

**NATIONAL
SENIOR CERTIFICATE**

GRADE 10

NOVEMBER 2020

**PHYSICAL SCIENCES P2 (CHEMISTRY)
(EXEMPLAR)**

MARKS: 150

TIME: 3 hours

This question paper consists of 20 pages, including 2 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your NAME and SURNAME in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of ELEVEN questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two subquestions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You are advised to use the attached DATA SHEETS.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round off your FINAL answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions, et cetera where required.
11. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1–1.10) in the ANSWER BOOK, for example 1.11 E.

1.1 Which ONE of the following is a good conductor of electricity?

- A Wood
- B Plastic
- C Silicon
- D Copper (2)

1.2 ${}^1_1\text{H}$, ${}^2_1\text{H}$ and ${}^3_1\text{H}$ occur in nature as isotopes of hydrogen. The term *isotope* is defined as ...

- A the group and the period number of an element in the periodic table.
- B an atom of the same element having the same number of protons but a different number of neutrons.
- C the mass of a particle on a scale where an atom of carbon-12 has a mass of 12.
- D the most probable region in space where electrons have the specific energy corresponding to the orbitals. (2)

1.3 Refer to the table below to fill in the spaces in the following sentence.

The density of the metals ... and that of non-metals ... across period 2 of the periodic table.

	METALS	NON-METALS
A	Decreases	Increases
B	Decreases	Decreases
C	Increases	Decreases
D	Increases	Increases

(2)

1.4 Which ONE of the following molecular mass represents hydrogen chloride?

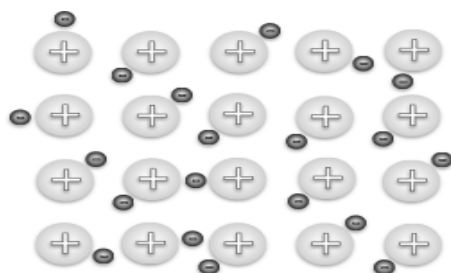
- A 57,5
- B 35,5
- C 36,5
- D 40,2 (2)

1.5 The bonding between crystal lattices can only be a/an ... bond.

- A ionic
- B metallic
- C covalent
- D pure

(2)

1.6 Study the diagram below.



The diagram above represents the following:

- A A lattice structure between ions
- B A buckminsterfullerene of sulphur
- C Intermolecular forces between molecules
- D Positive metal kernels and the sea of delocalised electrons

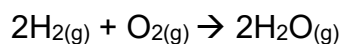
(2)

1.7 Thando slowly heats a chocolate bar and observes the changes. Which ONE of the following is the most accurate conclusion?

- A Chocolate undergoes a chemical change
- B Chocolate undergoes a physical change
- C Chocolate decomposes into its constituent components
- D Chocolate undergoes no change

(2)

1.8 Study the equation below:



Which ONE of the statements below is CORRECT?

- A 2 molecules of hydrogen gas react with 1 atom of oxygen gas to form 2 atoms of water vapour.
- B 2 moles of hydrogen gas react with 1 mole of oxygen gas to form 2 moles of water vapour
- C 4 atoms of hydrogen gas react with 2 molecules of oxygen gas to form 2 moles of water vapour.
- D 4 g of hydrogen gas react with 16 g of oxygen gas to form 18 g of water vapour. (2)

1.9 An aqueous mixture in a test tube contains $\text{Ag}^+(\text{aq})$, $\text{K}^+(\text{aq})$ and $\text{Pb}^+(\text{aq})$. How many different solids will form when $\text{NaCl}(\text{aq})$ is added to this mixture?

