basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES: CHEMISTRY (P2)

NOVEMBER 2016

MARKS: 150

TIME: 2 hours

This question paper consists of 12 pages and 2 data sheets.

K8P2

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GAUTENG

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 10 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

Four 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 Which ONE of the following groups of elements are classified as halogens?

A Li, Na, K

B Ne, Ar, Kr

C F, Cℓ, Br

D Si, Ge, As (2)

1.2 According to the kinetic molecular theory the particles of a solid …

A vibrate in their fixed positions and have a fixed shape.

B are free to move and are compressible.

C are free to move and have a fixed shape.

D vibrate in their fixed positions and are compressible. (2)

1.3 Which ONE of the following substances undergoes the process of sublimation?

A Water

B Wood

C Solid carbon dioxide

D Sodium chloride (2)

1.4 Which ONE of the molecules below contains the greatest number of atoms?

A N_2

B H_2O

C CH_4

D H_2SO_4 (2)

1.5 The chemical formula for sodium sulphate is …

A $NaSO_4$

B $Na_2(SO_4)_2$

C Na_2SO_4

D $Na(SO_4)_2$ (2)

1.6 Which ONE of the following electron configurations represents an ion of an alkali metal?

A $1s^2$

B $1s^2\ 2s^2$

C $1s^2\ 2s^2\ 2p^5$

D $1s^2\ 2s^2\ 2p^6\ 3s^1$ (2)

1.7 Which ONE of the following groups of elements shows the correct trend of the atomic radii of elements?

A F > Cℓ > Br > I

B I > Br > Cℓ > F

C Li < Be < B < N

D Li > B > N > Be (2)

1.8 Consider the unbalanced chemical equation below.

$$P_4(s) + H_2(g) \rightarrow PH_3(g)$$

Which ONE of the sets of coefficients will balance the chemical equation?

A 4, 2, 3

B 1, 6, 4

C 1, 4, 4

D 2, 10, 8 (2)

1.9 During the formation of an ionic bond electrons are ...

A shared equally.

B shared unequally.

C transferred from a metal to a non-metal.

D transferred from a non-metal to a metal. (2)

1.10 The hydrosphere is best described as …

A the layer of rock found above the earth's mantle.

B the hot liquid rock located in the earth's outer core.

C the very dense rock located in the earth's inner core.

D all the water below, on and above the surface of the earth. (2)

[20]

QUESTION 2 (Start on a new page.)

Most substances used in our daily lives are either pure substances or mixtures.

2.1 Define the term *pure substance*. (1)

2.2 Complete the table below. Write down only the answer next to the question number (2.2.1–2.2.4) in your ANSWER BOOK.

SUBSTANCE	ELEMENT/COMPOUND/MIXTURE	REASON
Diamond	**2.2.1**	**2.2.2**
Air	**2.2.3**	**2.2.4**

(4)

