National Qualifications 2016

2016 Chemistry

National 5

Finalised Marking Instructions

General Marking Principles for National 5 Chemistry

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 detailed marking instructions, which identify the key features required in candidate responses.

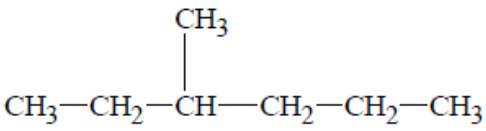
(a) Marks for each candidate response must always be assigned in line with these General Marking Principles and the specific Marking Instructions for this assessment.

(b) 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.

(c) Marking should always be positive. This means that, for each candidate response, marks are accumulated for the demonstration of relevant skills, knowledge and understanding: they are not deducted from a maximum on the basis of errors or omissions.

A guiding principle in marking is to give credit for correct chemistry rather than to look for reasons not to award 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 mark.

(d) **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 in the table

Structural formula	*pH*
CH_3COOH	1·65
$CH_2ClCOOH$	1·27
$CHCl_2COOH$	0·90
CCl_3COOH	0·51

State how the strength of the acids is 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 mark.

(e) There are no half marks awarded.

(f) Candidates must respond to the "command" word as appropriate and may be required to write extended answers in order to communicate fully their knowledge and understanding.

(g) Marks should be awarded for answers that have 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.

However the example below would not be given any credit, as an incorrect chemical term, which the candidate should know, has been given.

Example: If the correct answer is "ethene", and the candidate's answer is "ethane", this should not be accepted.

(h) A correct answer followed by a wrong answer should be treated as a cancelling error and no marks should be awarded.

Example: State what colour is seen when blue Fehling's solution is warmed with an aldehyde.
The answer 'red, green' gains no marks.

(i) If a correct answer is followed by additional information which does not conflict, the additional information should be ignored, whether correct or not.

Example: State why the tube cannot be made of copper.
If the correct answer is related to a low melting point, 'Copper has a low melting point and is coloured grey' would **not** be treated as having a cancelling error.

(j) Unless a numerical question specifically requires evidence of working to be shown, full marks should be awarded for a correct final answer (including units if required) on its own.
The partial marks shown in the marking scheme are for use when working is given but the final answer is incorrect. An exception is when candidates are asked to 'Find, by calculation', when full marks cannot be awarded for the correct answer without working.

(k) Where the marking instructions specifically allocate a mark for units in a calculation, this mark should not be awarded if the units are incorrect or missing. Missing or incorrect units at intermediate stages in a calculation should be ignored.

(l) As a general rule, where a wrong numerical answer (already penalised) is carried forward to another step, credit will be given provided the result is used correctly. The exception to this rule is where the marking instructions for a numerical question assign separate "concept marks" and an "arithmetic mark". In such situations, the marking instructions will give clear guidance on the assignment of partial marks.

(m) Ignore the omission of one H atom from a full structural formula provided the bond is shown or one carbon to hydrogen bond missing provided the hydrogen is shown.

(n) A symbol or correct formula should be accepted in place of a name **unless stated otherwise in the marking instructions.**

(o) 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.

(p) If an answer comes directly from the text of the question, no marks should be awarded.

Example: A student found that 0·05 mol of propane, C_3H_8 burned to give 82· 4 kJ of energy.

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

Name the type of enthalpy change which the student measured.

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

(q) Unless the question is clearly about a non-chemistry issue, eg costs in industrial chemical process, a non-chemical answer gains no marks.

Example: Suggest why the (catalytic) converter has 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 awarded.

Part Two: Marking Instructions for each question

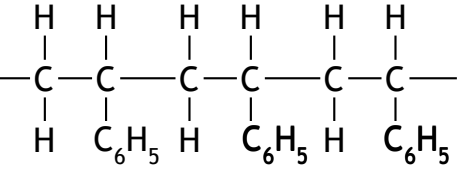
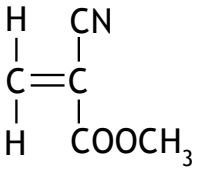
Section 1

Question	Answer	Max Mark
1.	D	**1**
2.	C	**1**
3.	D	**1**
4.	B	**1**
5.	B	**1**
6.	C	**1**
7.	A	**1**
8.	C	**1**
9.	B	**1**
10.	C	**1**
11.	B	**1**
12.	B	**1**
13.	A	**1**
14.	C	**1**
15.	D	**1**
16.	D	**1**
17.	A	**1**
18.	A	**1**
19.	C	**1**
20.	B	**1**