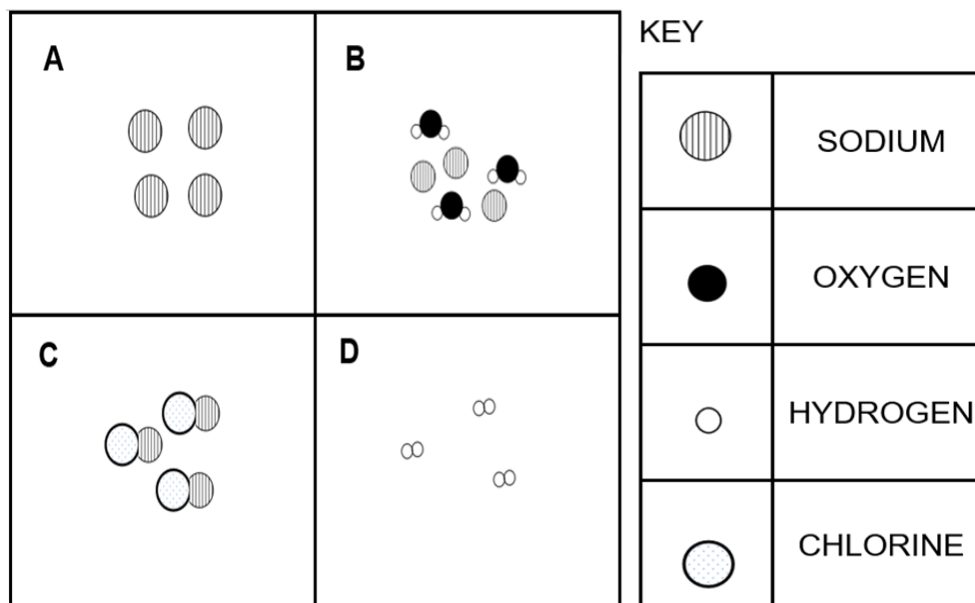
- A None
- B 1
- C 2
- D 3 (2)

1.10 SO_2 gas dissolves in water and contributes to acid rain. What is the name of the acid that forms during this reaction?

- A Sulfuric acid
 - B Carbon dioxide acid
 - C H_2CO_3
 - D Carbonic acid (2)
- [20]

QUESTION 2

The diagram below shows the particles of substances **A**, **B**, **C** and **D**.



2.1 Define the term *element*. (2)

2.2 Use the diagram and key provided to answer the following questions.

Write down the letter of the diagram that represents:

2.2.1 A substance that is solid at room temperature (1)

2.2.2 A mixture that is non-uniform (1)

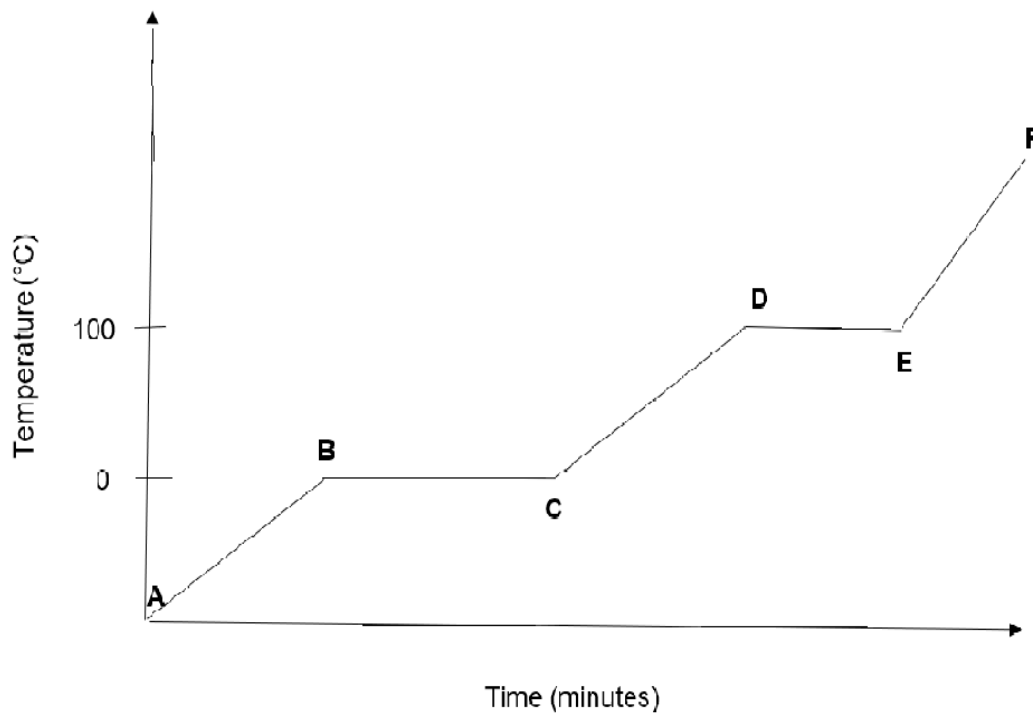
2.2.3 A pure substance consisting of two or more different elements (1)

2.2.4 A gas (1)

[6]

QUESTION 3

The following diagram, not drawn to scale, represents the heating curve for a certain substance. Point **A** represents $t = 0$ minutes where the substance is a solid.