2.3 Explain why pots and pans are made of metal but the handles are made of plastic or wood. (2)

2.4 Write down the chemical formulae of the following compounds:

2.4.1 Table salt (2)

2.4.2 Calcium hydroxide (2)

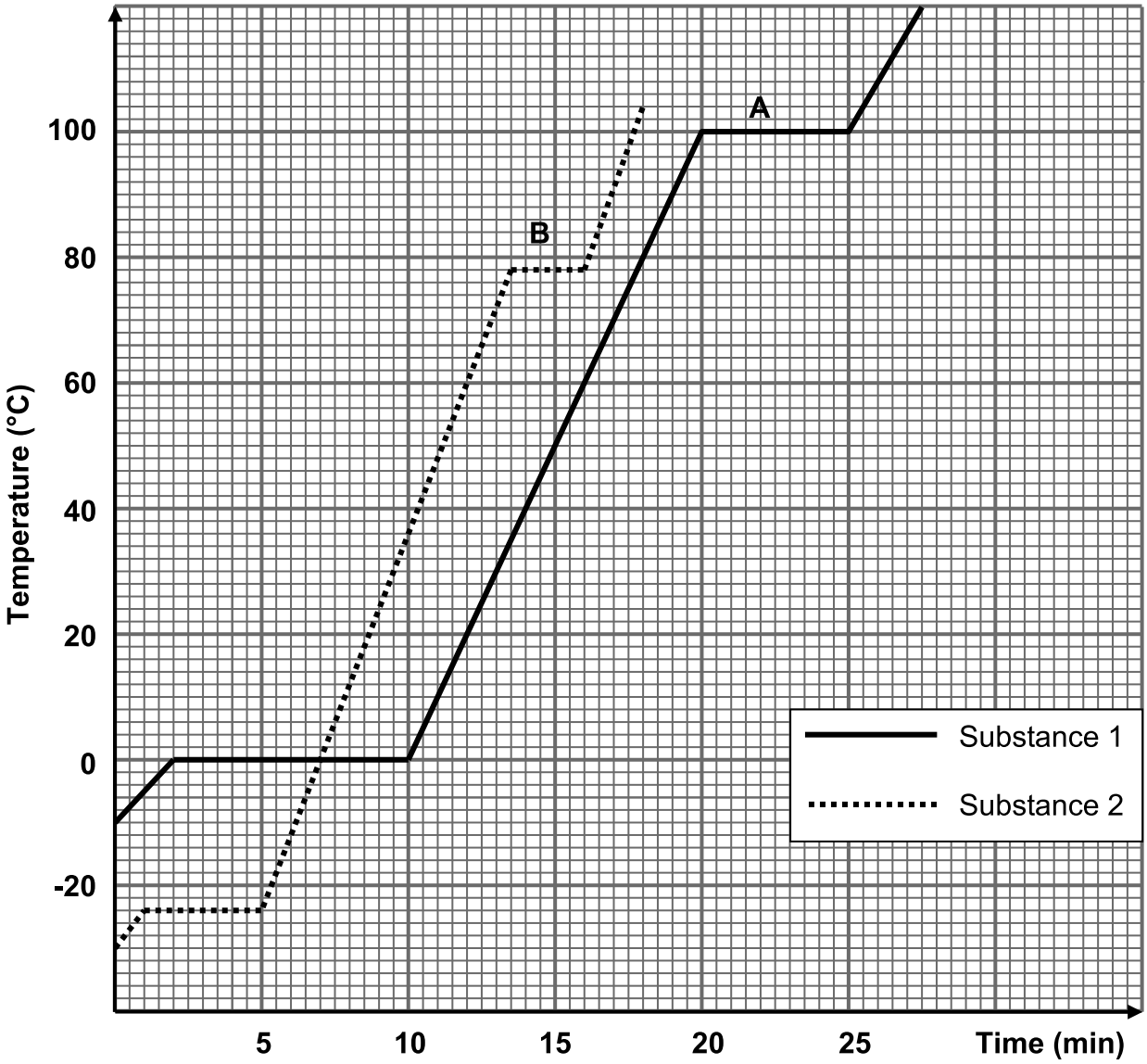
[11]

QUESTION 3 (Start on a new page.)

Learners are investigating the effect of increasing temperature on two different substances (1 and 2) over a period of time.

Study the temperature versus time graphs below and answer the questions that follow.

The heating curves of substances 1 and 2



3.1 Write down the:

3.1.1 Dependent variable (1)

3.1.2 Independent variable (1)

3.2 Write down an investigative question for this investigation. (2)

3.3 In which phase is substance 1 at -10 °C? (1)

3.4 At what temperature does substance 2 melt? (1)

3.5 Define the term *boiling point*. (2)

3.6 State the phase change that takes place at **B**. (1)

Temperature remains constant at **B**.

3.7 Explain this phenomenon in terms of the spaces and the forces between the particles. (4)

3.8 Which substance on the graph has the weakest intermolecular force between the molecules in the liquid phase? Give a reason for the answer. (2)

3.9 Name the apparatus used to measure the average kinetic energy of the particles. (1)

3.10 How does the average kinetic energy of substance 1 compare to the average kinetic energy of substance 2 at 90 °C?

Write down LESS THAN, EQUAL TO or GREATER THAN and give a reason for the answer. (2)
[18]

QUESTION 4 (Start on a new page.)

