basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES: CHEMISTRY (P2)

NOVEMBER 2017

MARKS: 150

TIME: 2 hours

This question paper consists of 13 pages and 2 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and class (for example 10A) in the appropriate spaces on the ANSWER BOOK.

2. This question paper consists of NINE 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 may use appropriate mathematical instruments.

8. You are advised to use the attached DATA SHEETS.

9. Show ALL formulae and substitutions in ALL calculations.

10. Round off your final numerical answers to a minimum of TWO decimal places.

11. Give brief motivations, discussions, et cetera where required.

12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

1.1 Air can be classified as a/an …

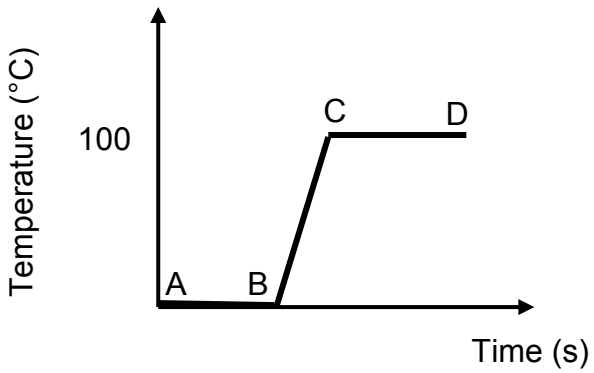
A element.

B compound.

C homogenous mixture.

D heterogeneous mixture. (2)

1.2 The graph below shows the heating curve of a substance.



In which part(s) of the graph does the substance gain kinetic energy?

A BC only

B CD only

C AB and CD

D AB, BC and CD (2)

1.3 In which ratio will group (I) elements react with group (VI) elements?

A 2 : 1

B 1 : 6

C 6 : 1

D 1 : 3 (2)

1.4 What is the total number of *nucleons* in the ion of calcium when calcium loses two electrons to form Ca^{2+}?

A 40

B 18

C 22

D 20 (2)

1.5 Which ONE of the following groups of elements shows the CORRECT trend of the density of metals?

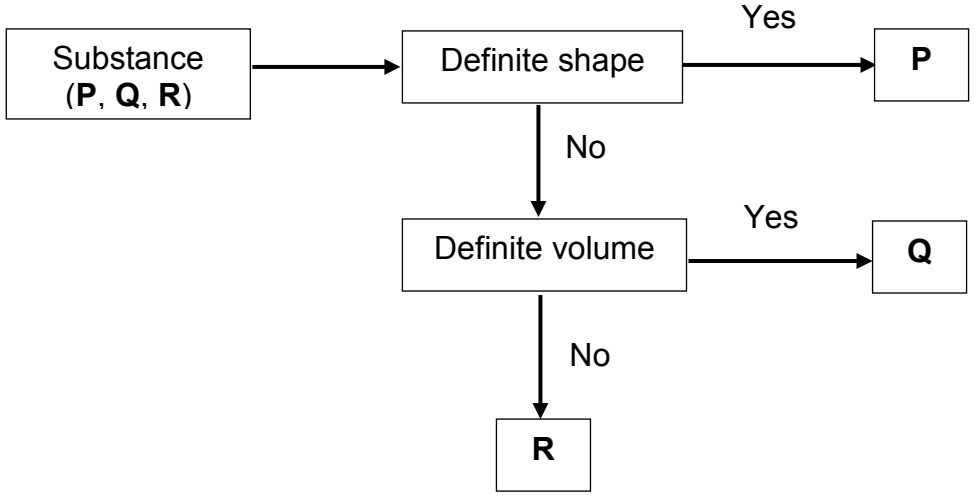
A Rb < K < Na < Li

B K < Na < Li < Rb

C Li < Na < K < Rb

D Na < Li <Rb < K (2)

1.6 A learner used the flow chart below to classify some examples of substances **P**, **Q** and **R**.



What could substances **P**, **Q** and **R** possibly be?

	P	Q	R
A	Marble	Oil	Oxygen
B	Oil	Marble	Oxygen
C	Oxygen	Oil	Marble
D	Oxygen	Marble	Oil

(2)

1.7 In a 20 g sample of molecules, which sample below has the greatest number of moles?

A NH_3

B N_2

C CO_2

D H_2 (2)

1.8 Carbon dioxide can change directly from the solid phase to the gas phase. This process is known as …

A sublimation.

B evaporation.

C decomposition.

D melting. (2)

1.9 The chemical name for $Fe_2(SO_4)_3$ is …

A iron sulphite.

