National Qualifications 2022

2022 Chemistry

National 5

Finalised Marking Instructions

These marking instructions have been prepared by examination teams for use by SQA appointed markers when marking external course assessments.

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Marking instructions for each question

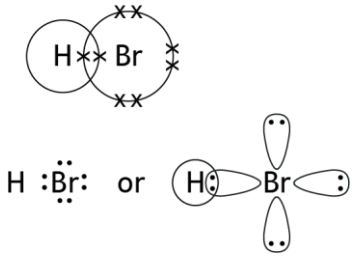
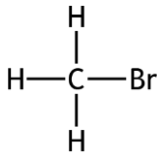
Question	Answer	Mark
1.	C	1
2.	B	1
3.	A	1
4.	C	1
5.	B	1
6.	A	1
7.	A	1
8.	D	1
9.	D	1
10.	C	1
11.	C	1
12.	D	1
13.	B	1
14.	B	1
15.	A	1
16.	B	1
17.	A	1
18.	D	1
19.	B	1
20.	C	1
21.	A	1
22.	B	1
23.	C	1
24.	D	1
25.	C	1

Section 2

Question			Expected response	Max mark	Additional guidance
1.	(a)	(i)	Beta/β	**1**	
		(ii)	Xenon/Xe / $^{131}_{54}Xe$ / ^{131}Xe	**1**	If atomic/mass numbers are given they must be correct.
	(b)	(i)	15 (days) **(2)** Partial marking: 1 mark can be awarded for either: 3 half-lives **OR** Number of days correctly calculated for an incorrect number of half-lives (provided the working supports the number of half-lives). **OR** Time for 3 half lives for the wrong radioisotope. i.e. 24 days for iodine or 90 years for caesium. (provided it is clear they have used the wrong half life).	**2**	Units not required but if given must be correct. This marking instruction must only be applied a maximum of once per paper.
		(ii)	Caesium-137/Caesium /Cs/ ^{137}Cs	**1**	

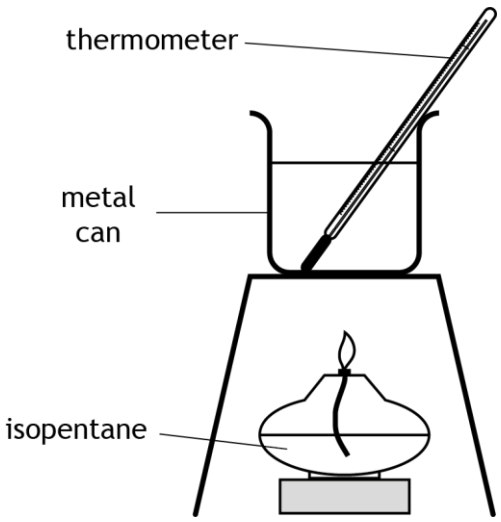
Question			Expected response	Max mark	Additional guidance
2.	(a)		Correct scales **(1)** Correct plotting and curve/line of best fit drawn **(1)**	**2**	
	(b)		5.33/5.3/5.0 (cm^3 min^{-1}) **(2)** --- Partial marking: **1 mark awarded for concept of change in volume/change in time.** (48-32) ÷ 3 **(1)** **OR** 16 ÷ 3 with an incorrect answer	**2**	Unit is not required, however a maximum of 1 mark 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 a final answer can only be awarded if the concept of **change in** volume/**change in** time is correct i.e. incorrect values **from the table** used (subtractions must be shown and volumes chosen **must** correspond to chosen times).
	(c)		Mass, pH, concentration, conductivity	**1**	If candidate mentions an incorrect direction of change for a correct alternative measurement this would negate the type of measurement.
	(d)		48 (cm^3)	**1**	Unit is not required but if given must be correct. This marking instruction must only be applied a maximum of once per paper.

