National Qualifications 2017

2017 Chemistry

National 5

Finalised Marking Instructions

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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.

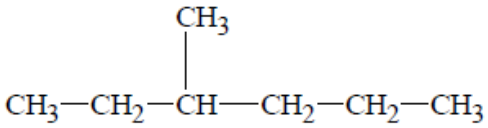
(a) Marks for each candidate response must always be assigned in line with these general marking principles and the specific Marking Instructions for this assessment.

(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.

Marking Instructions for each question

Section 1

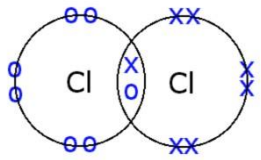
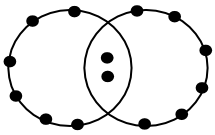
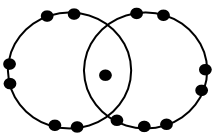
Question	Answer	Mark
1.	D	**1**
2.	C	**1**
3.	A	**1**
4.	D	**1**
5.	A	**1**
6.	B	**1**
7.	C	**1**
8.	B	**1**
9.	A	**1**
10.	A	**1**
11.	D	**1**
12.	C	**1**
13.	C	**1**
14.	B	**1**
15.	D	**1**
16.	C	**1**
17.	A	**1**
18.	B	**1**
19.	A	**1**
20.	C	**1**

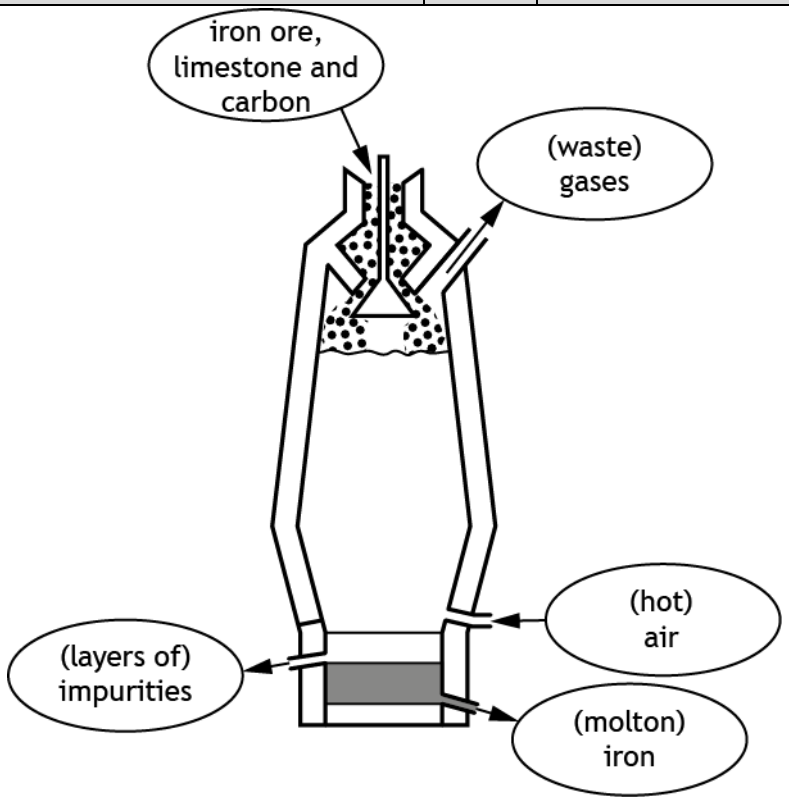
Detailed marking instruction for each question

Section 2

Question			Answer	Max mark	Additional guidance
1.	(a)		Isotope(s)	**1**	
	(b)		Different numbers of neutrons **or** the atoms have 18, 20 or 22 neutrons	**1**	Award zero marks for -different mass in the nucleus -different number of particles in the nucleus
	(c)		36 **or** $^{36}_{18}$Ar **or** ^{36}Ar	**1**	Accept amu or g if stated.