Section 2

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Max Mark</th><th>Additional Guidance</th></tr>
<tr><td>1.</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><td colspan="3">In the Nucleus</td></tr>
<tr><td>Particle</td><td>Relative Mass</td><td>Charge</td></tr>
<tr><td>Proton</td><td>1</td><td></td></tr>
<tr><td>Neutron</td><td></td><td>0
neutral
no charge</td></tr>
</table>
BOTH REQUIRED
</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>
<table>
<tr><td colspan="3">Outside the Nucleus</td></tr>
<tr><td>Particle</td><td>Relative Mass</td><td>Charge</td></tr>
<tr><td>ELECTRON</td><td></td><td>–
−1
negative</td></tr>
</table>
BOTH REQUIRED
</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>14·5</td><td>1</td><td>Accept 14·5 g or 14·5 amu.</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>Pyramidal
OR
Trigonal pyramidal</td><td>1</td><td>Zero marks awarded for trigonal on its own.

Zero marks awarded for ‘pyramid’.</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Haber</td><td>1</td><td></td></tr>
</table>

Question			Answer	Max Mark	Additional Guidance
2.	(a)		 With or without brackets	**1**	Do **not** deduct mark if one end bond is missing. Do **not** deduct mark if one end bond is shown with other end having an H in place of second end bond. Allow dot or ~ to represent end bond. Zero marks awarded if **both** end bonds are missing/both ends have H/less than or more than three monomers shown/bond between two carbons missing.
	(b)			**1**	Zero marks awarded if candidate draws **both monomers**, unless they have clearly identified the acrylonitrile monomer.

Question			Answer	Max Mark	Additional Guidance
3.	(a)		Exothermic **OR** exothermal	**1**	Zero marks awarded for 'combustion'. This also negates a correct answer.
	(b)	(i)	0·85 with no working 2 marks $\frac{29-12}{30-10}$ or $\frac{12-29}{10-30}$ **OR** 17/20 **(1)** 0·85 **(1)**	**2**	1 mark awarded for – correct method (ie change in volume/change in time) but incorrect arithmetic using correct values from table. 1 mark awarded for – correct method but incorrect values **from the table** used (subtractions must be shown and volumes chosen **must** correspond to chosen times). Award zero marks awarded if correct method is used but values are **not** in the table. Unit is not required however if the wrong unit is given do **not** award second mark. Acceptable units are $cm^3 s^{-1}$ **or** cm^3/s **or** cubic centimetres per second **or** cm^3 per second. Do not accept cm^3/s^{-1} **or** $cm^{3\ s-1}$ **or** cm3s−1 etc. 's' is the only acceptable abbreviation of second.
		(ii)	Any value greater than 50 and less than or equal to 60.	**1**	Zero marks awarded if correct answer given with incorrect unit of time (eg minutes). 's' is the only acceptable abbreviation of second.

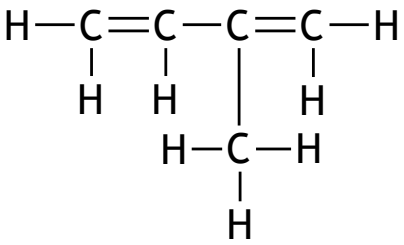
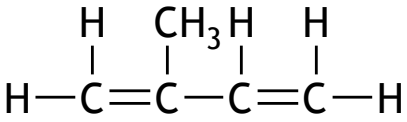
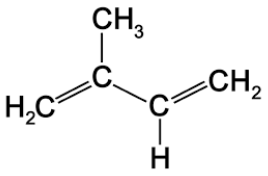
Question			Answer	Max Mark	Additional Guidance
3.	(b)	(iii)	Faster / quicker / increase /speed up	**1**	Zero marks awarded for less time, but does **not** negate. Zero marks awarded for "fast" reaction without comparison. Incorrect explanation negates eg the reaction speeds up due to increase in particle size.
	(c)	(i)	$Al(NO_3)_3$ circled, underlined etc	**1**	
		(ii)	0·36 with no working 2 marks 0·01 moles gives 0·015 moles **(1)** 0·015 × 24 = 0·36 **(1)** **This step on its own 2 marks**	**2**	If correct mole ratio (2:3) applied **and** answer of 36 eg 1·5 x 24 given award max 1 mark (working must be shown). If candidate shows mass of aluminium accept 54g to 72l or 27g to 36l for 1 mark Zero marks awarded for 0·01 × 24 = 0·24 Unit is not required however if the wrong unit is given do **not** award final mark.

