

National Qualifications 2019

X813/75/02

Chemistry Section 1 — Questions

FRIDAY, 10 MAY 1:00 PM – 3:30 PM

Instructions for the completion of Section 1 are given on *page 02* of your question and answer booklet X813/75/01.

Record your answers on the answer grid on page 03 of your question and answer booklet.

You may refer to the Chemistry Data Booklet for National 5.

Before leaving the examination room you must give your question and answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.





SECTION 1 — 25 marks Attempt ALL questions

Questions 1 and 2 refer to an experiment to investigate the rate of a reaction. The volume of gas collected in 2 minutes was 5 cm^3 .

- 1. What was the average rate of reaction over this time?
 - A 0.2
 - B 0.4
 - C 2.5
 - D 5.0
- 2. The unit for the average rate of this reaction is
 - A cm³/min⁻¹
 - B $cm^3 min^{-1}$
 - C min/cm³
 - D min cm⁻³
- **3.** Tennessine is a newly discovered element with a predicted electron arrangement of 2,8,18,32,32,18,7.

In which group of the periodic table should Tennessine be placed?

- A 1
- B 2
- C 7
- D 8

4. Which of the following is a positively charged ion?

	Protons	Neutrons	Electrons
Α	9	10	10
В	10	9	10
С	11	12	11
D	12	13	10

5. To turn a gas into a liquid it must be cooled below a temperature known as its critical temperature.

Gas	Formula	Relative formula mass	Critical temperature (°C)
hydrogen	H ₂	2	-240
helium	He	4	-268
ammonia	NH ₃	17	133
oxygen	0 ₂	32	–119
carbon dioxide	CO ₂	44	31

Identify the true statement based on the information in this table.

- A Carbon dioxide can be a liquid at 40 °C
- B Compounds have higher critical temperatures than elements
- C Critical temperature increases as relative formula mass increases
- D Diatomic elements have lower critical temperatures than Noble gases
- 6. A molecule of phosphorus trifluoride is shown.



Which term can be used to describe the shape of a phosphorus trifluoride molecule?

- A Linear
- B Angular
- C Tetrahedral
- D Trigonal pyramidal

- 7. In which of the following compounds do the ions have the same electron arrangement? You may wish to use the data booklet to help you.
 - A Na₂O
 - B LiF
 - C KBr
 - D MgCl₂
- 8. Several conductivity experiments were carried out using the apparatus below.



Identify the experiment in which the bulb would light.

	Substance X	Substance Y
Α	solid copper sulfate	liquid mercury
В	copper chloride solution	molten sodium chloride
С	solid potassium nitrate	nickel bromide solution
D	sodium chloride solution	liquid hexane

- **9.** Limewater can be made by dissolving calcium hydroxide in water. Which of the following terms correctly describes calcium hydroxide?
 - A Solute
 - B Solvent
 - C Solution
 - D Insoluble
- 10. Ammonium nitrate, NH_4NO_3 , has a gram formula mass of 80. The percentage by mass of nitrogen in ammonium nitrate is equal to
 - A $\frac{14}{80} \times 100$
 - B $\frac{28}{80} \times 100$
 - $C \qquad \frac{28}{100} \times 80$
 - $D \qquad \frac{80}{28} \times 100.$
- 11. As an alkaline solution is diluted with water
 - A the pH increases
 - B the pH stays the same
 - C the concentration of hydroxide ions increases
 - D the concentration of hydroxide ions decreases.
- 12. Which of the following compounds is a base?
 - A Sodium oxide
 - B Calcium chloride
 - C Potassium nitrate
 - D Ammonium sulfate

[Turn over

- 13. Which of the following compounds does not have an isomer?
 - A Cyclopropane
 - B But-1-ene
 - C Pentane
 - D Ethene
- 14. The systematic name for CH₃CH₂C(CH₃)CHCH₃ is
 - A 3-methylpentane
 - B 2-methylpentane
 - C 3-methylpent-2-ene
 - D 2-methylpent-3-ene.
- 15. When pent-1-ene undergoes an addition reaction with water, two products are formed.



Which of the following alkenes will also produce two products when it undergoes an addition reaction with water?

- A Oct-2-ene
- B Hex-3-ene
- C But-2-ene
- D Ethene

16. In the Clemmensen reaction, ketones can be converted to alkanes as shown.



Identify the alkane produced if the following ketone was used in this reaction?







[Turn over

17. Which line in the table correctly describes the trends going from hexanoic acid to butanoic acid?

	Formula mass	Solubility in water
А	increasing	decreasing
В	decreasing	increasing
С	decreasing	decreasing
D	increasing	increasing

18. Four cells were made by joining silver to different metals.The cells produced the following voltages 2.7 V, 1.1 V, 0.9 V and 0.5 V.