3.1 Define the term *melting point*. (2)

Use the information in the diagram to answer the following questions.

3.2 Write down:

3.2.1 Between which two letters is the vapour pressure equal to the atmospheric pressure? (1)

3.2.2 The phase of a substance between letters **E** and **F** (1)

3.2.3 The process taking place between letters **B** and **C** (1)

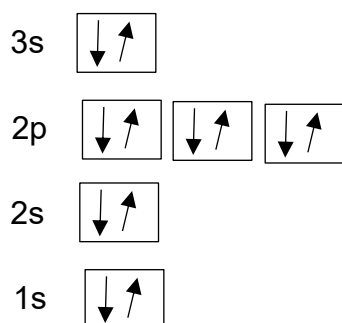
3.3 Is the energy ABSORBED, RELEASED or UNCHANGED between **D** and **E**? Give a reason for your answer. (2)

3.4 State how spaces between the particles change between letters **A** and **B**.

Write only INCREASE, DECREASE or UNCHANGED. (1)
[8]

QUESTION 4

Below is the Aufbau diagram of an unknown atom. Study the diagram and answer the following questions.



4.1 Define the term *atomic number*. (1)

Use the Aufbau diagram of an unknown atom above to answer the following questions.

4.2 In which group and period is the atom in the diagram above? (2)

4.3 Represent the atom in the diagram using A_ZX notation. (2)

4.4 How will the neutrality of the above atom change if it loses electron(s)? (1)

4.5 Write down the *sp* notation of an ion for the atom represented by the Aufbau diagram above. (2)

4.6 What will happen to the number of protons if the above atom loses electron(s) to become an ion?

Write down INCREASE, DECREASE or UNCHANGED. (1)
[9]

QUESTION 5

Study the following table of elements with the first ionisation energy values in $\text{kJ}\cdot\text{mol}^{-1}$ and answer the questions that follow.

ELEMENT	FIRST IONISATION ENERGY ($\text{KJ}\cdot\text{MOL}^{-1}$)
Li	520
Be	899
B	801
C	1 086
N	1 402

5.1 Define the term *ionisation energy*. (2)

5.2 A certain element in the table above is in group II of the periodic table.

5.2.1 Write down:

(a) The CHEMICAL NAME of this element (1)

(b) The NAME of the group to which this element belongs (1)

(c) The chemical symbol of an element with the same number of electrons as Be^{2+} (1)

5.2.2 Explain the difference in first ionisation energy of this element with that of lithium. (2)

5.3 Refer to the elements of period II of the periodic table in the table above.

How does the electronegativity of these elements change across a period in the periodic table?

Write down INCREASE, DECREASE or UNCHANGED. Explain your answer. (2)
[9]

QUESTION 6

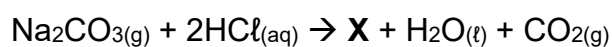
- 6.1 Methane gas is one of the hydrocarbons that is used as a source of fuels worldwide. When methane reacts with oxygen, water and carbon dioxide are formed.

Atoms of water molecules in the above reaction are bonded by a covalent bond.

6.1.1 Define the term *covalent bond*. (2)

6.1.2 Write down the balanced chemical equation. (3)

- 6.2 Consider the following balanced equation of a chemical reaction.



Write down:

6.2.1 The chemical formula of compound **X** in the above reaction (1)

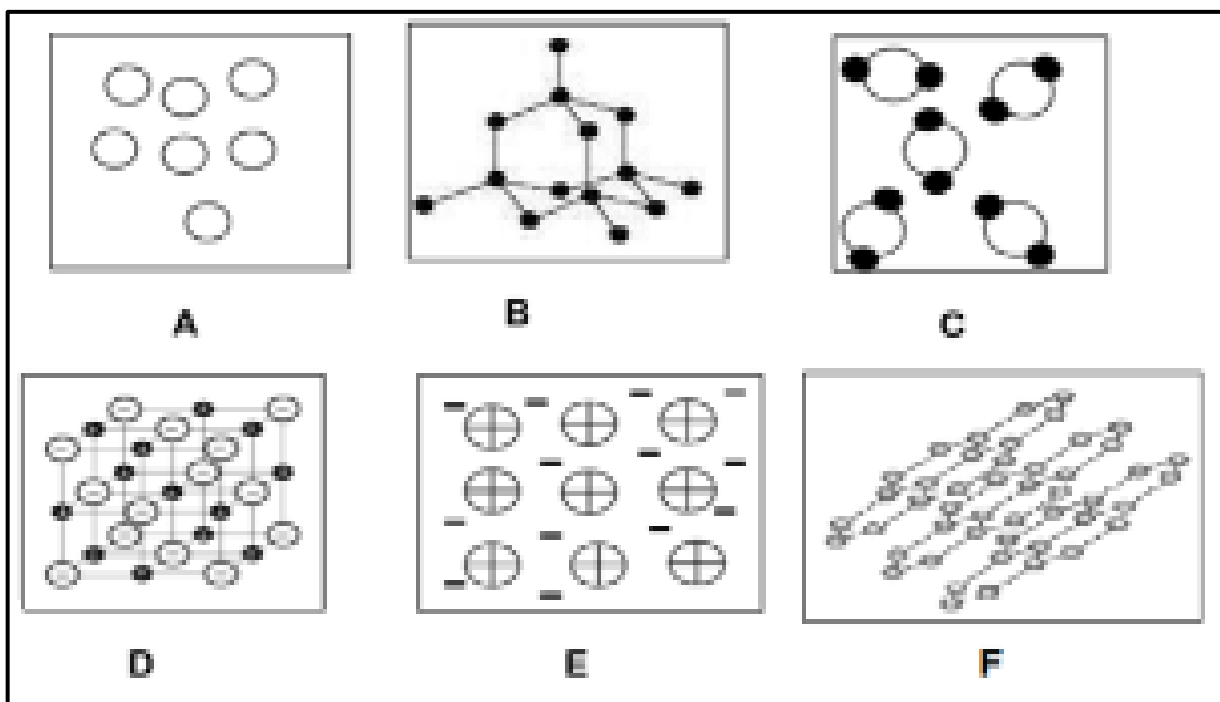
6.2.2 The type of bond that exists in compound **X** (1)

6.2.3 The Lewis structure of compound **X** (2)

[9]

QUESTION 7

Study the illustrations of the diagrams below and answer the questions which follow.

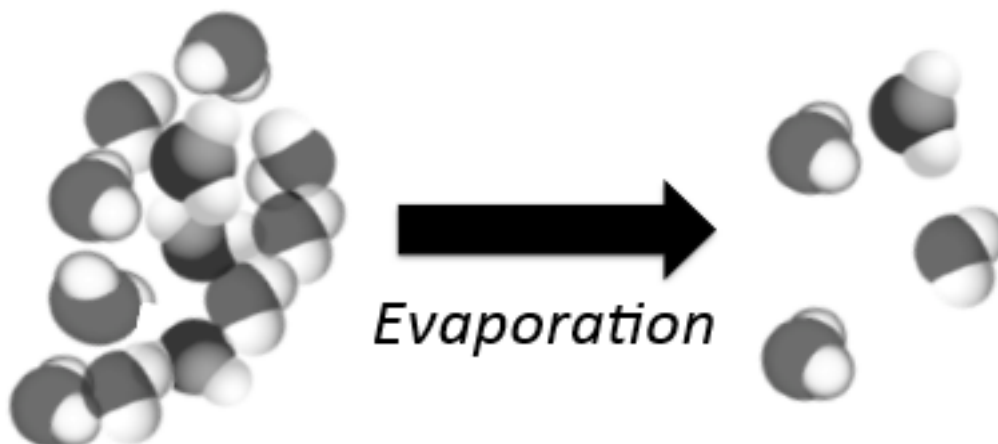


- 7.1 Define the term *compound*. (2)
- 7.2 Choose from the different diagram illustrations above ONE that best describes each of the following substances. Write down the letter only.
- 7.2.1 Diamond (1)
- 7.2.2 Carbon dioxide (1)
- 7.2.3 Helium (1)
- 7.2.4 Magnesium (1)
- 7.2.5 Sodium chloride (1)
- 7.2.6 Graphite (1)
- 7.3 Name the type of bond that exists between the particles of a diamond. (1)
- 7.4 From the above illustrations, write down the LETTER(S) of those that represent the following chemical structures:
- 7.4.1 Ionic structure (1)
- 7.4.2 Covalent network structure (2)
- 7.4.3 Metallic structure (1)

- 7.5 Consider the illustration of substances from the diagram on page 11 and write down the LETTER(S) that represent:
- 7.5.1 The illustration(s) with an empirical formula of **C** (2)
- 7.5.2 The illustration of the only substance found in atomic form of ambient condition (1)
- 7.5.3 The illustration that can be used as a cutting tool because of its strength (1)
- 7.6 Differentiate between *molecular structure* and *giant molecular structure*. (2)
- [19]**

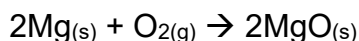
QUESTION 8

- 8.1 Consider the diagram below that shows liquid water evaporating to form water vapour.