Question			Answer	Max Mark	Additional Guidance
4.	(a)	(i)	Andalusite and kyanite **BOTH REQUIRED**	**1**	
		(ii)	<table><tr><td>Temperature (^{o}C)</td><td>490 – 510</td></tr><tr><td>Pressure (kbar)</td><td>3·9 – 4·1</td></tr></table> **BOTH REQUIRED**	**1**	
	(b)		17 or 17·28 or 17·3 with no working 3 marks GFM 162 **(1)** 28/162 × 100 (concept mark) **(1)** **This step on its own 2 marks** 1 mark for correct arithmetic to give final answer (this mark can only be awarded if the concept mark has been awarded).	**3**	Maximum 2 marks if candidate correctly calculates percentage of aluminium (33 or 33·3 %) or oxygen (49 or 49·38 or 49·4 %) rather than silicon but **working must be shown.** Maximum 2 marks if atomic numbers are used (17·5 % of silicon) but **working must be shown.** If candidate incorrectly rounds to 17·2 then a maximum of 2 marks can be awarded only if working is shown. If value divided by 162 does not correspond to an element in the compound award a maximum of 1 mark. Unit is not required however if the wrong unit is given do **not** award final mark.

Question			Answer	Max Mark	Additional Guidance
5.	(a)		Unreactive **OR** does not react with water/air/alkalis/ (almost all) acids **OR** Can be beaten into shape **OR** Found uncombined	**1**	Zero marks awarded for phrases like "associated with wealth" on their own but do **not** negate correct answer. Zero marks awarded for soft on its own but does **not** negate.
	(b)		118	**1**	
	(c)	(i)	$CO + O_2 \longrightarrow CO_2$ **ALL CORRECT FOR 1 MARK** **OR** $CO + O_2 \xrightarrow{Au} CO_2$	**1**	If equation is balanced then it needs to be correct eg $2CO + O_2 \longrightarrow 2CO_2$ $CO + \frac{1}{2}O_2 \longrightarrow CO_2$ Zero marks awarded for $CO + O_2 = CO_2$ $CO + O_2 + Au \longrightarrow CO_2 + Au$ State symbols should be ignored. Zero marks awarded for a word equation on its own but this does **not** negate a correct formulae equation.
		(ii)	Catalyst **OR** catalysis **OR** speeds up the reaction **OR** allows less energy/heat to be used for the reaction **OR** lowers activation energy	**1**	Zero marks awarded for spectator ion and this negates correct answer.
	(d)		hydroxide hydrogen hydroxide hydrogen **BOTH REQUIRED**	**1**	

Question			Answer	Max Mark	Additional Guidance
6.	(a)	(i)	Flame test or correct description e.g. burn it/fertiliser/potassium, put in Bunsen flame etc. **AND** purple/lilac **Both required**	**1**	Mention of burning the plant negates correct answer.
		(ii)	To add/provide/supply nitrogen or it contains nitrogen. Any wording that implies that plants need nitrogen.	**1**	Zero marks awarded for 'essential/key element' on its own but does **not** negate correct answer. Zero marks awarded for 'to make plants grow better' on its own but does **not** negate correct answer.
	(b)		$H_3PO_4 + \mathbf{3}NH_4OH \longrightarrow (NH_4)_3PO_4 + \mathbf{3}H_2O$ If rewritten accept $H_3PO_4 + \mathbf{3}NH_4OH \downarrow (NH_4)_3PO_4 + \mathbf{3}H_2O$	**1**	Accept correct multiples If equation is rewritten, **all** formulae must be correct and correct format see marking instructions for Question 10c(ii). If state symbols are given they must be correct.

Question			Answer	Max Mark	Additional Guidance
7.	(a)		This is an open ended question **1 mark:** The student has demonstrated a limited understanding of the chemistry involved. The candidate has made some statement(s) which is/are relevant to the situation, showing that at least a little of the chemistry within the problem is understood. **2 marks:** The student has demonstrated a reasonable understanding of the chemistry involved. The student makes some statement(s) which is/are relevant to the situation, showing that the problem is understood. **3 marks:** The maximum available mark would be awarded to a student who has demonstrated a good understanding of the chemistry involved. The student shows a good comprehension of the chemistry of the situation and has provided a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. This does not mean the answer has to be what might be termed an "excellent" answer or a "complete" one.	**3**	

Question			Answer	Max Mark	Additional Guidance
8.	(a)		The correct structural formula for isoprene eg  OR  However if CH_3 is used the bond must be going to the carbon	**1**	Zero marks awarded for 
	(b)		Diagram showing delivery tube passing into a test tube which is placed in a water/ice bath. Delivery tube must extend close enough to the neck of the test tube to ensure the vapour can enter the test tube.	**1**	Do not penalise if boiling tube/measuring cylinder etc has been used in place of test tube. Diagram does **not** need to be labelled. Delivery tube must be open and no lines drawn across it. Ignore a stopper as long as it does **not** close off the delivery tube.