The metals used were copper, zinc, iron and magnesium.

Which voltage was produced in the cell containing silver and copper? You may wish to use the data booklet to help you.

- A 2.7 V
- B 1.1 V
- C 0.9V
- D 0.5 V

19. Information about the reactions of three different metals, X, Y and Z is given in the table.

Metal	Reaction with dilute acid	Reaction with water
X	reacts	no reaction
Y	no reaction	no reaction
Z	reacts	reacts

Which of the following shows the metals in order of increasing reactivity?

- A Y, Z, X
- B Z, X, Y
- C Y, X, Z
- D X, Y, Z
- 20. A co-polymer is formed when two different monomers polymerise.Part of the structure of a co-polymer, showing three monomer units, is given below.



One of the monomers used is propene. Identify the other monomer.

- A Pent-2-ene
- B Pent-1-ene
- C But-2-ene
- D But-1-ene

[Turn over

21. Nitrogen dioxide is a brown coloured gas that is soluble in water and more dense than air.

Which of the following diagrams shows the most appropriate method for collecting and measuring the volume of nitrogen dioxide?



- 22. A solution of a metal chloride burns with a green flame.Which of the following metal ions could be present in the metal chloride?You may wish to use the data booklet to help you.
 - A Ba²⁺
 - B Ca²⁺
 - C K⁺
 - D Na⁺
- 23. Identify the gas that turns limewater cloudy.
 - A Oxygen
 - B Nitrogen
 - C Hydrogen
 - D Carbon dioxide

Questions 24 and 25 refer to the equation shown.

 $AgNO_3(aq) + NaBr(aq) \rightarrow NaNO_3(aq) + AgBr(s)$

- 24. The reaction shown by the equation is an example of
 - A addition
 - B combustion
 - C precipitation
 - D neutralisation.
- 25. Which of the following ions are spectator ions in the reaction?
 - A Ag⁺ and NO_3^-
 - B Na⁺ and NO₃⁻
 - C Ag⁺ and Br⁻
 - D Na⁺ and Br⁻

[END OF SECTION 1. NOW ATTEMPT THE QUESTIONS IN SECTION 2 OF YOUR QUESTION AND ANSWER BOOKLET]

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Total marks — 100						
SECTION 1 — 25 marks						

Attempt ALL questions. Instructions for the completion of Section 1 are given on *page 02*.

SECTION 2 — 75 marks

Attempt ALL questions.

You may refer to the Chemistry Data Booklet for National 5.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers and rough work is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting. Any rough work must be written in this booklet. You should score through your rough work when you have written your final copy.

Use blue or black ink.

Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.





The questions for Section 1 are contained in the question paper X813/75/02.

Read these and record your answers on the answer grid on page 03 opposite.

Use **blue** or **black** ink. Do NOT use gel pens or pencil.

- 1. The answer to each question is **either** A, B, C or D. Decide what your answer is, then fill in the appropriate bubble (see sample question below).
- 2. There is **only one correct** answer to each question.
- 3. Any rough working should be done on the additional space for answers and rough work at the end of this booklet.

Sample question

To show that the ink in a ball-pen consists of a mixture of dyes, the method of separation would be

- A fractional distillation
- B chromatography
- C fractional crystallisation
- D filtration.

The correct answer is B — chromatography. The answer B bubble has been clearly filled in (see below).



Changing an answer

If you decide to change your answer, cancel your first answer by putting a cross through it (see below) and fill in the answer you want. The answer below has been changed to **D**.



If you then decide to change back to an answer you have already scored out, put a tick (\checkmark) to the **right** of the answer you want, as shown below:







You must record your answers to Section 1 questions on the answer grid on Page 03 of your answer booklet.



page 03

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page 04

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page 05

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SECTION 2 — 75 marks Attempt ALL questions

- There are many different types of glass.
 Glass is made from the chemical silica, SiO₂, which is obtained from sand.
 - (a) Silica has a melting point of 1713 °C.State the term used to describe the structure of silica.
 - (b) Borosilicate glass is a type of glass that also contains the element boron. A sample of boron contains two different types of atom.

¹⁰₅B ¹¹₅B

- (i) State the term used to describe these different types of boron atom.
- (ii) Explain why the mass number of each type of boron atom is different.

(iii) The relative atomic mass of boron is 10.8.State the mass number of the most common type of atom in the sample.



(continued) (c) Glass that contains a minimum of 24% lead oxide is known as crystal glass. Calculate the mass, in grams, of lead oxide in a sample of crystal glass weighing 500 g. 1

1.