Question			Expected response	Max mark	Additional guidance
3.	(a)		Ammonia and carbon dioxide	**1**	Both required to award the mark.
	(b)		1.625 /1.63/1.6 (kg)	**1**	Unit is not required but if given must be correct. This marking instruction must only be applied a maximum of once per paper.
	(c)		Hydrogen hydroxide	**1**	
	(d)		Not toxic or flammable OR Not toxic **OR** Not flammable	**1**	
	(e)	(i)	It also contains phosphorus **OR** It contains nitrogen and phosphorus **OR** It contains two of the elements essential (for healthy plant growth)	**1**	
		(ii)	21.21/21.2/21 (%) **(3)** --- Partial marking: 1 mark for correctly calculating the GFM of $(NH_4)_2HPO_4$ = 132 **(1)** $\frac{28}{132}$ x 100 This step on its own is awarded 2 marks. **(2)** Using the correct concept of: $\frac{\text{candidate's mass of nitrogen in GFM}}{\text{candidate's GFM}}$ x 100 **(1)** A further mark can be awarded for arithmetical follow through to the candidate's answer **only if the mark for the concept has been awarded**.	**3**	If no working of GFM is shown then mass of nitrogen must be 28. Working **must** be shown to support an incorrect GFM to allow the concept mark to be awarded. 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.

Question			Expected response	Max mark	Additional guidance
4.	(a)	(i)	addition	**1**	
		(ii)	 **Either** the correct symbol for bromine **or** hydrogen **must** be shown.	**1**	The non-bonding electrons in bromine must be shown but do not need to be together/shown as a pair. Bonding electrons **must** be on the line or in the overlapping area. If inner electrons on bromine are shown they must be correct i.e. 2, 8, 18.
		(iii)	Hydrogen chloride/HCl/ hydrochloric acid	**1**	
	(b)	(i)	 OR CH_3Br Accept any halogen in place of bromine.	**1**	If the candidate attempts to draw the nitrile as well as the haloalkane this should be ignored.
		(ii)	vinegar	**1**	

Question			Expected response	Max mark	Additional guidance
5.			This is an open-ended question. **1 mark**: The candidate has demonstrated a limited understanding of the chemistry involved. They have made some statement(s) that are relevant to the situation, showing that at least a little of the chemistry within the problem is understood. **2 marks**: The candidate has demonstrated a reasonable understanding of the chemistry involved. They make some statement(s) that are relevant to the situation, showing that they have understood the problem. **3 marks:** The maximum available mark would be awarded to a candidate who has demonstrated a good understanding of the chemistry involved. The candidate 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. The answer does not need to be 'excellent' or 'complete' for the candidate to gain full marks.	**3**	**Award 0 marks** where the candidate has not demonstrated, at an appropriate level, an understanding of the chemistry involved. There is no evidence that they have recognised the area of chemistry involved, or they have not given any statement of a relevant chemistry principle. Award zero marks also if the candidate merely restates the chemistry given in the question.

Question			Expected response	Max mark	Additional guidance
6.	(a)		(2-) methylbutane	**1**	Punctuation/spaces/omission of a hyphen should not be penalised. 2 is the only acceptable number.
	(b)	(i)	fuel	**1**	
		(ii)	$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$	**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.
		(iii)	10/10.03/10.032 **(3)** --- Partial marking: Using $cm\Delta T$ with c = 4.18 **(1)** To be awarded this concept mark, candidates do not specifically need to write $cm\Delta T$. The concept mark is awarded for using this relationship with three values, one of which must be 4.18 For values 0.2 (kg) **and** 12 (°C) **(1)** A further mark can be awarded for arithmetical follow through to the candidate's answer only if the mark for the $cm\Delta T$ concept has been awarded. **(1)**	**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. 10032 J can be awarded 3 marks if used with 4180 and the correct unit is given. If candidate follows through to 12.54 kJ g^{-1} then 3 marks can still be awarded provided working is shown to support this answer.

Question			Expected response	Max mark	Additional guidance
6.	(b)	(iv)	1 mark awarded for a workable, labelled method that allows the heat energy to be absorbed by the water. (labelled diagram to include beaker/can/test-tube with water) (water line is acceptable in place of a 'water' label). 1 mark for a labelled thermometer.  	**2**	Unsafe methods (such as including a Bunsen burner/heating isopentane) would be awarded zero marks. Candidate cannot access the mark for labelled thermometer unless a workable diagram is given.

<table>
<tr><th colspan="3">Question</th><th>Expected response</th><th>Max mark</th><th>Additional guidance</th></tr>
<tr><td>7.</td><td>(a)</td><td>(i)</td><td>43.875/43.88/43.9/44

Partial marks can be awarded for a maximum of two of the following three steps:

1 mark for correctly calculating the number of moles of sodium chloride.
i.e. n = cV = 1.5 x 0.5 = 0.75 mol (1)

1 mark for correctly calculating the GFM of sodium chloride
i.e. GFM = 58.5 (1)

1 mark for calculating the mass of sodium chloride
i.e. m = n x GFM using candidate's calculated moles of sodium chloride and candidate's calculated GFM (1)</td><td>3</td><td>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.</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>(mass) balance/scale(s) / measuring scale</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>106.67/106.7/107 (°C)</td><td>1</td><td>106.6 is not acceptable.

