basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL
SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES: CHEMISTRY (P2)

NOVEMBER 2019

MARKS: 150

TIME: 2 hours

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

XPSCE2

EASTERN CAPE

INSTRUCTIONS AND INFORMATION

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

2. This question paper consists of EIGHT 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 subquestions, e.g. 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, etc. where required.

12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various 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 to 1.10) in the ANSWER BOOK, e.g. 1.11 E. Each question has only ONE correct answer.

1.1   Nitrogen gas is an example of a/an …

A   element.

B   compound.

C   heterogeneous mixture.

D   homogeneous mixture.   (2)

1.2   The heating curve, not drawn to scale, of a compound is shown below.
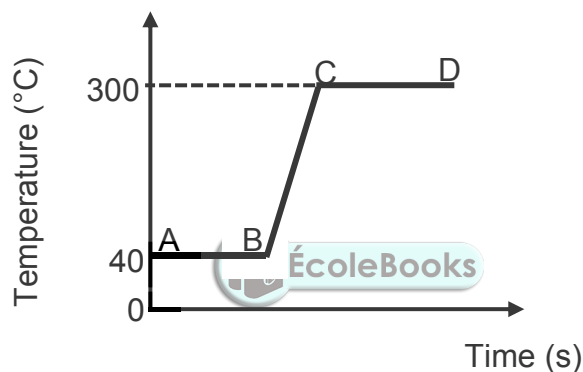
During which section(s) on the curve will the potential energy of the compound INCREASE?

A   BC only

B   CD only

C   AB and CD

D   AB, BC and CD   (2)

1.3   Elements in the periodic table are arranged in order of increasing …

A   mass number.

B   number of protons.

C   number of neutrons.

D   number of nucleons.   (2)

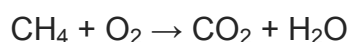1.4   Avogadro's number is equal to the number of …

   A   atoms in 1 mole CO.

   B   atoms in 1 mole Br_2.

   C   molecules in 1 mole Au.

   D   molecules in 1 mole N_2.   (2)

1.5   The unbalanced equation for a chemical reaction is shown below.

$$CH_4 + O_2 \rightarrow CO_2 + H_2O$$

   Which ONE of the following represents the coefficients of reactants and products in the BALANCED equation?

	CH_4	O_2	CO_2	H_2O
A	2	1	2	1
B	1	1	2	2
C	1	2	1	2
D	2	2	1	1

(2)

1.6   A covalent bond forms …

   A   between metal and non-metal atoms.

   B   through electron transfer.

   C   through sharing of electrons.

   D   between positive and negative ions.   (2)

1.7   The reaction between hydrogen chloride (HCℓ) and sodium hydroxide (NaOH) is an example of a/an … reaction.
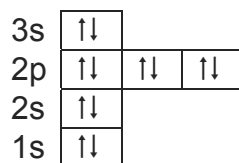
   A   redox

   B   acid-base

   C   precipitation

   D   gas forming   (2)

1.8   Consider the Aufbau diagram of an element below.

3s [↑↓]
2p [↑↓] [↑↓] [↑↓]
2s [↑↓]
1s [↑↓]

The element is a/an …

A   halogen.

B   noble gas.

C   alkali metal.

D   alkaline-earth metal.   (2)

1.9   Which ONE of the following equations represents a precipitation reaction?

A $NaOH + HC\ell \rightarrow NaC\ell + H_2O$

B $NaC\ell + HNO_3 \rightarrow NaNO_3 + HC\ell$

C $NaC\ell + AgNO_3 \rightarrow AgC\ell + NaNO_3$

D $Na_2CO_3 + 2HC\ell \rightarrow 2NaC\ell + CO_2 + H_2O$ (2)

1.10   The air surrounding the Earth is the …

A   biosphere.

B   lithosphere.

C   atmosphere.

D   hydrosphere.   (2)
                                                                                            [20]

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QUESTION 2 (Start on a new page.)

Most elements found on Earth are metals. All metals have a metallic structure.

2.1 For a metallic structure, write down the:

   2.1.1 Type of particles present   (2)

   2.1.2 Type of chemical bond formed between particles   (1)

2.2 In which region on the periodic table are metals found? Choose from LEFT or RIGHT.   (1)

2.3 Write down the SYMBOL of a metal which is a liquid at room temperature. (1)

2.4 To prevent iron from rusting it is often mixed with other metals, e.g. stainless steel is a mixture of iron, chromium and nickel.