B iron(III) sulphate.

C iron(II) sulphate.

D iron sulphide. (2)

1.10 All the soil on Earth is known as the …

A atmosphere.

B biosphere.

C lithosphere.

D hydrosphere. (2)
[20]

QUESTION 2 (Start on a new page.)

Consider the following substances:

C_{90}; NaCℓ; CO_2; Fe; H_2O

2.1 Write down a substance from the list above that is the following:

2.1.1 A molecular structure (1)

2.1.2 A metallic structure (1)

2.1.3 A covalent network structure (1)

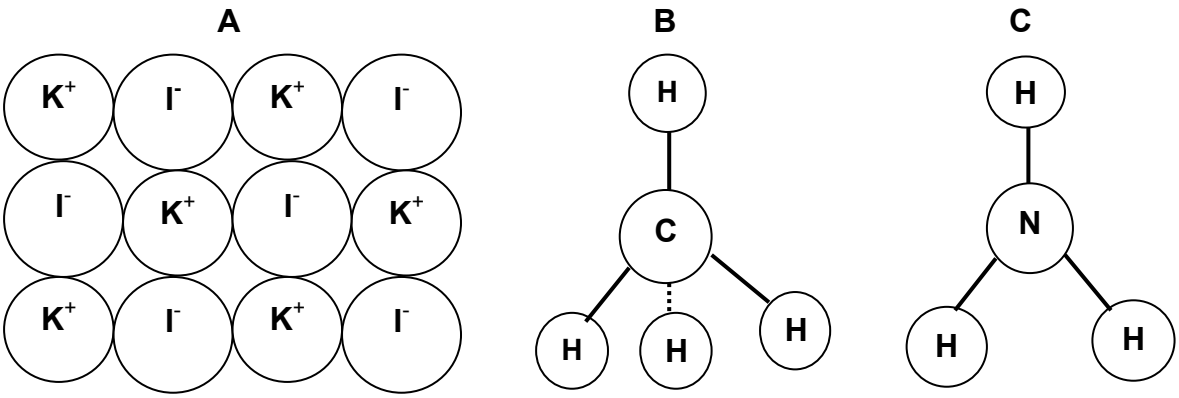
2.1.4 An ionic network structure (1)

2.2 Draw the Lewis dot diagram for the CO_2 molecule. (2)

2.3 Identify the type of chemical bond in H_2O. (1)

2.4 Draw the Lewis dot diagrams to show the formation of NaCℓ. (3)

2.5 Study the models of compounds **A**, **B** and **C** below and answer the questions that follow.



Write down the:

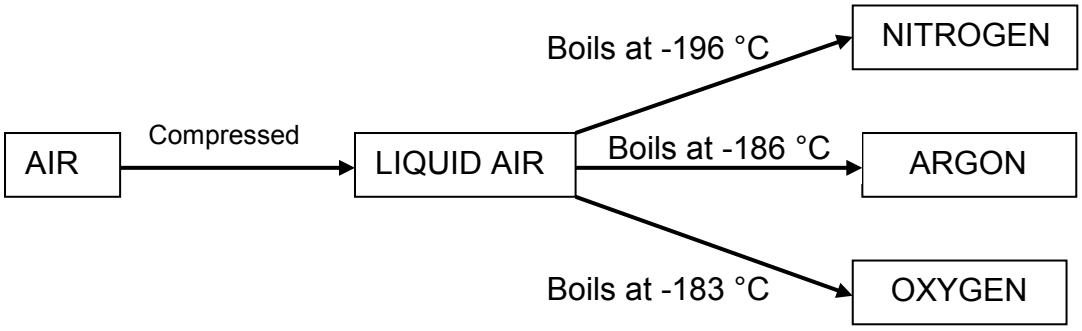
2.5.1 Chemical name of compound **A** (1)

2.5.2 Chemical formula of compound **B** (1)

2.5.3 Common name of compound **C** (1)

2.6 Many of the gases in air are very useful. An important industrial process, fractional distillation of liquid air, separates these gases from one another.

Consider the diagram below and answer the questions that follow.



2.6.1 Is this separation process *physical* or *chemical*? (1)

2.6.2 Which physical property is used to separate the gases after they have been liquefied? (1)

2.6.3 Which gas has the weakest intermolecular forces? Explain the answer. (2)

2.7 State how EACH of the following changes when *liquid nitrogen* changes into *gaseous nitrogen*. Write down only INCREASE, DECREASE or REMAIN THE SAME.