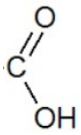
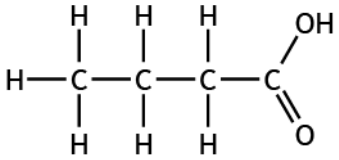
Question			Answer	Max mark	Additional guidance
2.	(a)		Carbon nanotube **or** Nanotube	**1**	Award zero marks for -carbon on its own -graphene nanotubes -graphite nanotubes
	(b)		Lithium or Li	**1**	
	(c)		20·5 with no working **(2)** 21 with correct working **(2)** Partial marking Demonstration of the correct use of the relationship concept. ie 41/2. **(1)** **or** 41/1 = 41 **(1)** Working must be shown	**2**	Accept mol l^{-1} or mol/l Zero marks awarded for - 41 without working.

Question			Answer	Max mark	Additional guidance
3.	(a)		Must show **all** outer electrons  	**1**	Accept cross or dot or e or e- to represent electrons or a mixture of these. Accept petal diagram. The non-bonding electrons in each chlorine atom 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. The example below is awarded zero marks.  If inner electrons are shown they must be correct ie 2,8
	(b)		Tetrahedral / tetrahedron	**1**	
	(c)		Gains an electron (from sodium) **or** Indication that the electron arrangement increases by 1 eg electron arrangement goes from 2.8.7 to 2.8.8, outer electron number goes from 7 to 8.	**1**	Accept - sodium gives an electron - chlorine takes an electron Award zero marks for - implying that chlorine gains more than one electron - a chloride ion gains an electron
	(d)		**low no 1 mark** **high no 1 mark** 1 mark for **both** correct **properties** for **chloromethane gas** 1 mark for **both** correct **properties** for **solid sodium chloride**	**2**	

Question			Answer	Max mark	Additional guidance
4.	(a)	(i)		**2**	All 4 correct – 2 marks 2/3 correct – 1 mark 0/1 correct – 0 marks
		(ii)	Iron would not melt/ be molten/liquid or able to flow **or** Iron would be solid **or** Iron needs to be molten/liquid/flowing	**1**	Award zero marks for: -it is the melting point of iron however, this does not negate a correct answer.
	(b)		$Fe^{2+} \rightarrow Fe^{3+} + e^-$ **or** $Fe^{2+} - e \rightarrow Fe^{3+}$	**1**	State symbols are not required however, if given they must be correct

Question			Answer	Max mark	Additional guidance
5.	(a)	(i)	14 (days)	**1**	No units required but no mark is awarded if wrong unit is given. (Wrong units are only penalised once in any paper).
		(ii)	42 (days) **(2)** Partial marking 3 half-lives **(1)** **or** Correct number of days for an incorrect number of half-lives-working must be shown. **(1)**	**2**	Allow follow through from part (a)(i) to allow the candidate to access both marks No units required but maximum of 1 mark is awarded if wrong unit is given. (Wrong units are only penalised once in any paper).
	(b)		beta **or** β **or** $^{0}_{-1}\beta$ **or** $^{0}_{-1}e$ **or** $^{0}_{-1}e^{-}$	**1**	

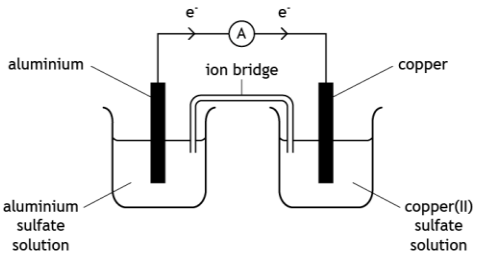
Question			Answer	Max mark	Additional guidance
6.			**1 mark:** The student has demonstrated a limited understanding of the chemistry involved. The candidate has made some statement(s) which is/are relevant to the situation, showing that at least a little of the chemistry within the problem is understood. **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
7.	(a)		Carboxyl **or**  **or** COOH	**1**	
	(b)	(i)	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. Award zero marks for C_3H_7COOH

Question			Answer	Max mark	Additional guidance
7.	(b)	(ii)	Butanoic acid or it has bigger / stronger / more forces (of attraction) **(1)** Between molecules **or** mention of intermolecular attractions **(1)**	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 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 propanoic acid has a lower melting point but propanoic acid **must** be stated in their answer.
			If neither of these two points are given, a maximum of 1 mark can be awarded for - butanoic acid or it is bigger has more carbons or hydrogens or atoms longer carbon chain		More bonds in the compound is not sufficient to imply a larger molecule but does not negate.

