Province of the
EASTERN CAPE
EDUCATION

NATIONAL
SENIOR CERTIFICATE

GRADE 10

NOVEMBER 2017

PHYSICAL SCIENCES P2
(CHEMISTRY)

MARKS: 150

TIME: 2 hours

This question paper consists of 16 pages, including a formula sheet and a data sheet.

INSTRUCTIONS AND INFORMATION

1.   Write your full NAME and SURNAME in the appropriate spaces on the ANSWER BOOK.

2.   This question paper consists of TEN 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.   Give brief motivations, discussions, et cetera where required.

7.   You may use a non-programmable calculator.

8.   You may use appropriate mathematical instruments.

9.   YOU ARE ADVISED TO USE THE ATTACHED DATA SHEETS.

10. Show ALL formulae and substitutions in ALL calculations.

11. Round off your FINAL numerical answers to a minimum of TWO decimal places.

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. Write only the letter (A–D), corresponding to the correct answer of your choice, next to the question number (1.1–1.10) in the ANSWER BOOK, for example 1.11 D.

1.1   An example of a mixture is …

    A   water.
    B   brass.
    C   oxygen.
    D   carbon dioxide.   (2)

1.2   Which ONE of the following statements is correct about the following elements?

$$_{9}^{19}F \text{ and } _{10}^{20}Ne$$

    A   They have the same mass number.
    B   They have the same number of electrons.
    C   They have the same atomic number.
    D   They have the same number of neutrons.   (2)

1.3   Consider the following atoms:

C, Li, Mg and Cl

Which of the following options represents the atoms in increasing electronegativity?

    A   Cℓ > C > Li > Mg
    B   Li > Mg > C > Cℓ
    C   Li > Mg > Cℓ > C
    D   Cℓ > C > Mg > Li   (2)

1.4   Which of the following is NOT a chemical change?

    A   Magnesium combusting in oxygen
    B   Freezing of water
    C   Heating of zinc carbonate
    D   The rusting of iron   (2)

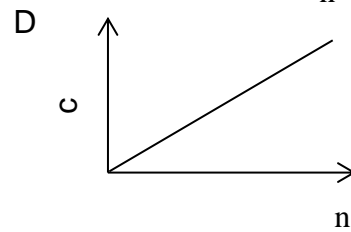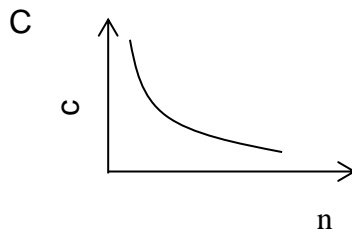1.5   Which one of the following represents an acid-base reaction?
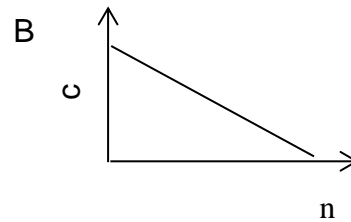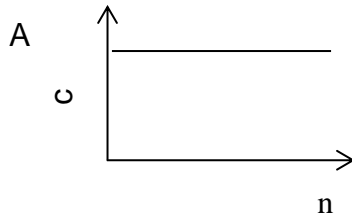
    A $CaCO_3 \longrightarrow CaO + CO_2$
    B $N_2 + 3H_2 \longrightarrow 2NH_3$
    C $HCℓ + NaOH \longrightarrow NaCℓ + H_2O$
    D $Na_2SO_4 + Ba(NO_3)_2 \longrightarrow BaSO_4 + 2 NaNO_3$ (2)

1.6   What mass of hydrogen is contained in a 500 g sample of sulphuric acid, H_2SO_4?

      A   204 g
      B   10,2 g
      C   326,53 g
      D   163,27 g   (2)

1.7   Which graph best represents the relationship between concentration and the amount of substance?
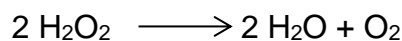

                                                                           (2)

1.8   Which ONE of the following is true regarding the amount of substance of any gas at STP?

      A   1 mole of gas occupies a volume of 22,4 dm^3 at STP
      B   2 moles of gas occupy a volume of 22,4 dm^3 at STP
      C   1 mole of gas occupies a volume of 24,2 dm^3 at STP
      D   2 moles of gas occupy a volume of 24,2 dm^3 at STP   (2)

1.9   Study the chemical equation below:

$$2\,H_2O_2 \longrightarrow 2\,H_2O + O_2$$

Which ONE of the following correctly describes the mole ratio of the reaction?