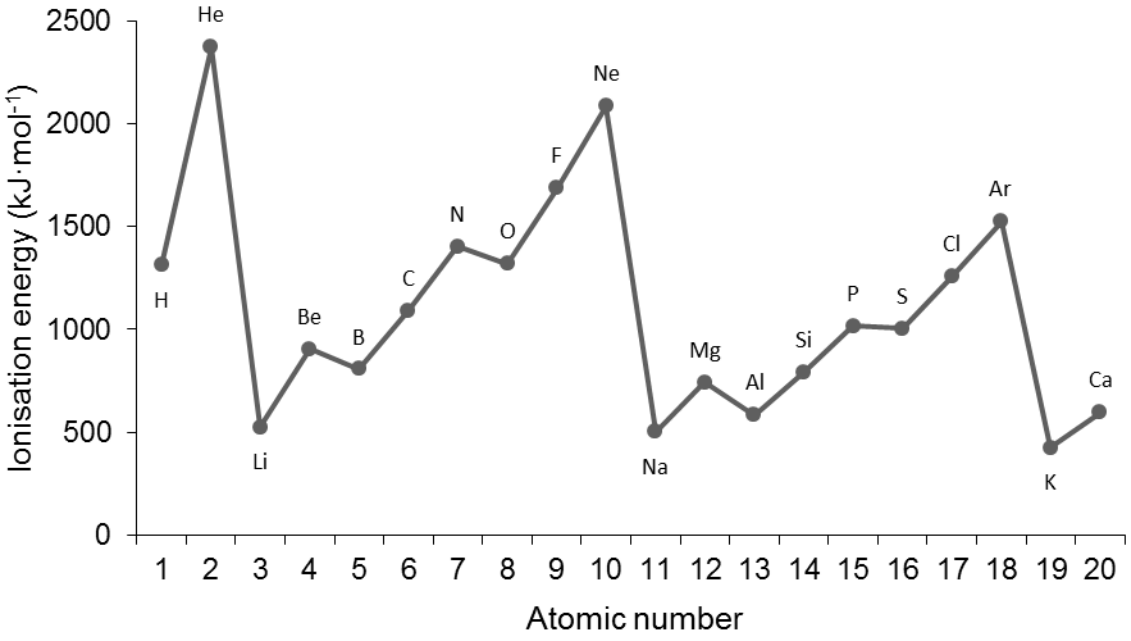
2.7.1 Spaces between the particles (1)

2.7.2 Strength of the forces between the particles (1)

2.7.3 Energy of the particles (1)
[20]

QUESTION 3 (Start on a new page.)

Consider the graph of the first ionisation energy and answer the questions that follow.



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

3.2 State the general trend in ionisation energy from left to right across a period on the periodic table. (2)

3.3 There is a drop in ionisation energy from beryllium to boron.

3.3.1 Write down the sp-notation for beryllium AND boron. (4)

3.3.2 Explain this drop in ionisation energy. (3)

3.4 Is the following statement TRUE or FALSE? If false, rewrite the statement correctly.

The ionisation energy of noble gases is high because of the half-filled s- and p-orbitals. (2)

3.5 Study the ionisation energy of the group (I) elements in the graph above and answer the questions that follow.

3.5.1 Give the general name of the group (I) elements. (1)

3.5.2 State the trend in the reactivity of elements in group (I). (2)

3.5.3 Explain the reason for the trend in QUESTION 3.5.2 by using the graph of ionisation energy. (2)

[18]

QUESTION 4 (Start on a new page.)

4.1 A certain element, X, has two isotopes in nature. One isotope has an atomic mass of 106,9 amu. The percentage appearance of this isotope is 50%. The atomic mass of the other isotope is 109,1.

4.1.1 Define the term *isotope.* (2)

4.1.2 Calculate the relative atomic mass of element X. (5)

4.1.3 Identify element X in QUESTION 4.1.2. (2)

4.2 Complete the table below. Write only the answer next to the question number (4.2.1–4.2.7).

ELEMENT	ATOMIC NUMBER	MASS NUMBER	NUMBER OF PROTONS	NUMBER OF NEUTRONS	NUMBER OF ELECTRONS
Al	**13**	**27**	4.2.1	4.2.2	4.2.3
K^+	**19**	4.2.4	4.2.5	4.2.6	4.2.7

(7)
[16]

QUESTION 5 (Start on a new page.)