Study the table of first and second ionisation energies and answer the questions that follow.

	FIRST IONISATION ENERGY ($kJ.mol^{-1}$)	**SECOND IONISATION ENERGY ($kJ.mol^{-1}$)**
Li	520	7 297
Be	899	1 757
B	801	2 427
C	1 086	2 352
N	1 402	2 854
O	1 214	3 391
F	1 681	3 381
Ne	2 080	3 964

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

4.2 Use the information in the table to explain why:

4.2.1 Metals form cations easily (2)

4.2.2 Non-metals form anions easily (2)

4.3 Explain why the second ionisation energy of lithium is higher than its first ionisation energy. (2)
[8]

QUESTION 5 (Start on a new page.)

5.1 Define the term *isotope*. (2)

5.2 Study the unknown elements **A** to **E** below.

A	**B**	**C**	**D**	**E**
$^{19}_{9}X$	$^{19}_{10}X$	$^{20}_{9}X$	$^{21}_{11}X$	$^{19}_{8}X$

5.2.1 Which of the elements above are isotopes of each other? (1)

5.2.2 Write down the name of this isotope. (1)

5.3 Calculate the relative atomic mass of copper by using the following isotopes of copper:

Copper isotopes: ^{63}Cu - 69% and ^{65}Cu - 31% (4)

5.4 Complete the table below. Write only the answer next to the question number (5.4.1–5.4.5).

ELEMENT	MASS NUMBER	ATOMIC NUMBER	NUMBER OF PROTONS	NUMBER OF NEUTRONS	NUMBER OF ELECTRONS
Fluoride ion	**5.4.1**	9	9	**5.4.2**	10
5.4.3	25	**5.4.4**	12	**5.4.5**	12

(5)

Ammonia (NH_3) is manufactured using an industrial process, known as the Haber process. It is used in the production of inorganic fertilisers, such as ammonium sulphate.

5.5 Write down the chemical formula for ammonium sulphate. (1)

5.6 Name the type of bond between the atoms in the ammonia molecule. Give a reason for the answer. (2)

5.7 Draw the Aufbau diagram (orbital box diagram) for nitrogen. (2)

5.8 How many valence electrons does nitrogen have? (1)

5.9 Draw the Lewis dot diagram for the ammonia molecule. (2)

[21]

QUESTION 6 (Start on a new page.)

The unbalanced chemical equation (i) and the word equation (ii) for two chemical reactions are shown below.

(i) $C\ell_2(g) + H_2(g) \rightarrow HC\ell(g)$

(ii) aluminium carbonate $\rightarrow$ aluminium oxide + carbon dioxide

6.1 Which ONE of the reactions, (i) or (ii), is:

6.1.1 A decomposition reaction (1)

6.1.2 A synthesis reaction (1)

6.2 What does the (g) in reaction (i) represent? (1)

6.3 Write down the chemical formulae for the following:

6.3.1 Aluminium carbonate (2)

6.3.2 Aluminium oxide (2)

6.4 Write a balanced chemical equation for equation (i). (2)

6.5 Use the balanced equation in QUESTION 6.4 to show that mass is conserved in a chemical reaction. (3)

6.6 Calculate the percentage composition of hydrogen chloride. (3)
[15]

QUESTION 7 (Start on a new page.)

Potassium chloride dissociates in water to form an electrolyte.

7.1 Define the term *electrolyte*. (2)

7.2 Use a chemical equation to show how potassium chloride dissociates in water. (3)

7.3 If 2 mol of potassium ions form during the process used in QUESTION 7.2, how many moles of the metal salt dissolved? (2)

7.4 Calculate the percentage potassium in potassium chloride. (2)

7.5 How will an increase in the concentration of potassium chloride affect the conductivity of the electrolyte?

Write down only INCREASE, DECREASE or REMAIN THE SAME. (1)

7.6 Give a reason for the answer to QUESTION 7.5. (2)
[12]

QUESTION 8 (Start on a new page.)