[Turn over



2. Read the passage below and answer the questions that follow.

Antifreeze

Antifreeze lowers the freezing point of water. When diluted, antifreeze is used in car engines to prevent water-based liquids from freezing.

Different brands of antifreeze can contain either ethane-1,2-diol or propane-1,2-diol.





MARKS DO NOT

THIS

ethane-1,2-diol

propane-1,2-diol

Ethane-1,2-diol is toxic if swallowed. In the liver, an enzyme converts ethane-1,2-diol into oxalic acid.



oxalic acid

The oxalic acid then reacts with calcium in the body to form calcium oxalate. Calcium oxalate is the main component of kidney stones, which can cause extreme pain.

Propane-1,2-diol is not regarded as toxic because the body breaks down the molecule to harmless lactic acid, which is also produced naturally in the body during exercise.



lactic acid

Adapted from Education in Chemistry, May 2008, Volume 45 Number 3



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	2.	(cor	itinued)		MV ROM
		(a)	Name the functional group found in both ethane-1,2-diol and propane-1,2-diol.	1	
		(b)	Name the type of substance used to convert ethane-1,2-diol into oxalic acid.	1	
		(c)	Name the salt mentioned in the passage.	1	
		(d)	Calculate the mass, in grams, of 1 mole of the harmless product formed, in the body, from propane-1,2-diol.	1	
_			[Turn over		
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- 3. Nitrogen and hydrogen react together to form ammonia. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ (a) Draw a diagram, showing all outer electrons, to represent a molecule of nitrogen gas, N₂. 1
 - (b) The following method can be used to prepare small quantities of ammonia in the laboratory.



Suggest what colour the damp pH paper would be after the mixture is heated.

1



3. (continued)

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(c) In industry, ammonia can be produced by the Haber process.

The table shows the yield of ammonia produced at different temperatures by this process.

Temperature (°C)	100	200	400	500	600	700
Percentage yield of ammonia (%)	97	87	46	28	17	10

(i) Describe the relationship between temperature and percentage yield of ammonia.

(ii) Draw a graph of the percentage yield of ammonia against temperature.

(Additional graph paper, if required, can be found on *page 33*.)







(ii) **On the flow diagram**, draw an arrow to show how the process can be made more economical.

1



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	4.	Rad	ioisoto	opes emit radiation to become more stable.		
		(a)	State	where the radioactive decay occurs in an atom.	1	
		(b)	lodin the ti	e-131 is a radioisotope with a half-life of 8 days and can be used in reatment of thyroid cancer.		
			(i)	State what is meant by the term half-life.	1	
			(ii)	Calculate the percentage of iodine-131 that would have decayed	2	
				after 24 days.	3	
			(iii)	Different concentrations of iodine-131 are used to treat different types of cancer.		
				Circle the correct words to complete the sentence.	1	
				When an iodine-131 solution is diluted,		
				gets longer		
				the half-life \prec stays the same \succ		
				gets shorter		
L						
				* X 8 1 3 7 5 0 1 1 3 *		

- 5. The alkenes are a family of unsaturated hydrocarbons.
 - (a) Describe the chemical test, including the result, to show that a hydrocarbon is unsaturated.

(b) Propene is an alkene that can take part in a range of addition reactions.



(i) Name the type of addition reaction taking place in reaction X.

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(ii) Name the chemical that reacts with propene to form compound Y.

(iii) Name the polymer formed in reaction Z.

* X 8 1 3 7 5 0 1 1 4 *

page 14

5. (continued)

(c) The cycloalkenes are another family of unsaturated hydrocarbons.

(i) Cyclohexene can be made by reacting ethene with butadiene in a reaction called the Diels-Alder reaction as shown.

 $\begin{array}{cccc} C_2H_4 & + & C_4H_6 & \longrightarrow & C_6H_{10} \\ ethene & butadiene & cyclohexene \end{array}$

Calculate the mass, in grams, of ethene required to make 410g of cyclohexene.

Show your working clearly.

(ii) The table gives information about cyclopentene and cyclohexene.

Cycloalkene	Boiling point (°C)
cyclopentene	45
cyclohexene	83

Explain why cyclopentene has a lower boiling point than cyclohexene.



2

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3



6. An oxide is a compound that contains at least one oxygen atom and **only one** other element in its chemical formula.

Using your knowledge of chemistry, comment on the chemistry of oxides.

3



[Turn over for next question

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page 17

Γ		N	ARKS	DO NOT WRITE IN
7	· Pa	araffin wax is a mixture of hydrocarbon molecules that belong to the same omologous series.		MARGIN
	(8	a) State what is meant by the term homologous series.	1	
	()	a) An example of one hydrocarbon contained in paraffin way is C. H		
	(r	(i) Name the homologous series to which this hydrocarbon belongs.	1	
		(ii) Write the molecular formula for the molecule, containing 72 hydrogen atoms, that belongs to the same homologous series	1	
			·	



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7. (continued)

(c) The table contains information about some hydrocarbon molecules.