- Use chemical formulae to represent the process in the diagram above and indicate the phases of the substance undergoing this process. (2)
- 8.2 Give THREE separation methods that can be used to reverse a physical change. (3)
- 8.3 Two Grade 10 learners investigate whether mass is conserved during a reaction. They burn 5 g of magnesium in oxygen to form a white powder, magnesium oxide.

The following balanced chemical equation represents the chemical reaction that took place in the investigation above.



- 8.3.1 Write down:
- (a) An investigative question for this investigation (2)
 - (b) An independent variable of this investigation (1)
 - (c) The dependent variable of this investigation (1)
 - (d) The variable that was kept constant in this investigation (1)
- 8.3.2 Is this reaction a SYNTHESIS or DECOMPOSITION? Give a reason for your answer. (2)
- 8.3.3 When a white powder of magnesium oxide was formed in the above investigation, heat was given off. Give the term that best describes the underlined phrase. (1)
- 8.3.4 Write down the law of conservation of mass in words. (2)

8.3.5 Show by means of a calculation that mass is conserved during the reaction represented by the balanced equation in QUESTION 8.3. (4)

8.3.6 MgO is the chemical formula of the chemical substance formed during the chemical reaction represented by the balanced chemical equation above.

Study the chemical formula of this substance and answer the following questions.

(a) Give the term used to describe the substance formed in the chemical reaction. (1)

(b) Calculate the percentage of oxygen in a 20 g sample of magnesium oxide produced. (4)

[24]

QUESTION 9

A hydrous salt is composed of anions and cations which are surrounded by a weakly bonded water molecule. Each hydrous salt has a fixed number of water molecules associated with it. When a salt holds a water molecule, we call it a hydrated or hydrous salt.

9.1 Write down the term that best describes the water molecule that is weakly bonded with salt. (1)

9.2 An unknown salt is found to contain 30,6% of water. The formula mass for anhydrous salt (AS) is 100 amu.

9.2.1 Calculate the amount of water bonded with an unknown salt. (3)

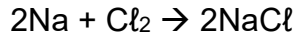
9.2.2 An anhydrous salt above consists of a metal with a molar mass of 40.

(a) Write down the chemical symbol of this metal. (1)

(b) To which group does the metal belongs? (1)

9.2.3 Write down the chemical formula of an anhydrous salt above. (2)

9.3 The balanced equation below represents the chemical reaction, where 3 moles of sodium react with chlorine.



9.3.1 Calculate the mass of sodium chloride formed. (3)

9.3.2 Calculate the volume of chlorine at STP if it reacts with 3,5 moles of sodium. (4)

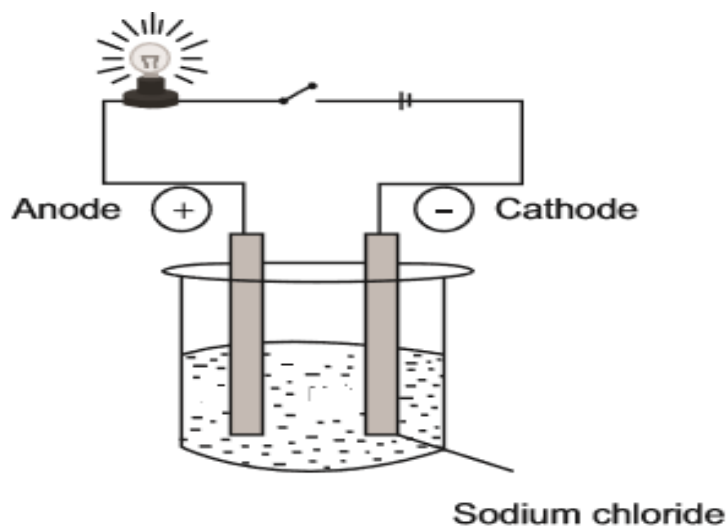
9.4 A sample of sodium sulphate compound is found to contain 29% of sodium, 40,5% of sulphur and 30, 4% of oxygen.