Hydrogen peroxide decomposes at room temperature according to the following balanced chemical equation:

$$2H_2O_2(aq) \rightarrow O_2(g) + 2H_2O(\ell)$$

5.1 What does the (aq) represent in the equation above? (1)

5.2 Identify the type of reaction above. Choose between PRECIPITATION and REDOX. Give a reason for the answer. (2)

5.3 Is the reaction an example of a *physical* or a *chemical* change? (1)

5.4 Define the term *one mole* of a substance. (2)

5.5 If 4 moles of hydrogen peroxide decomposes, calculate the volume of gas formed at STP. (4)

5.6 Calculate the number of oxygen atoms in H_2O_2 if 17 g of H_2O_2 decomposes. (4)
[14]

QUESTION 6 (Start on a new page.)

6.1 Study the balanced chemical equation of the reaction between sodium carbonate (Na_2CO_3) and hydrochloric acid ($HC\ell$) and answer the questions that follow.

$$Na_2CO_3 + 2HC\ell \rightarrow 2NaC\ell + CO_2 + H_2O$$

Identify the type of reaction above. Choose between REDOX and GAS FORMING. (1)

6.2 In a reaction, 10,6 g of sodium carbonate reacts completely with excess hydrochloric acid.

6.2.1 Calculate the molar mass of sodium carbonate. (2)

6.2.2 Calculate the initial number of moles of sodium carbonate. (2)

6.2.3 Calculate the mass of CO_2 produced during this reaction. (4)

6.2.4 Calculate the mass of sodium chloride produced if 4,87 dm^3 of carbon dioxide was produced at STP. (6)

6.3 14,2 g of a sample of hydrated sodium carbonate, $Na_2CO_3 \bullet xH_2O$, was strongly heated until no further change in mass was recorded. On heating, all the water of crystallisation evaporated as follows:

$$Na_2CO_3 \bullet xH_2O \rightarrow Na_2CO_3 + xH_2O$$

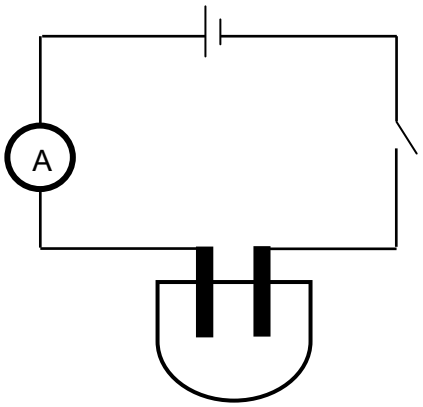
Calculate the number of moles of water of crystallisation in the sodium carbonate sample, if 5,3 g of solid remained after strong heating. (5)

[20]

QUESTION 7 (Start on a new page.)

Learners investigated the relationship between the concentration of a silver nitrate ($AgNO_3$) solution and its conductivity at a constant temperature.

They set up the apparatus, as shown below, and recorded the current. The initial reading of the ammeter was taken before anhydrous $AgNO_3$ was added to distilled water.



The anhydrous $AgNO_3$ was added to 200 cm^3 distilled water spoon by spoon. The ammeter reading was recorded after each spoon was added. The results are shown in the table below.

SPOONS OF $AgNO_3$ IN DISTILLED WATER	AMMETER READING (mA)
0	0
1	0,18
2	0,92
3	1,47
4	1,84

7.1 Give a reason why the ammeter reading was initially zero. (1)

7.2 Give ONE word/term for a solution that conducts electricity. (2)

7.3 Write down a balanced chemical equation to show how $AgNO_3$ dissociates in water. (2)

7.4 Write down the following for the investigation above:

7.4.1 A hypothesis (2)

7.4.2 Dependent variable (1)

7.4.3 Independent variable (1)

7.4.4 Controlled variable (1)

7.5 Define the term *anhydrous*. (1)

7.6 If the mass of $AgNO_3$ is 5,3 g per spoon, calculate the concentration of the solution after TWO spoons have been added. (4)

7.7 Can tap water be used for this experiment? Give a reason for the answer. (2)

7.8 From the results, deduce the relationship between the ion concentration in the solution and its conductivity. (2)

7.9 A learner accidentally dropped hydrochloric acid into the solution.

7.9.1 How will this affect the ammeter reading? Write down only INCREASE, DECREASE or REMAIN THE SAME. (1)

7.9.2 Explain the answer to QUESTION 7.9.1. (2)
[22]

QUESTION 8 (Start on a new page.)

Your teacher asked you to use your knowledge of precipitation reactions to test the quality of water in the local river.

