National Qualifications 2024

2024 Chemistry

National 5

Question Paper Finalised Marking Instructions

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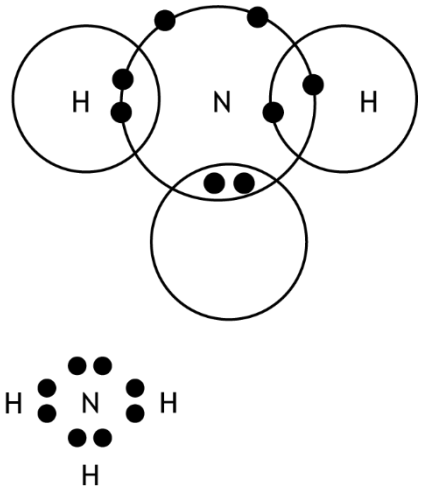
Marking instructions for each question

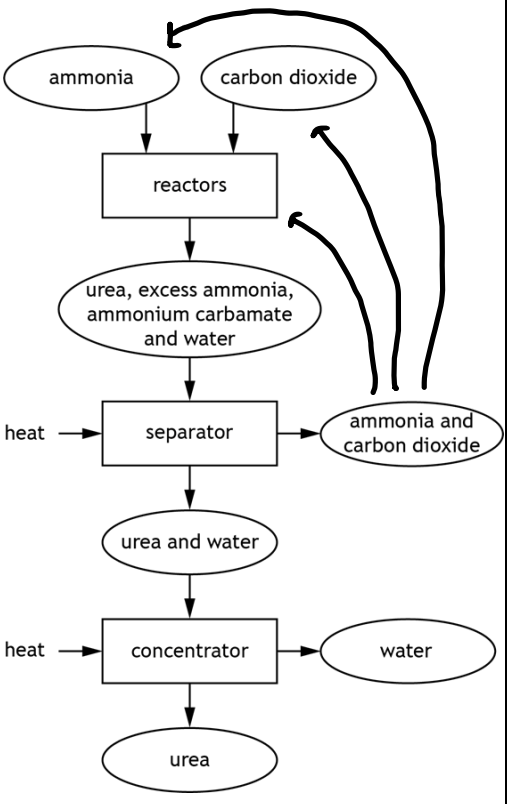
Section 1

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

Section 2

Question			Expected response	Max mark	Additional guidance
1.	(a)	(i)	$2\ H_2O_2 \rightarrow 2\ H_2O + O_2$	**1**	Accept correct multiples. If equation is rewritten, all formulae must be correct and correct format. If state symbols are given, they must be correct.
		(ii)	Catalyst	**1**	If the chemical is named it must be correct. Accept manganese oxide/manganese dioxide in place of manganese (IV) oxide.
		(iii) (A)	It is insoluble/low solubility	**1**	
		(iii) (B)	36 (cm^3) --- Partial Marking: 1 concept mark ΔQuantity = average rate × time = 1.2 × 30	**2**	Unit not required but, if given, must be correct. This marking instruction must only be applied a maximum of once per paper. If the concept mark is not awarded then the mark for arithmetical follow through cannot be awarded.
		(iii) (C)	Any value < 1.2 **($cm^3\ s^{-1}$)**	**1**	Award zero marks for a value of 1.2. Award zero marks if the value has been calculated using any other relationship than ΔQuantity/ΔTime.
	(b)	(i)	(Limewater turning) chalky/milky/ cloudy/precipitate	**1**	
		(ii)	Endothermic	**1**	

Question			Expected response	Max mark	Additional guidance
2.	(a)	(i)	Pyramidal **OR** Trigonal pyramidal	**1**	Zero marks awarded for trigonal on its own. Zero marks awarded for 'pyramid'.
		(ii)	Diagram showing three hydrogen atoms and one nitrogen atom with three pairs of bonding electrons and two non-bonding electrons in nitrogen eg  	**1**	Accept cross/dot/petal/circles. The non-bonding electrons in nitrogen must be shown but do not need to be together/shown as a pair. Electrons can be on the line or in the overlapping area. Either the nitrogen or all three hydrogen symbols must be shown. If inner electrons on nitrogen are shown they must be correct ie 2 electrons
	(b)		Nitric acid / HNO_3	**1**	

Question			Expected response	Max mark	Additional guidance
2.	(c)		For appropriate format: bars (not points) **(1 mark)** The 'percentage' axis of the graph has a suitable scale. For the graph paper provided within the question paper, the graph must occupy at least half of the width and half of the height of the graph paper. **(1 mark)** The axes of the graph have suitable labels. **(1 mark)** All bars are plotted accurately (within a half box tolerance). This mark can only be accessed if a linear scale for the percentage axis has been provided. **(1 mark)**	**4**	If a scatter/line graph is drawn a maximum of 3 marks can be awarded. If the scale is non-linear then the mark for accurate plotting can only be accessed if the error occurs out with the data-set.
	(d)			**1**	Accept arrow going to ammonia and/or carbon dioxide rather than reactors.