      A   2 moles of H_2O_2 decompose to produce 2 moles of H_2O and 2 moles of O_2.
      B   6 moles of H_2O_2 decompose to produce 5 moles of H_2O and 2 moles of O_2.
      C   2 atoms of H_2O_2 decompose to produce 2 atoms of H_2O and 1 atom of O_2.
      D   4 moles of H_2O_2 decompose to produce 4 moles of H_2O and 2 moles of O_2.   (2)

1.10   The body of air surrounding the Earth refers to …

      A   lithosphere.
      B   biosphere.
      C   atmosphere.
      D   hydrosphere.   (2)
                                                                              [20]

QUESTION 2

Chemical substances can be classified into various groups (pure substances, mixtures, metals, non-metals, magnetic and non-magnetic, etc). Study the substances in the table below and answer the questions that follow:

Air	Sodium	N_2O_5	Sulphur dichloride
$AlCl_3$	Ammonium Phosphate	Silicon	Iron

2.1 From the table above, write down:

    2.1.1 A homogeneous mixture (1)

    2.1.2 A metalloid (1)

    2.1.3 A substance that is both malleable and ductile (1)

2.2 Write down the chemical formula for the following:

    2.2.1 Ammonium phosphate (2)

    2.2.2 Sulphur dichloride (2)

2.3 Write down the name for the following:

    2.3.1 N_2O_5 (2)

    2.3.2 $AlCl_3$ (2)

2.4 Is iron a ferromagnetic or non-ferromagnetic material?
Give a reason for your answer. (2)

[13]

QUESTION 3

The Kinetic Molecular theory of matter describes the movement of particles in three states (solid, liquid and gas). The flow diagram below represents three states according to the Kinetic Molecular theory. Study the flow diagram and answer the questions that follow.
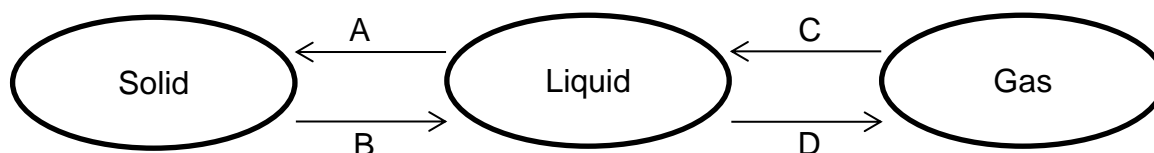

3.1   List THREE properties of the substance according to the Kinetic Molecular theory when it is in solid state.   (3)

3.2   In which of the above states are the particles furthest apart?   (1)

3.3   How does the average kinetic energy of the particles in liquid compare to that of a solid?
       Write down only HIGHER THAN, SMALLER THAN or EQUAL TO.   (1)

3.4   What is the temperature called at which processes A and D take place?   (2)

3.5   Does the temperature of the substance INCREASE, DECREASE or REMAIN THE SAME during process B?

       Give a reason for this observation by referring to the intermolecular forces and kinetic energy.   (3)

3.6   The Particle nature of matter states:

       Matter is made up of tiny particles that are in constant motion.

       State TWO processes that prove the constant motion of the particle nature of matter.   (2)
                                                                                                            [12]

QUESTION 4

4.1 The electron structure of lithium atom in a neutral state is represented by the diagram below:

2s $\boxed{\uparrow}$

1s $\boxed{\uparrow\downarrow}$
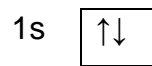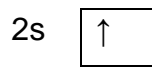
     4.1.1   Identify the type of electron structure represented above.   (1)

     4.1.2   Two rules are used when assigning electrons in the diagram above. Identify the names and state the TWO rules.   (6)

     4.1.3   Consider the sp-notation $1s^2$.

           Does the sp-notation represent lithium or lithium ion? Explain your answer.   (2)

4.2 Lithium reacts with bromine to produce lithium bromide.

     4.2.1   What type of chemical bond does lithium bromide represent? Give a reason for your answer.   (2)

     4.2.2   Use the Lewis diagram to show the formation of lithium bromide.   (4)

4.3 Bromine occurs in nature as a diatomic molecule.

     4.3.1   Write down the definition of a molecule.   (2)

     4.3.2   Write down the Lewis structure of bromine.   (2)

4.4 Lithium has two natural occurring isotopes.

$$^6Li \text{ and } ^7Li$$

     4.4.1   Identify the particle by which the two lithium atoms differ.   (1)

     4.4.2   The relative atomic mass of lithium is 6,94.

           Determine by calculation which lithium occurs most in abundance.   (4)

                                                                     [24]

QUESTION 5

5.1   Study the elements in period 3 of the periodic table of elements.

Name ONE element that complies with each of the following:

5.1.1   Forms an ionic compound with the formula XF_2 (1)

5.1.2   Has the highest electron affinity (1)

5.1.3   Has the largest atomic radius (1)

5.1.4   Forms ions with double positive charges (1)

5.1.5   Has a half-filled p-energy level.
Support your answer with the relevant sp-notation. (2)

5.1.6   Is a halogen (1)

5.1.7   Bonds with hydrogen to form a compound with a molecular mass of 34 g. Support your answer with the correct chemical formula. (2)