Use relevant calculations to determine the empirical formula of this compound. (4)

[19]

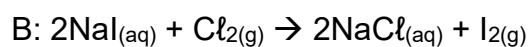
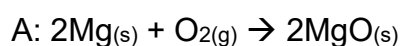
QUESTION 10

- 10.1 The experimental set-up below is used in a Grade 10 class to demonstrate the electrical conductivity of a sodium chloride solution.



- 10.1.1 Define the term *electrolyte*. (2)
- 10.1.2 Write down the formula of ions present in this set-up. (1)
- 10.1.3 What will happen to the brightness of the bulb in the set-up above if sodium chloride is replaced by calcium chloride?
Write down INCREASE, DECREASE or REMAIN THE SAME.
Give a reason for your answer. (3)

- 10.2 Study the reactions **A** and **B** below and answer the following questions.



- 10.2.1 Which of the reactions is an ion exchange reaction? Give a reason for your answer. (2)
- 10.2.2 Which of the reactions is a redox reaction? Give a reason for your answer. (2)

- 10.3 A group of Grade 10 learners want to investigate the reaction of ions in solutions. They pour the following solutions into six different test-tubes marked **A** to **F**.

NaCl, CaCO₃, Na₂SO₄, NaBr, NaI, Tap water

However, the learners forgot to write down which solution is in which test-tube.

- 10.3.1 Write down an equation to show how solid calcium carbonate dissociates in water. (2)
- 10.3.2 Write down the name of the chemical they would use to test for the presence of halides. (1)
- 10.3.3 How can they distinguish between the THREE types of halides used during the test mentioned in QUESTION 10.3.2? (3)
- 10.3.4 Learners add a few drops of barium nitrate solution to test-tubes **B** and **C** and a white precipitate is formed in each of the test-tubes. They then add nitric acid solution to both test tubes. In test tube **B** the precipitate DISSOLVES, whilst in test-tube **C** the precipitate REMAINS.

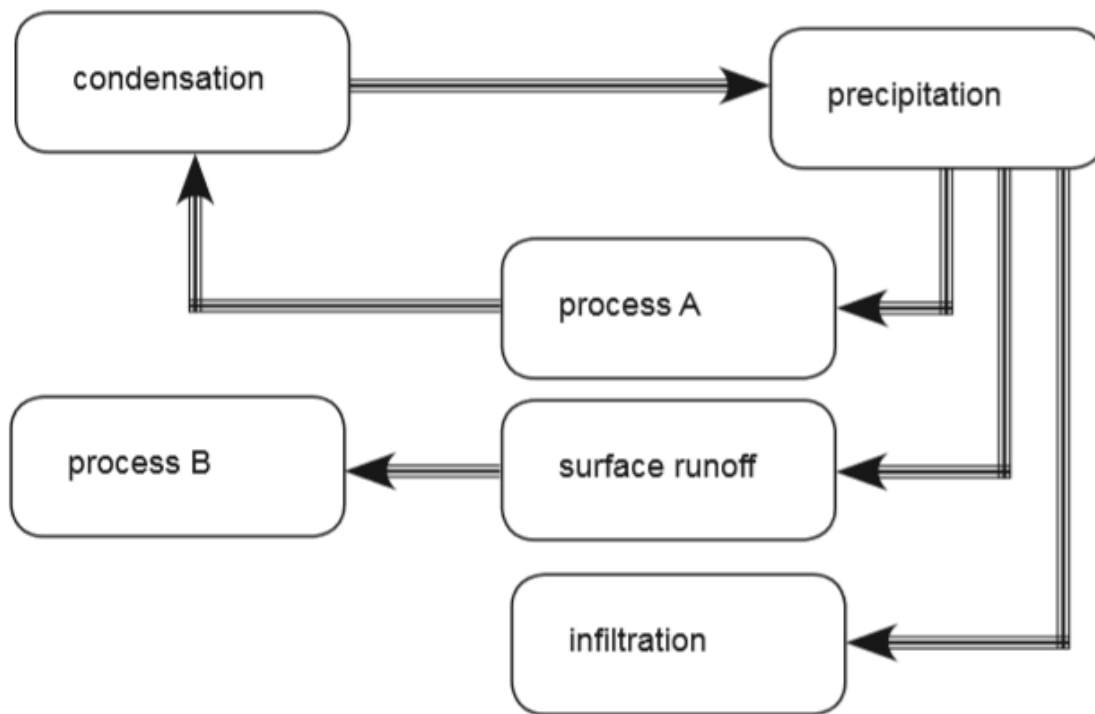
Write down the name of the compound that was tested in:

- (a) Test-tube **B** (1)
- (b) Test-tube **C** (1)
- 10.3.5 What type of reaction takes place between the precipitation in **B** and the nitric acid? (1)

[19]

QUESTION 11

The following diagram is the representation of the water cycle and the processes involved.