Question			Answer	Max Mark	Additional Guidance
8.	(c)	(i)	Addition / additional **OR** bromination	**1**	Zero marks awarded for 'add.' Zero marks awarded for 'Addition' followed by incorrect answer eg 'polymerisation', 'distillation', 'combustion' etc.
		(ii)	$C_{10}H_{16}Br_4$	**1**	Symbols can be in any order. Numbers must be smaller than symbol or subscript Symbols must be correct Zero marks awarded for: C10 H16 Br4 $C_{10}H_{16}br_4$ $C_{10}H_{16}BR_4$ $C_{10}H_{16} + Br_4$

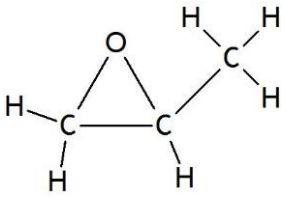
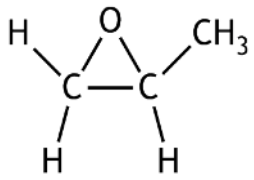
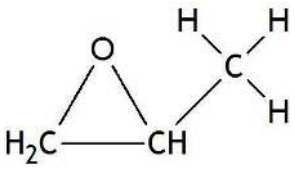
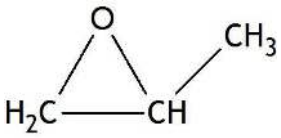
Question			Answer	Max Mark	Additional Guidance
9.	(a)		1 mark for **Method A** *The second mark for the explanation **cannot** be awarded if the first mark is not gained.* 1 mark for explanation of accuracy of **A** (or inaccuracy of **B**) based on • Heat loss • Heat transfer • Mass loss (due to ethanol being combusted/used up) eg **- Method A** because more heat is transferred to water - **Method B** because less heat is transferred to water - **B** releases more heat to the surroundings	**2**	Explanation is assumed to be for chosen method unless otherwise stated. The explanation mark **cannot** be awarded for restating or describing Step 3 eg • the fuel in **A** doesn't start to burn until it is under the (copper) can / water • the fuel in **B** starts to burn before it is under the (copper) can /water Zero marks awarded for an explanation in terms of evaporation of ethanol but does not negate a correct explanation.

Question			Answer	Max Mark	Additional Guidance
	(b)	(i)	A statement that identifies the effect of changing the position on the energy released. eg If the alcohol is 2-ol then less energy is released compared with 1-ol or vice versa. **OR** As you move from one to two (carbon/position) then the energy decreases or vice versa. **OR** As it (the position of the functional group) increases/gets higher, the energy released decreases or vice versa **OR** Functional group (or it/hydroxyl/–OH) on (position) 1/end carbon/first carbon – energy released is greater/higher/bigger/increases **OR** Functional group (or it/hydroxyl/–OH) on position 2/not on the end carbon energy released is smaller/lower/decreases **OR** As it/functional group goes further along/further down/further up the lower the energy or vice versa.	**1**	Award zero marks for as the number of carbons increase/alcohol gets bigger the energy released also increases or vice versa.
		(ii)	3967 – 3971	**1**	Unit is not required however if the wrong unit is given do **not** award mark. Accept kj, kJ, Kj or KJ. Also accept kJ mol^{-1}or kJ/mol or kilo Joules per mole in words.

Question			Answer	Max Mark	Additional Guidance
	(c)		55 or 55·02 with no working 3 marks 1 mark for using the correct concept of $\Delta T = Eh / cm$ with **both 4·18 and 23** correctly substituted 1 mark for 0·1 with or without concept 1 mark for correct arithmetic **(this mark can only be awarded if the concept mark has been awarded).**	**3**	Unit is not required however if the wrong unit is given do **not** award final mark. Do not accept ° on its own. 1 mark awarded if **23000 and 4180** are both used together in correct concept. If a mass of 100 is used then 23000 **and** 4·18 must be used to access all 3 marks.