<table>
<tr><th colspan="3">Question</th><th>Expected response</th><th>Max mark</th><th>Additional guidance</th></tr>
<tr><td>3.</td><td>(a)</td><td></td><td>Essential (oils)</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>All 4 correct for 2 marks.

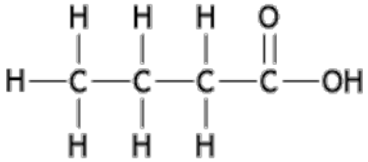
Partial Marking
1 mark for having the two oils inverted but the boiling points and densities correctly identified.

<table><tr><td></td><td>Lavender flower oil</td><td>Lavender spike oil</td></tr><tr><td>Density (g cm^{-3})</td><td>0.885</td><td>0.905</td></tr><tr><td>Boiling point (°C)</td><td>204</td><td>183</td></tr></table></td><td>2</td><td>Zero marks awarded for incorrect pairings of density and boiling point.</td></tr>
<tr><td></td><td>(c)</td><td></td><td>(lavender) spike (oil)</td><td>1</td><td></td></tr>
<tr><td></td><td>(d)</td><td></td><td>Bromine/Br_2 decolourised (by linalool, geraniol and nerol).
OR
Bromine/Br_2 goes colourless (by linalool, geraniol and nerol).</td><td>1</td><td>Accept bromine/bromine water/ bromine solution but do not accept bromide or Br.

Zero marks awarded for ‘goes clear’ however if given in addition to a correct answer it does not negate.

If starting colour is given it must be correct
eg orange/yellow/red/orange-brown/red-brown or brown.</td></tr>
</table>

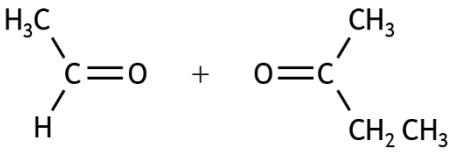
Question			Expected response	Max mark	Additional guidance
3.	(e)		Stronger forces **(1 mark)** Between molecules/intermolecular **(1 mark)**	**2**	The term bond is only acceptable if it is specifically identified as between the molecules or used with the term intermolecular. Mention of breaking bonds/bonds within molecule or chain/breaking carbon to carbon or carbon to hydrogen bonds or more bonds/carbons/hydrogens/atoms/ chain length cannot gain the second mark but does not negate the first mark. Candidates can be awarded the full/partial marks if they correctly explain why linalool and/or nerol have a lower boiling point but linalool and/or nerol must be stated in their answer. If candidate answer states that nerol has the lowest boiling point then a maximum of one mark can be awarded.
	(f)		2.643 / 2.64 / 2.6 **(g)** **----------** **Partial Marking** 0.881 × 3 1 mark for selecting correct data and using it with the given relationship **(1 mark)** 1 mark for correct arithmetic with wrong data using given relationship **(1 mark)**	**2**	Zero marks awarded for 3 (g) with no working shown.

Question			Expected response	Max mark	Additional guidance
4.	(a)		Homologous (series)	**1**	Zero marks awarded for homogeneous.
	(b)	(i)	137 – 143 (°C)	**1**	
		(ii)	As the number of carbon atoms/hydrogen atoms/ (molecular) size/length/mass increase the boiling point increases.	**1**	Zero marks awarded for an incorrect cause and effect eg the number of carbon atoms/hydrogen atoms/ (molecular) size/length/mass increase as the boiling point increases.
	(c)	(i)	Hydroxyl to carboxyl	**1**	
		(ii)	Any acceptable structural formula for butanoic acid eg $CH_3CH_2CH_2COOH$ $CH_3(CH_2)_2COOH$ 	**1**	Accept mixture of shortened and full structural formula Ignore - the omission of one H atom (from a carbon atom) in full structural formula provided the bond is shown or - one carbon to hydrogen bond missing provided the hydrogen is shown. Zero marks awarded for C_3H_7COOH.
		(iii)	$(K^+)_2Cr_2O_7^{2-}$ **OR** $K^+{}_2Cr_2O_7^{2-}$	**1**	Zero marks awarded for $K_2{}^+Cr_2O_7^{2-}$ **OR** $K_2^+Cr_2O_7^{2-}$

Question			Expected response	Max mark	Additional guidance
5.			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) that is/are relevant to the situation, showing that at least a little of the chemistry within the context is understood. **2 marks**: The student has demonstrated a reasonable understanding of the chemistry involved. The student makes some statement(s) that is/are relevant to the situation, showing that the context 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 context. This does not mean the answer has to be what might be termed an "excellent" answer or a "complete" one.	**3**	