Unit is not required but if given must be correct.

This marking instruction must only be applied a maximum of once per paper.</td></tr>
<tr><td></td><td></td><td>(ii)</td><td><table><tr><th>Concentration (mol l^{-1})</th><th>(Average) Boiling Point (°C)</th></tr><tr><td>0.5</td><td>101.3</td></tr><tr><td>1.0</td><td>104</td></tr><tr><td>1.5</td><td>Candidate's answer from (b)(i)</td></tr></table>
1 mark for correct headings with units
1 mark for matching data</td><td>2</td><td>Units do not need to be in the headings but would need to be correctly shown for every entry in the table.

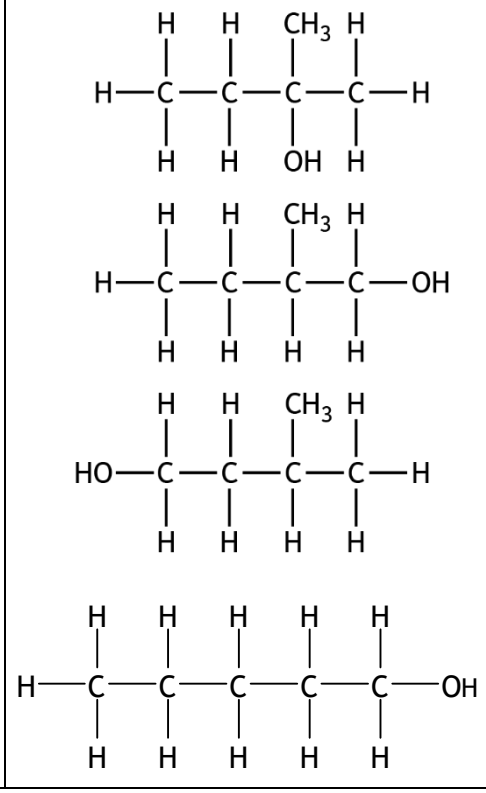
Units can be included in both the heading and entries.

A unit on its own is not sufficient to award the mark for a correct heading.</td></tr>
</table>

Question			Expected response	Max mark	Additional guidance
7.	(c)		Line graph/scatter graph	**1**	Accept "points"
	(d)		As the concentration increases the boiling point increases. OR The boiling decreases as the concentration decreases.	**1**	If candidates answer to b(i) does not allow them to make a conclusion, then the candidate can state this for 1 mark. Zero marks awarded for an incorrect cause and effect e.g. the concentration increases as the boiling point increases.

Question			Expected response	Max mark	Additional guidance
8.	(a)		Sulfuric (acid) / H_2SO_4 / hydrogen sulfate	**1**	
	(b)		Hydrogen / H_2	**1**	
	(c)		a gas/carbon dioxide is no longer produced no more fizzing/bubbling	**1**	Award zero marks for - any mention of dissolving - saturated solution Both of these would negate a correct answer. 'until it no longer reacts' is awarded zero marks but does not negate a correct answer.
	(d)		Barium sulfate	**1**	
	(e)		The reaction of an acid with a base (to produce water).	**1**	If the candidate names the types of bases all three must be mentioned.

Question			Expected response	Max mark	Additional guidance
9.	(a)		same atomic number/ number of protons but a different mass number/number of neutrons.	**1**	Mention of molecules/compounds negates.
	(b)		It has a stable electron arrangement/ Noble gases have full/ stable outer shells	**1**	
	(c)	(i)	$XeF_2 + F_2 \longrightarrow XeF_6$	**1**	Equation does not need to be balanced but if balanced it must be correct. If a catalyst is included its formula must be correct and shown over/under the arrow. Zero marks awarded for a word equation on its own but this does **not** negate a correct formulae equation. Ignore state symbols
		(ii)	(Covalent) Molecular / molecule	**1**	
		(iii) (A)	35 (g)	**1**	Unit is not required but if given must be correct. This marking instruction must only be applied a maximum of once per paper.
		(B)	(£)277.60	**1**	Accept 27760p. Do not accept "27760" on its own. Unit is not required but if given must be correct. This marking instruction must only be applied a maximum of once per paper.