Question			Answer	Max Mark	Additional Guidance
10.	(a)		Electrolyte	**1**	
	(b)	(i)	From zinc to copper on or near the wire/voltmeter	**1**	Zero marks awarded if – arrow goes into solution – arrow is drawn on wire and ion bridge – arrow is drawn closer to the ion bridge than the wire / voltmeter
		(ii)	Ion bridge **OR** Salt bridge	**1**	Correct description of an ion bridge eg filter paper soaked in an electrolyte.
	(c)	(i)	Oxidation	**1**	Zero marks awarded for redox.
		(ii)	$Br_2(\ell) + SO_3^{2-}(aq) + H_2O(\ell) \longrightarrow 2Br^-(aq) + SO_4^{2-}(aq) + 2H^+(aq)$ **OR** $Br_2(\ell) + SO_3^{2-}(aq) + H_2O(\ell)$ $\downarrow$ $2Br^-(aq) + SO_4^{2-}(aq) + 2H^+(aq)$ **1** State symbols are not required but if included must be correct. Zero marks awarded for any electrons shown in equation, unless clearly scored out. Zero marks awarded for $Br_2(\ell) + SO_3^{2-}(aq) + H_2O(\ell) \longrightarrow$ $2Br^-(aq) + SO_4^{2-}(aq) + 2H^+(aq)$		
		(iii)	Carbon or graphite	**1**	Zero marks awarded for hydrogen, diamond or charcoal and these negate a correct answer.

Question			Answer	Max Mark	Additional Guidance
11.	(a)		Methoxypropane (**spelling must be correct**)	**1**	Zero marks awarded for propoxymethane.
	(b)		$C_nH_{2n+2}O$ **OR** $C_nH_{2n+2}O_1$ OR $C_nH_{n2+2}O$	**1**	Symbols can be in any order eg $H_{2n+2}OC_n$ Accept another letter in place of n eg $C_xH_{2x+2}O$ Zero marks awarded for CnH2n+2O C_nH_{2n+2} + O $C_nH_{2n+2}O_n$ Award zero marks for $C_nH_{2n+1}OH$, $C_nH_{2n+1}OC_nH_{2n+1}$
	(c)		{ **WEAK** / strong } { weak / **STRONG** } **BOTH REQUIRED**	**1**	
	(d)	(i)	Ethene / Eth-1-ene OR Ethylene	**1**	Accept a correct molecular or structural formula for ethene. Incorrect formulae in addition to ethene negates. Mention of any other substance negates.

Question			Answer	Max Mark	Additional Guidance
		(ii)	Any acceptable full, shortened or abbreviated structural formula e.g.    	1	Allow one carbon to hydrogen bond to be missing provided the hydrogen is shown. Allow one hydrogen to be missing provided the carbon to hydrogen bond is shown.

Question			Answer	Max Mark	Additional Guidance
12.	(a)		hydroxyl	**1**	Zero marks awarded for OH however this does **not** negate hydroxyl. Zero marks awarded for hydroxide and this negates correct answer.
	(b)		Weak acid, strong base/alkali **BOTH REQUIRED**	**1**	Zero marks awarded for mention of weak and strong without stating acid or base.
	(c)		15·0	**1**	Unit is not required however if the wrong unit is given do **not** award mark. If more than two numbers have been averaged the mark cannot be awarded even if the candidate has the correct answer.
	(d)		0·02	**1**	Zero marks awarded for 0·02 mol^{-1} or 0·02 mol l^{-1} etc.

Question			Answer	Max Mark	Additional Guidance
13.			This is an open ended question **1 mark**: The student has demonstrated a limited understanding of the chemistry involved. The candidate has made some statement(s) which is/are relevant to the situation, showing that at least a little of the chemistry within the problem is understood. **2 marks:** The student has demonstrated a reasonable understanding of the chemistry involved. The student makes some statement(s) which is/are relevant to the situation, showing that the problem is understood. **3 marks:** The maximum available mark would be awarded to a student who has demonstrated a good understanding of the chemistry involved. The student shows a good comprehension of the chemistry of the situation and has provided a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. This does not mean the answer has to be what might be termed an "excellent" answer or a "complete" one.	**3**	**0 marks**: The student has demonstrated no understanding of the chemistry involved. There is no evidence that the student has recognized the area of chemistry involved or has given any statement of a relevant chemistry principle. This mark would also be given when the student merely restates the chemistry given in the question.

[END OF MARKING INSTRUCTIONS]