8.1 The empirical formula of a certain compound is to be determined. On analysis of a sample of the compound it was found to contain 40% C, 6,6% H and 53,3% O.

8.1.1 Define the term *empirical formula*. (2)

8.1.2 Determine the empirical formula of the compound. Show ALL calculations. (5)

8.1.3 If the molecular mass of the compound is 60 $g \cdot mol^{-1}$, calculate the molecular formula of the compound. (3)

8.2 The molar mass of hydrated sodium carbonate is found to be 268 $g \cdot mol^{-1}$. The formula of the hydrated sodium carbonate is $Na_2CO_3.xH_2O$.

Calculate the number of moles of water of crystallisation (x) in the compound. (4)
[14]

QUESTION 9 (Start on a new page.)

The reaction between sodium and water is represented by the following balanced chemical equation:

$$2Na(s) + 2H_2O(\ell) \rightarrow 2NaOH(aq) + H_2(g)$$

During the reaction 10 g of sodium reacts with 2 dm^3 water to produce hydrogen gas at STP.

9.1 Write down the values of temperature and pressure at STP. (2)

9.2 Calculate the following:

9.2.1 Mass (in gram) of hydrogen gas produced (5)

9.2.2 Volume (in dm^3) of hydrogen gas produced at STP (3)

9.2.3 Mass (in gram) of NaOH produced (4)

9.2.4 Concentration of the sodium hydroxide solution (3)
[17]

QUESTION 10 (Start on a new page.)

Chlorides and sulphates are found in water. These ions may be identified by the *insoluble substances* they form in chemical reactions.

10.1 Write down the correct term for the following description:

The *insoluble substance* that forms when some solutions react (1)

10.2 Complete the following reactions by filling in the missing reactants/products, where applicable:

10.2.1 Test for sulphate ions:

Step I: $Na_2SO_4(aq) + \ldots \rightarrow BaSO_4(s) + NaC\ell(aq)$

Step II: $BaSO_4(s) + HNO_3(aq) \rightarrow \ldots$ (2)

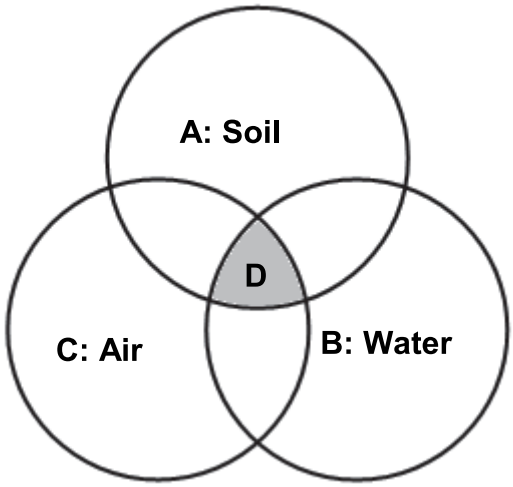
10.2.2 Test for chloride ions:

Step I: $KC\ell(aq) + \ldots \rightarrow AgC\ell(s) + KNO_3(aq)$

Step II: $AgC\ell(s) + \ldots \rightarrow$ no reaction (2)

10.2.3 What is the colour of the insoluble solid formed in step I of QUESTION 10.2.2? (1)

10.3 The diagram below represents components of the global system.



Which ONE of the symbols represents the:

10.3.1 Atmosphere (1)

10.3.2 Biosphere (1)

10.3.3 Lithosphere (1)

10.4 Name the THREE main processes involved in the transfer of water from one part of the water cycle to the next. (3)

10.5 Describe ONE way in which the demand for water is currently met. (2)

[14]

TOTAL: 150

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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

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$

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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*

Atomic number *Atoomgetal*

Electronegativity *Elektronegatiwiteit*: 1,9

Symbol *Simbool*: Cu

Approximate relative atomic mass *Benaderde relatiewe atoommassa*: 29, 63,5

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