Question			Expected response	Max mark	Additional guidance
10.	(a)		They have the same general formula **AND** similar/same chemical properties Both required for **(1 mark)**	**1**	Award zero marks for - molecular formula - structural formula - chemical formula Award zero marks for - physical properties in place of chemical properties however, it does not negate if given in addition to chemical properties.
	(b)	(i)	Hydroxyl	**1**	Zero marks awarded for OH/-OH/hydroxide/OH^- General marking principle **(m)** does not apply in this question. Zero marks awarded if hydroxide is given along with hydroxyl. Refer to general marking principle **(g)** for guidance.
		(ii)	secondary	**1**	
		(iii)	Any correct full/shortened structural formula for a primary or tertiary isomer of 3-methylbutan-2-ol eg 	**1**	

Question			Expected response	Max mark	Additional guidance
11.	(a)	(i)	Relights a glowing splint	**1**	
		(ii)	K^+ ClO_3^-	**1**	
	(b)	(i)	(A reaction that) releases/gives off energy/heat/gets hotter.	**1**	
		(ii)	Because there is potassium present **OR** Potassium chloride is present **OR** Potassium chlorate is present	**1**	

Question			Expected response	Max mark	Additional guidance
11.	(c)		2.4/2 (g) --- Partial marks can be awarded for a maximum of two of the following three steps: **<u>Method A</u>** 1 mark for correctly calculating the number of moles of glucose i.e. n=m/GFM = 2.25/180 = 0.0125 mol **(1)** 1 mark for calculating the moles of oxygen by correctly applying the molar ratio i.e. 6 x candidate's calculated number of moles of glucose **(1)** 0.075 mol on its own **(2)** 1 mark for calculating the mass of oxygen i.e. m = n x GFM using candidate's calculated moles of oxygen and candidate's calculated GFM **(1)** --- **<u>Method B</u>** Both GFMs 180 and 32 **(1)** 180 → 192 This step on its own is worth 2 marks. **(2)** Correct application of mole ratio to candidate's GFM of oxygen $2.25 \leftrightarrow \frac{6 \text{ x candidate's GFM oxygen}}{\text{candidate's GFM glucose}}$ x 2.25 Where the candidate has been awarded the mark for correct proportionality, shown by GFM oxygen over GFM glucose with or without the mole ratio applied, a further mark can be awarded for correct follow through to a final answer.	**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. A maximum of two marks can be awarded where the candidate has carried out the calculation using glucose and one wrong chemical provided working is shown. i.e. if a candidate calculates the mass of CO_2 or H_2O instead of oxygen a maximum of 2 marks can be awarded for 3.3 (g) for using CO_2 and 1.35 (g) for using H_2O provided the GFM of each of these chemicals is correct. $\frac{32}{180}$ x 2.25 = 0.4 is awarded 2 marks Working **must** be shown to support an incorrect GFM to allow the concept mark to be awarded

Question			Expected response	Max mark	Additional guidance
12.	(a)	(i)	decreases	**1**	
		(ii)	increases	**1**	
		(iii)	Between 175 and 214 (picometres).	**1**	Unit is not required but if given must be correct. This marking instruction must only be applied a maximum of once per paper.
	(b)		234 (picometres)	**1**	Unit is not required but if given must be correct. This marking instruction must only be applied a maximum of once per paper.
	(c)	(i)	2,8 Accept a correctly drawn electron arrangement diagram.	**1**	
		(ii)	(it has) one fewer electron shell 'It' is assumed to refer to the sodium ion.	**1**	The use of 'outer shells' is acceptable in place of electron shells. Zero mark awarded for it loses an electron but this does not negate a correct response. Candidates can be awarded the mark if they explain why the sodium atom is larger than the sodium ion. It must be clear from the candidate's response they are referring to the sodium atom.

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.

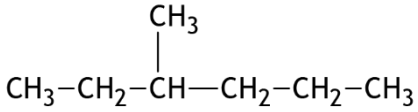
(a) Marks for each candidate response must <u>always</u> be assigned in line with these general marking principles and the detailed marking instructions for this assessment.

(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 instructions 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.