5.2   The bar graph below represents the first ionisation energies of elements in period 2.
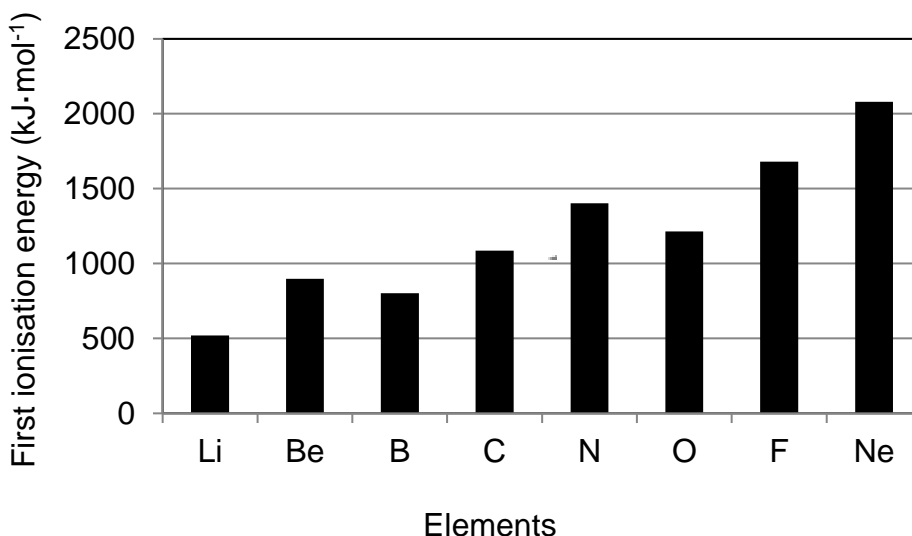
5.2.1   Define the term *first ionisation energy.* (2)

5.2.2   Describe the general trend of the first ionisation energy for elements in period 2 from the graph above. (1)
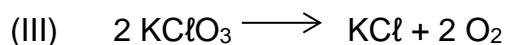
5.2.3   The graph above shows that the first ionisation energy of fluorine is greater than that of lithium.

Give a reason for this observation by referring to the atomic radii, electrons in the outer energy level and ionisation energy. (3)

[15]

QUESTION 6

Study the three equations that are represented below.

(I) $2 H_{2(g)} + O_{2(g)} \longrightarrow 2 H_2O_{(g)}$

(II) $H_2O_{(\ell)} \longrightarrow H_2O_{(s)}$

(III) $2 KC\ell O_3 \longrightarrow KC\ell + 2 O_2$
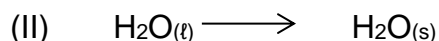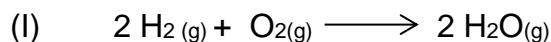
6.1   Which ONE of the equations represents a …

    6.1.1   physical change? (1)

    6.1.2   synthesis reaction? (1)

6.2   How does the energy changes in equation (I) compare to that in equation (II)?
Write only HIGHER THAN, SMALLER THAN or EQUAL TO. (1)

6.3   Was energy supplied or removed from the type of change that occurred in equation (II)? Give a reason for your answer. (3)

6.4   State the law of conservation of mass. (2)

6.5   Show that the law of conservation of mass has not been correctly applied in equation (III). (3)

6.6   Apply the conservation of mass correctly in equation (III). (2)

[13]

QUESTION 7

7.1 Sodium chloride (table salt) is an ionic compound with a formula unit of $NaC\ell$. It forms a crystal lattice in a solid form as shown below.
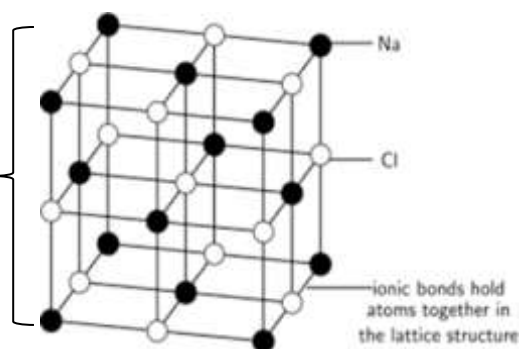
FIGURE 1   FIGURE 2

7.1.1 Define the term *crystal lattice.* (2)

7.1.2 From FIGURE 2 above, identify how many sodium ions (Na^+) surrounds the central chloride ion ($C\ell^-$) in the crystal lattice? (1)

7.1.3 Will sodium chloride be able to conduct electricity, if it is in crystal lattice form? Give a reason for your answer. (3)

7.2 Sodium chloride is dissolved in water to test whether or not sodium chloride will form an electrolyte. The following set-up was used:
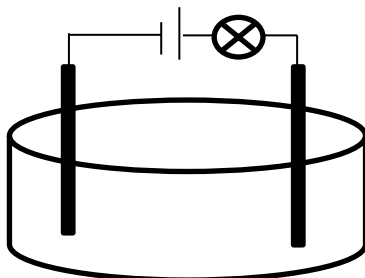
It is found that the **light bulb glows** when the circuit is complete.