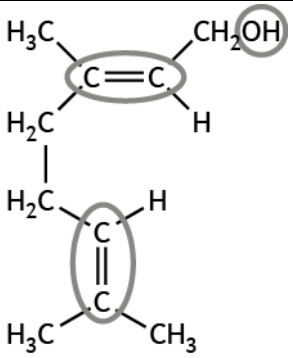
Question			Answer	Max mark	Additional guidance
8.	(a)	(i)	Glowed brighter/more brightly than zinc **or** Glowed most brightly/very brightly/white light	**1**	
		(ii)	Faster/higher/speed up/increase	**1**	Award zero marks for -takes less time on its own but does not negate correct answer.
	(b)		Magnesium **or** Mg	**1**	Can be circled, highlighted etc

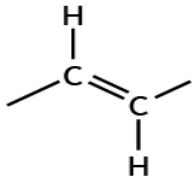
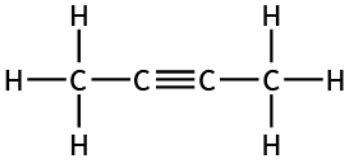
Question			Answer	Max mark	Additional guidance
9.	(a)		They have the same general formula **AND** similar/same chemical properties **Both required for 1 mark**	**1**	Award zero marks for -molecular formula -structural formula -chemical formula Award zero marks for - physical properties in place of chemical properties however, it does not negate
	(b)		Isomer(s)	**1**	
	(c)	(i)	Increasing carbon chain length/ number of carbons takes more time (longer, slower) **or** Decreasing carbon chain length/ number of carbons takes less time (faster, quicker) **or** Straight chain takes more time (longer, slower) than branched chain **or** Branched chain takes less time (faster, quicker) than straight chain	**1**	
		(ii)	Indication that the expected position occurs anywhere on the horizontal line between ethane and 2-methylpropane.	**1**	

Question			Answer	Max mark	Additional guidance
10.	(a)	(i)	 ALL REQUIRED FOR 1 MARK	**1**	Accept - copper sulfate instead of copper(II) sulfate - name of solution without (aq) or solution.
		(ii)	$3Cu^{2+} + 2Al \longrightarrow 3Cu + 2Al^{3+}$	**1**	Accept correct multiples Zero marks awarded for -electrons shown in equation, unless clearly scored out. State symbols are not required however if given they must be correct

Question			Answer	Max mark	Additional guidance
10.	(b)		15·79 or 15·8 or 16 (%) **(3)** Partial marking GFM = 342 **(1)** 54/342 x 100 (concept mark) **(1)** **This step on its own 2 marks** Calculation of final answer using the correct relationship **(1)**	**3**	Maximum 2 marks **(working must be shown)** Incorrectly calculated GFM- allow follow through using the mass of aluminium from working **or** Using mass of Al as 27- 27/342 x 100 = 7·89 or 7·9 or 8 **or** Using atomic numbers- 26/170 x 100 = 15 or 15·29 or 15·3 **or** Candidate correctly calculates percentage of sulfur (28 or 28·1%) or oxygen (56 or 56·1%) rather than aluminium Maximum of 1 mark - **working must be shown for** value divided by 342 does not correspond to an element in the compound, award a maximum of 1 mark. No units required but maximum of 2 marks can be awarded if wrong unit is given. (Wrong units would only be penalised once in any paper)