- 11.1 Of which sphere in the earth's system is the water cycle a part of? (1)
- 11.2 Briefly describe the process of precipitation. (2)
- 11.3 Process **A** takes place in living plants. Name process **A**. (1)
- 11.4 Write down ONE advantage of infiltration. (1)
- 11.5 Name process **B**. (1)
- 11.6 Name TWO significant factors which endanger the hydrosphere as a result of human interactions. (2)
- [8]**

TOTAL: 150

**DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 2 (CHEMISTRY)**

**GEGEWENS VIR FISIESTE WETENSKAPPE GRAAD 10
VRAESTEL 2 (CHEMIE)**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESTE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Avogadro's constant <i>Avogadro-konstante</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$
Charge on electron <i>Lading op elektron</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Electron mass <i>Elektronmassa</i>	m_e	$9,11 \times 10^{-31} \text{ kg}$
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$	$n = \frac{N}{N_A}$
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1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)																												
KEY/SLEUTEL																																													
Atomic number																																													
Electronegativity <i>Elektronegatiwiteit</i>																																													
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Approximate relative atomic mass <i>Benaderde relatiewe atoommassa</i>																																													
1 2,1 H 1	4 1,5 Be 9																	2 He 4																											
3 1,0 Li 7	4 1,5 Be 9																	5 2,0 B 11	6 2,5 C 12	7 3,0 N 14	8 3,5 O 16	9 4,0 F 19	10 Ne 20																						
11 0,9 Na 23	12 1,2 Mg 24																	13 1,5 Al 27	14 1,8 Si 28	15 2,1 P 31	16 2,5 S 32	17 3,0 Cl 35,5	18 Ar 40																						
19 0,8 K 39	20 1,0 Ca 40	21 1,3 Sc 45	22 1,5 Ti 48	23 1,6 V 51	24 1,6 Cr 52	25 1,5 Mn 55	26 1,8 Fe 56	27 1,8 Co 59	28 1,8 Ni 59	29 1,9 Cu 63,5	30 1,6 Zn 65	31 1,6 Ga 70	32 1,8 Ge 73	33 2,0 As 75	34 2,4 Se 79	35 2,8 Br 80	36 Kr 84																												
37 0,8 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 Nb 92	42 1,8 Mo 96	43 1,9 Tc	44 2,2 Ru 101	45 2,2 Rh 103	46 2,2 Pd 106	47 1,9 Ag 108	48 1,7 Cd 112	49 1,7 In 115	50 1,8 Sn 119	51 1,9 Sb 122	52 2,1 Te 128	53 2,5 I 127	54 Xe 131																												
55 0,7 Cs 133	56 0,9 Ba 137	57 La 139	72 1,6 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 1,8 Tl 204	82 1,8 Pb 207	83 1,9 Bi 209	84 2,0 Po	85 2,5 At	86 Rn																												
87 0,7 Fr	88 0,9 Ra 226	89 Ac																																											
<table border="1"> <tr> <td>58 Ce 140</td> <td>59 Pr 141</td> <td>60 Nd 144</td> <td>61 Pm</td> <td>62 Sm 150</td> <td>63 Eu 152</td> <td>64 Gd 157</td> <td>65 Tb 159</td> <td>66 Dy 163</td> <td>67 Ho 165</td> <td>68 Er 167</td> <td>69 Tm 169</td> <td>70 Yb 173</td> <td>71 Lu 175</td> </tr> <tr> <td>90 Th 232</td> <td>91 Pa</td> <td>92 U 238</td> <td>93 Np</td> <td>94 Pu</td> <td>95 Am</td> <td>96 Cm</td> <td>97 Bk</td> <td>98 Cf</td> <td>99 Es</td> <td>100 Fm</td> <td>101 Md</td> <td>102 No</td> <td>103 Lr</td> </tr> </table>																		58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175	90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr
58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175																																
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr																																