You are provided with the following chemicals:

$AgNO_3$, $BaCl_2$, dilute HNO_3

8.1 Which chemical would you choose to test for the presence of carbonates (CO_3^{-2})? (1)

8.2 Use a balanced chemical equation to show the test for carbonates in QUESTION 8.1. (4)

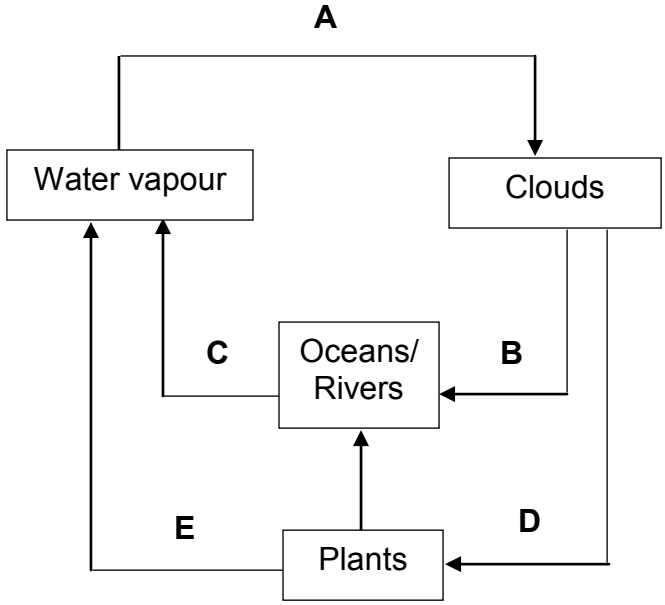
8.3 Both carbonates and sulphates form a white precipitate with the chemical in QUESTION 8.1.

Use a balanced chemical equation to explain how you would confirm that the precipitate is a carbonate. (4)

8.4 Give the chemical name of the precipitate formed when the carbonate and the chemical in QUESTION 8.1 reacts. (2)
[11]

QUESTION 9 (Start on a new page.)

Study the water cycle below and answer the questions that follow.



9.1 The water cycle consists of many processes.

Identify the following processes:

9.1.1 **A** (1)

9.1.2 **B** (1)

9.1.3 **E** (1)

9.2 Is energy ABSORBED or RELEASED during condensation? Give a reason for the answer. (2)

9.3 Give ONE reason why water vapour is referred to as an important greenhouse gas. (2)

9.4 The amount of rainfall in large parts of South Africa has decreased considerably recently. Various reasons have been given to explain the drought.

State ONE possible strategy that a community can adopt to ensure that they have a regular supply of water. (2)
[9]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 10
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Standard pressure *Standaarddruk*	p^{θ}	1,013 x 10^5 Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	22,4 $dm^3 \cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K
Charge on electron *Lading op elektron*	e	1,6 x 10^{-19} C
Avogadro's constant *Avogadro-konstante*	N_A	6,02 x 10^{23} mol^{-1}

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$

TABLE 3: THE PERIODIC TABLE OF ELEMENTS/*TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE*

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)
2,1 H 1																	2 He 4
1,0 Li 7	1,5 Be 9											2.0 B 11	2.5 C 12	3.0 N 14	3.5 O 16	4.0 F 19	10 Ne 20
0,9 Na 23	1,2 Mg 24											1.5 Aℓ 27	1.8 Si 28	2.1 P 31	2.5 S 32	3.0 Cℓ 35,5	18 Ar 40
0,8 K 39	1,0 Ca 40	1,3 Sc 45	1,5 Ti 48	1.6 V 51	1,6 Cr 52	1.5 Mn 55	1.8 Fe 56	1,8 Co 59	1.8 Ni 59	1.9 Cu 63,5	1.6 Zn 65	1.6 Ga 70	1.8 Ge 73	2.0 As 75	2.4 Se 79	2.8 Br 80	36 Kr 84
0,8 Rb 86	1,0 Sr 88	1,2 Y 89	1,4 Zr 91	41 Nb 92	1,8 Mo 96	1.9 Tc	2.2 Ru 101	2.2 Rh 103	2.2 Pd 106	1.9 Ag 108	1.7 Cd 112	1.7 In 115	1.8 Sn 119	1.9 Sb 122	2.1 Te 128	2.5 I 127	54 Xe 131
0,7 Cs 133	0,9 Ba 137	57 La 139	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	1.8 Tℓ 204	1.8 Pb 207	1.9 Bi 209	2.0 Po	2.5 At	86 Rn
0,7 Fr 87	0,9 Ra 226	89 Ac															

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

KEY/*SLEUTEL*