<table>
<tr><th colspan="3">Question</th><th>Expected response</th><th>Max mark</th><th>Additional guidance</th></tr>
<tr><td>6.</td><td>(a)</td><td></td><td>They contain delocalised electrons/ free moving electrons
OR
They have electrons that are free to move</td><td>1</td><td>Any mention of ions moving would negate.</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Heat with carbon/carbon monoxide
OR
Electrolysis</td><td>1</td><td>Accept C/CO</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>2 marks
<table><tr><th>Order in the electrochemical series</th><th>Metal</th></tr><tr><td rowspan="5">highest
↓
lowest</td><td>C</td></tr><tr><td>A</td></tr><tr><td>Copper</td></tr><tr><td>D</td></tr><tr><td>B</td></tr></table>Partial marks

1 mark for having copper in the third position.
1 mark for having metals A, B, C and D in the correct order</td><td>2</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>It is not ionic/it is covalent/it does not conduct/it doesn’t have ions (that are free to move)</td><td>1</td><td></td></tr>
<tr><td></td><td>(d)</td><td>(i)</td><td>Ion/salt bridge</td><td>1</td><td>Correct description of an ion bridge eg filter paper soaked in electrolyte</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Lead(II) nitrate
OR
Lead(II) bromide
OR
Lead(II) chloride</td><td>1</td><td>Roman numerals are not required and if given are ignored.</td></tr>
</table>

Question			Expected response	Max mark	Additional guidance
7.	(a)		Kills bacteria **AND** viruses	**1**	Both required for 1 mark.
	(b)		Sodium, hydrogen, sulfur and oxygen Na/H/S/O All 4 required **(1 mark)**	**1**	Accept loose spelling of element names. Accept H_2/O_2.
	(c)		$Cl_2 + H_2O \rightarrow HOCl + HCl$	**1**	Equation is already balanced. Correct multiples are accepted. Ignore state symbols if given.
	(d)			**1**	

Question			Expected response	Max mark	Additional guidance
8.	(a)	(i)	$Ag^+(aq) + Cl^-(aq) \rightarrow Ag^+Cl^-(s)$	**1**	State symbols are not required but, if included, must be correct.
		(ii)	Precipitation	**1**	
	(b)	(i)	Pipette	**1**	
		(ii)	They are concordant **OR** They are within 0.2(cm^3) **OR** Titre 1 is rough/non-concordant	**1**	

Question			Expected response	Max mark	Additional guidance
8.	(b)	(iii)	0.312 / 0.31 / 0.3 (mol l^{-1}) --- **Partial marks can be awarded for a maximum of two of the following three steps:** **Method A** 1 mark for the correct number of moles of oxalic acid. ie n = CV = 0.1 × 0.0156 = 0.00156 mol **(1 mark)** 1 mark for calculating the moles of sodium hydroxide by correctly applying the molar ratio ie 2 × candidate's calculated number of moles of $H_2C_2O_4$ **(1 mark)** 0·00312 mol NaOH on its own **(2 marks)** 1 mark for calculating the concentration of the sodium hydroxide ie C = n/V using candidate's calculated number of moles of $H_2C_2O_4$ and 0·01 **(1 mark)** --- **Method B** $\frac{C_1 \times 10}{2} = \frac{0.1 \times 15.6}{1}$ **(1 mark) (1 mark)** $C_1 \times 5 = 3.12$ or $C_1 \times 10 = 6.24$ (this step on its own gets 2 marks) **OR** $\frac{C_1 \times 0.01}{2} = \frac{0.1 \times 0.0156}{1}$ $C_1 \times 0{\cdot}01 = 0{\cdot}0624$ (this step on its own gets 2 marks)	**3**	No units required but a maximum of two marks can be awarded if an incorrect unit is given. This marking instruction must only be applied a maximum of once per paper. Accept mol l^{-1} or mol/l but not mol/l^{-1} or mol^{-1} or mol l **Award zero marks if the candidate's working makes it clear that they have not used oxalic acid.** If candidate does not attempt to calculate the number of moles of $H_2C_2O_4$ then 1 mark can be awarded for using 2 moles of sodium hydroxide and V = 0·01. ie 2/0·01 = 200 **(1 mark)** For method B using relationship shown in the data book 1 mark is awarded for the correct pairings of volume (in the same unit) and concentration. 1 mark is awarded for the correct mole ratio **being applied**. 1 mark is awarded for the correct arithmetic. This mark can only be awarded if either of the first two marks have been awarded.
		(iv)	Pink to colourless	**1**	