Number of carbon atoms	Boiling point (°C)
20	343
21	356
22	369
23	381

Predict the boiling point, in °C, of the hydrocarbon with 24 carbon atoms. 1

[Turn over



8. Read the passage below and answer the questions that follow.

Beryllium

1

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THIS MARGIN

Beryllium is a rare element in the universe. Unlike most elements it was not formed during the Big Bang or by stars. In fact, beryllium is only formed in supernova explosions.

Beryllium is found in the mineral Beryl, which has the chemical name beryllium aluminium silicate. Beryl makes up a range of glittering gemstones such as emerald and aquamarine.

In 1828 the metal beryllium was extracted from beryllium chloride $(BeCl_2)$ by reacting this compound with potassium. Potassium chloride was also produced in this reaction.

In 1932 James Chadwick discovered when a sample of beryllium was bombarded with X-rays from radium, it emitted a new kind of sub-atomic particle that had mass but no charge. He called this new particle a neutron and was awarded the Nobel Prize for his work in 1935.

Adapted from Education in Chemistry, November 2015, Volume 52, Issue 6

(a) State where beryllium is formed.

(b) Name the elements found in the mineral Beryl.







THIS Alcohols can take part in different types of chemical reaction. 9. (a) When alcohols are burned, heat energy is released. State the term used to describe all chemical reactions that release heat energy. 1 (b) A student carried out the following experiment. thermometer glass beaker ethanol (i) When 0.8 g of ethanol was burned, 8.36 kJ of energy was absorbed by the water. If the temperature of the water increased by 40 °C, calculate the mass, in kg, of water used by the student in this experiment. 3 You may wish to use the data booklet to help you. Show your working clearly.



9. (b) (continued)

(ii) The experiment was repeated, replacing the glass beaker with a copper can and using a heat shield.



Explain why these changes resulted in more heat energy being absorbed by the water.

[Turn over



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2

1

9. (continued)

(c) Alcohols can react with hot copper(II) oxide.

Depending on the structure of the alcohol used, the product will be either an aldehyde or a ketone.



(i) Write a general statement linking the position of the functional group in an alcohol to the **type** of product formed.



9. (c) (continued)

(ii) The following alcohol reacts with hot copper(II) oxide to produce an aldehyde.



Draw the full structural formula for the aldehyde produced when this alcohol reacts with hot copper(II) oxide.

[Turn over

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10.	(b)	(continued)	MARKS	DO NOT WRITE IN THIS MARGIN
		(iii) Write the redox equation for the overall reaction.	1	
	(c)	Carbon in the form of graphite is a suitable material for use as ar electrode as it does not react with the solutions.		
		Suggest another reason why it is a suitable material.	1	
		[Turn over		
		* X 8 1 3 7 5 0 1 2 7 *		

THIS **11.** A student was asked to prepare the soluble compound, calcium propanoate. A section of the procedure used by the student is shown. Preparation of calcium propanoate Procedure 1. Using a measuring cylinder add 20 cm³ of dilute acid to a beaker. 2. Add a spatulaful of calcium carbonate to the acid and stir the reaction mixture with a glass rod. 3. Continue adding the calcium carbonate until . . . (a) Write the formula, showing the charge on each ion, for calcium carbonate. 1 (b) Name the acid used to prepare calcium propanoate. 1 (c) Complete the instruction for step 3 of the procedure. 1 Continue adding the calcium carbonate until . . . (d) After step 3 has been completed a further two techniques are carried out to prepare a dry sample of calcium propanoate. Name the two techniques, in the correct order, that must be carried out. 1 1st technique 2nd technique







[Turn over



page 30

12. (continued)

(iii) The average volume of sodium carbonate used was $15 \cdot 0 \text{ cm}^3$. To calculate the average volume of sodium carbonate used, the student only used titre volumes within $0 \cdot 2 \text{ cm}^3$ of each other. State the term used to describe these titre volumes.

(iv) The equation for the reaction is

 $Na_2CO_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(\ell) + CO_2(g)$

Calculate the concentration, in $moll^{-1}$, of the hydrochloric acid solution.

Show your working clearly.

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[Turn over for next question



		MARKS	DO NOT WRITE IN THIS MARGIN
13.	The force of attraction between oppositely charged particles is important in chemistry.		
	Using your knowledge of chemistry, explain why this force of attraction is important.	s 3	

[END OF QUESTION PAPER]



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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional graph for use with question 3 (c) (ii)





ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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Additional diagram for question 3 (d) (i)





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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK



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page 35

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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