] = 1 \times 10^{-5}$ mol l^{-1} (Units not required, incorrect units – ½)	**1**		
		(ii)	The marks for this question are divided into two separate marks- The first mark is awarded for the ammonia/ammonium equilibrium. NH_3 (aq) + H_2O (ℓ) ⇆ NH_4+ (aq) + OH^-(aq) For this equation on its own (½) If the candidate indicates that they appreciate that the position of this equilibrium is such that the ammonium ions tend to remove OH^- ions from solution eg NH_4^+ (aq) OH^- (aq) → NH_3 + H_2O eg NH_4^+(aq) + OH^-(aq) → NH_4OH or suitable description in words (1) The second mark is awarded for the water equilibrium. H_2O (ℓ) ⇆ H^+ (aq) + OH^- (aq) For this equation on its own (½) If the candidates that they appreciate that water molecules dissociate resulting in an increased H^+ ion concentration Eg H_2O (ℓ) → H^+ (aq) + OH^- (aq) or suitable description in words (1)	**2**	If the candidate has neither given the equations opposite, nor explained these reactions as text, they may get 1 mark for stating that Ammonium nitrate is (the salt) of a strong acid/weak base	Excess hydrogen ions (on its own)

Mark Scheme		Worth ½	Worth 0
(b) Answers showing an appreciation that a large volume or large number of moles of gas is produced (1) **OR** There is an increase in the number of moles of gas **OR** Oxygen gas is produced which can support combustion (1) **OR** It is an oxidising agent (1)	**1**		Oxygen is flammable Answers given only in terms of pressure with no mention of increasing number of moles of gas Oxygen is produced

Mark Scheme				Worth ½	Worth 0
15	**(a)**	**(i)**	to keep the current/amps constant or to adjust the current/amps **1**		Answers mentioning voltage
		(ii)	the current (½) and the time (½) (deduct ½ for each additional measurement if more than two measurement suggested; ignore vol. of gas)		
	(b)	**(i)**	Recycle/reuse the $\underline{SO_2}$ and/or $\underline{H_2O}$ (1) Or O_2 can be sold (1)	Releases energy (½)	Because the H_2SO_4 is made in step 1 Reuse products (not named)
		(ii)	$H_2O \rightarrow H_2 + ½O_2$ or $2H_2O \rightarrow 2H_2 + O_2$ **1**		

Mark Scheme		Worth ½	Worth 0
16 **(a)**	**1 or 0**  (General Marking Instruction 10 does apply)		
(b)	2-methylbutane (1) (do not penalise for missing hyphen) or methylbutane (1) or isopentane (1) **1**		$CH_3—CH(CH_3)—CH_2—CH_3$ 3-methylbutane pentane

[END OF MARKING INSTRUCTIONS]