Question			Expected response	Max mark	Additional guidance
9.	(a)	(i)	It would stop bubbling/fizzing/no more gas produced/no more reacts/solid collects at bottom of the beaker/nickel(II) carbonate collects at bottom of the beaker	**1**	Award zero marks for any mention of dissolves/dissolving. Accept pH 7 if mentions how it would be tested. Accept correct colour change for neutral if indicator is specified.
		(ii)	Water/H_2O	**1**	
		(iii)	Base	**1**	Any mention of alkali would negate.
		(iv)	0.025 / 0.03 (moles/mols/mol)	**1**	Unit not required but, if given, must be correct. This marking instruction must only be applied a maximum of once per paper.
	(b)		Filtration/filter/filtering	**1**	Accept filteration A correct description of the process of filtration would be awarded 1 mark.
	(c)		Heat it/boil it	**1**	Zero marks awarded for Bunsen burner on its own. It must be clear that heat is being applied.
	(d)		37.86/37.9/38 (%) **(3 marks)** --- Partial marking: GFM = 154.5 **(1 mark)** $\frac{58.5}{\text{candidate's GFM}} \times 100$ **(1 mark)** This step on its own is worth 2 marks if the candidate's GFM is 154.5. Calculation of final answer using the relationship $\%\text{ by mass} = \frac{m}{GFM} \times 100$ **(1 mark)**	**3**	Unit is not required, however a maximum of 2 marks can be awarded for the correct value with incorrect unit. This marking instruction must only be applied a maximum of once per paper. The mark for the final answer can only be awarded if the correct relationship between total mass of element present divided by gfm × 100 is shown with working.

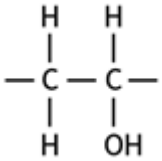
<table>
<tr><th colspan="3">Question</th><th>Expected response</th><th>Max mark</th><th>Additional guidance</th></tr>
<tr><td>10.</td><td>(a)</td><td></td><td>(A compound containing) hydrogen and carbon only</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>
<table>
<tr><th>Bond</th><th>Bond Energy (kJ)</th><th>Number of bonds made</th><th>Total energy released (kJ)</th></tr>
<tr><td>C=O</td><td>804</td><td>2</td><td>1608</td></tr>
<tr><td>O—H</td><td>463</td><td>4</td><td>1852</td></tr>
<tr><td colspan="3">Total energy to make all of the bonds in the products =</td><td>3460</td></tr>
</table>
Partial marks:

1 mark for having 2 and 4 in the correct positions

1 mark for a correctly calculated final value using candidate’s number of bonds made.</td><td>2</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>-816 (kJ)

Correct arithmetic for candidates calculated energies (1 mark)
2644 – 3460 = -816

Allow follow through from part (i)</td><td>1</td><td>Do not accept +816 (kJ)</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>2,4-dimethylhexane</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>A correct structure for cyclohexane or branched cycloalkane with the formula C_6H_{12}</td><td>1</td><td>Ignore H_2 if given.</td></tr>
</table>

Question			Expected response	Max mark	Additional guidance
10.	(d)	(i) (A)	C_6H_{14}	**1**	
		(i) (B)	Hydration	**1**	
		(ii) (A)	Poly (ethenol)/polyethenol	**1**	
		(ii) (B)		**1**	Allow dot or ~ to represent end bond. Ignore brackets or n written outside the bracket at side of repeating unit. Allow one end bond to be missing without penalty. Allow one hydrogen bonded to a carbon to be missing as long as bond from carbon is shown. Allow one bond between a carbon and a hydrogen to be missing as long as hydrogen is shown. Zero marks awarded if both end bonds are missing or both/either end has a H or the bond between the carbons or the carbon to oxygen is missing. Award one mark if a polymer section is drawn and brackets are used to identify one repeating unit.

Question			Expected response	Max mark	Additional guidance
11.			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) that is/are relevant to the situation, showing that at least a little of the chemistry within the context is understood. **2 marks:** The student has demonstrated a reasonable understanding of the chemistry involved. The student makes some statement(s) that is/are relevant to the situation, showing that the context 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 context. This does not mean the answer has to be what might be termed an "excellent" answer or a "complete" one.	**3**	

[END OF 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.

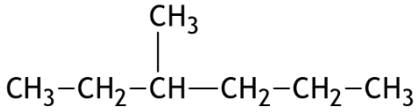
(a) Marks for each candidate response must <u>always</u> be assigned in line with these general marking principles and the detailed marking instructions for this assessment.

(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.

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.

(d) There are no half marks awarded.

(e) 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.

(f) 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.

(g) 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.

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.

(h) 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.

(i) In most questions units are not required. However, if the candidate writes units then they must be correct. An incorrect unit would not be acceptable and one mark would not be awarded.

This marking instruction must only be applied a maximum of once per paper.

(j) 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.

(k) 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.

(l) 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.

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

(n) 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.

(o) 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.

(p) 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.