Question			Answer	Max mark	Additional guidance
11.	(a)		pH of solution goes down / decreases / goes below 7 / goes to a value less than 7 from 7 **because** the H^+ ion / hydrogen ion concentration increases /goes up or more H^+ than OH^- / $H^+ > OH$ **(2)** Partial marking pH of solution goes down/ decreases/goes below 7/ goes to a value less than 7 from 7 **(1)** **or** H^+ ion / hydrogen ion concentration increases/goes up / more H^+ than OH^- / $H^+ > OH^-$ **(1)**	**2**	Award zero marks for - it gets more acidic - sulfur dioxide is a non-metal /acidic oxide These two do **not** negate a correct answer. Award zero marks for any mention of pH being above 7. If the candidate states the pH increases/goes up/goes above 7, the mark for the description of more H^+ cannot be awarded.
	(b)		Decreases /goes down /gets lower	**1**	If the candidate mentions temperature **and** solubility in their answer the cause and effect must be given ie - as the temperature increases the solubility decreases **or** the solubility decreases as the temperature increases Award zero marks for - as the solubility decreases the temperature increases or - the temperature increases as the solubility decreases

Question			Answer	Max mark	Additional guidance
12.	(a)			**1**	Circling of either C=C or OH. Award zero marks for
	(b)		Ester(s)	**1**	
	(c)		21 (g) **(3)** Partial marks 1 mark for **either**: Both GFMs ie 154 and 210 **or** Moles of geraniol ie (15·4 / 154) = 0·1 mol 1 concept mark for **either:** $15{\cdot}4 \times \frac{\text{GFM of ester}}{\text{GFM of geraniol}}$ ie 15.4 x (210 / 154) **or** Moles of geraniol x GFM of ester ie 0·1 x 210 **(Either of these two steps on their own with all correct substitutions 2 marks)** 1 mark for calculated final answer **provided the concept mark** has been awarded.	**3**	No units required but a maximum of two marks can be awarded if wrong unit is given. (Wrong units are only penalised once in any paper)

Question			Answer	Max mark	Additional guidance
13.	(a)		C_nH_{2n-2} **or** C_nH_{n2-2} **or** $C_nH_{2(n-1)}$	**1**	Accept **x** etc in place of **n**
	(b)	(i)			Allow one end bond to be missing.
		(ii)	Addition / additional	**1**	Award zero marks for - add
	(c)	(i)		**1**	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.
		(ii)	The two bromine atoms are not next to one another. **or** The two bromines are separated by a hydrogen. **or** The two bromine branches are not next to one another.	**1**	Award zero marks for -bromide -bromine molecules. Accept words/phrases that imply not together or not next to each other.

Question			Answer	Max mark	Additional guidance
14.	(a)	(i)	Any correct shortened or full structural formula for hexan-1-ol	**1**	Bond to the hydroxyl group **must** be to the O of the OH. Ignore the omission of one H atom (from a carbon atom) in full structural formula provided the bond is shown **or** ignore one carbon to hydrogen bond missing provided the hydrogen is shown.
		(ii)	188 (kJ)	**1**	No units required but no mark is awarded if wrong unit is given. (Wrong units are only penalised once in any paper).
	(b)		3·9 or 3·91 or 4 (kJ kg^{-1} $°C^{-1}$) **(3)** Partial marking Using the correct concept of $c = E_h / m\,\Delta T$ with E_h = 13·3 **(1)** 0·1 **and** 34 **(1)** A further mark can be awarded for the candidate's calculated answer **only** if the mark for the concept has been awarded. **(1)**	**3**	No units required but a maximum of two marks can be awarded if wrong unit is given. (Wrong units are only penalised once in any paper) 13300 and 100 can be used if the calculation is carried out in J/g. (The final answer would be 3·9 and the unit is correct if given as J g^{-1} $°C^{-1}$. or as kJ kg^{-1} $°C^{-1}$) Alternatively -13300 and 0·1 can be used but the final answer should be 3912 J kg^{-1} $°C^{-1}$ (units must be shown and correct for 3 marks to be awarded). If no unit, or the unit given in question is used then 2 marks are awarded as the mark for the final calculated answer is not awarded. Or alternatively - the answer, 3912, can be divided by 1000 to give the correct answer in kJ kg^{-1} $°C^{-1}$.

Question			Answer	Max mark	Additional guidance
15.			**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**	

[END OF MARKING INSTRUCTIONS]