7.2.1 Formulate an investigative question for the investigation above. (2)

7.2.2 Is sodium chloride solution an electrolyte? Give a reason for your answer. (2)

7.3   Two test tubes marked X and Y, contain sodium chloride and calcium carbonate solutions respectively.

Tests were performed to identify which of the test tubes contain the sodium chloride and the calcium carbonate solution.

Below are the results of the tests:

TEST TUBE X

TEST	OBSERVATION
Silver nitrate was added to the solution in test tube X.	A white precipitate formed.
Nitric acid was added.	No changes occurred.

TEST TUBE Y

TEST	OBSERVATION
Barium nitrate was added to the solution in test tube Y.	A white precipitate formed.
Nitric acid was added.	The white precipitate dissolved.

7.3.1   Which test tube, X or Y, contained the sodium chloride solution?   (1)

7.3.2   Write down the balanced equation for the test that was performed in test tube X. Also include the state of the compounds.   (4)

7.3.3   Write down the name of the precipitate that formed in test tube Y.   (2)

[17]

QUESTION 8

8.1 A well-known anaesthetic contains 64,9% carbon, 13,5% hydrogen and 21,6% oxygen by mass.

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

    8.1.2 Determine the empirical formula of the compound.

           Show ALL calculations. (6)

8.2 6,7 g of Na_2CO_3 is dissolved in enough water to prepare 250 cm^3 of solution.

    8.2.1 Calculate the concentration of the Na_2CO_3 solution. (4)

    8.2.2 Write down the dissociation reaction of Na_2CO_3. (2)

    8.2.3 Calculate the concentration of the sodium ions (Na^+) in the solution. (3)

[17]

QUESTION 9

The reaction between zinc and hydrochloric acid is carried out under standard conditions.

The chemical reaction equation is represented below:

$Zn_{(s)} + 2\ HC\ell_{(aq)} \longrightarrow ZnC\ell_{2(aq)} + H_{2\ (g)}$
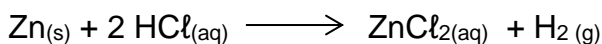
During the experiment 12 g of zinc is placed in excess hydrochloric acid solution.

9.1 Calculate the number of moles of zinc that was placed in the hydrochloric acid solution. (3)

9.2 Determine the volume of hydrogen gas, in dm^3, that was produced during the chemical reaction. (4)

9.3 Show by calculation that $1,08 \times 10^{23}$ number of $ZnC\ell_2$ particles was produced. (4)

[11]

QUESTION 10

Study the flow diagram which shows the interaction of water between the atmosphere and lithosphere.
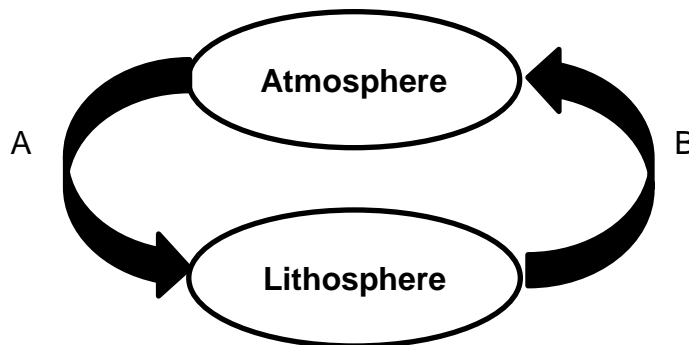
10.1   Explain what is meant by *lithosphere.*   (2)

10.2   Write down the names of the following processes:

        10.2.1   A   (1)

        10.2.2   B   (1)

10.3   Some of the water is solidly frozen in soil layers.

        What is the general name for the solid frozen soil?   (1)

10.4   Write down TWO advantages of dams for the human population.   (2)

10.5   Write down ONE disadvantage of dams on the ecology.   (1)

                                                    [8]

                              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*

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

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

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

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

KEY/ *SLEUTEL*

Atoomgetal
Atomic number

Elektronegatiwiteit
Electronegativity

Simbool
Symbol

$$\begin{array}{c} 29 \\ 1{,}9 \quad \text{Cu} \\ 63{,}5 \end{array}$$

Benaderde relatiewe atoommassa
Approximate relative atomic mass

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)
1 2,1 H 1																	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															

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