   2.4.1 Is stainless steel a HOMOGENEOUS or HETEROGENEOUS mixture? Give a reason for the answer.   (2)

   2.4.2 Rusting is the formation of iron(III) oxide. Write down the FORMULA of iron(III) oxide.   (1)

2.5 The physical properties of two substances, **A** and **B**, are shown in the table below.

SUBSTANCES	DENSITY $(g \cdot cm^{-3})$	ELECTRICAL CONDUCTIVITY	THERMAL CONDUCTIVITY
A	4,94	Poor	Poor
B	7,87	Good	Good

   2.5.1 Which ONE of the substances, **A** or **B**, has the smaller mass to volume ratio? Give a reason for the answer.   (2)

   2.5.2 Explain the difference between *electrical conductivity* and *thermal conductivity*.   (2)

   2.5.3 Which ONE of the substances, **A** or **B**, is a metal? Give a reason for the answer.   (2)

[14]

QUESTION 3 (Start on a new page.)

3.1 The three isotopes of magnesium are Mg-24, Mg-25 and Mg-26. The percentage abundance of the three isotopes is 80%, 10% and 10% respectively.

     3.1.1 Define the term *isotope.* (2)

     3.1.2 Calculate the relative atomic mass of magnesium. (4)

     3.1.3 The number of protons and electrons, the mass number and the atomic number of Mg-24 and its ion are shown in the table below.

        Some of these values in the table have been omitted. Write down the letters **(a–e)** in the ANSWER BOOK and next to each letter the number omitted.

	NUMBER OF PROTONS	NUMBER OF ELECTRONS	MASS NUMBER	ATOMIC NUMBER
Mg	12	**(a)**	24	**(b)**
Mg^{2+}	**(c)**	**(d)**	**(e)**	12

        (5)

3.2 The sp notation of an unknown element **X** is shown below.

$$1s^2 2s^2 2p^6 3s^2 3p^5$$
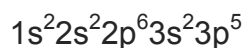
For element **X**, write down the:

     3.2.1 Number of valence electrons (1)

     3.2.2 Period where this element is found on the periodic table (1)

     3.2.3 Highest energy level in which electrons occur (1)

     3.2.4 Symbol (1)

Magnesium combines with element **X** to form a compound.

     3.2.5 Write down the type of bond that forms between magnesium and element **X**. (1)

     3.2.6 Draw the Aufbau diagram for the MAGNESIUM ION. (2)

     3.2.7 Draw Lewis dot diagrams to show the bond formation between magnesium and element **X**. (4)

        [22]

       EASTERN CAPE   Please turn over

QUESTION 4 (Start on a new page.)

A section of the periodic table is shown below. Imaginary symbols are used to represent some of the elements.

	1	2		13	14	15	16	17	18
1									L
2		E					G	J	
3				D		M			
4	A				H				

4.1   Write down the IMAGINARY SYMBOL, as shown above, of the element that:

     4.1.1   Is a halogen   (1)

     4.1.2   Will form a cation with a charge of +2   (1)

     4.1.3   Has the largest atomic radius   (1)

     4.1.4   Has the highest electronegativity   (1)

     4.1.5   Is a metalloid   (1)

     4.1.6   Is a noble gas   (1)

     4.1.7   Will form a diatomic molecule   (1)

     4.1.8   Has three valence electrons   (1)

4.2   The first ionisation energy of element **A** is 400 kJ·mol^{-1}.

     4.2.1   Define the term *first ionisation energy*.   (2)

     4.2.2   The first ionisation energy of element **A** can be represented by the following incomplete equation:

               A(g) + 400 kJ·mol^{-1} → ... + ...

               Copy the equation above into the ANSWER BOOK and complete it.   (2)

4.3   Atoms of element **J** release the most energy when gaining electrons to form negative ions.

     Write down ONE word or term for the underlined phrase.   (1)

4.4   Write down the formula of the compound formed when:

     4.4.1   **D** combines with **G**   (2)

     4.4.2   **A** combines with **J**   (2)

                                               [17]

QUESTION 5 (Start on a new page.)

Consider the compound $A\ell_2(SO_4)_3$.

5.1   Write down the NAME of the compound above.   (1)

5.2   Define the term *molar mass*.   (2)

5.3   Calculate the following for $A\ell_2(SO_4)_3$:

     5.3.1   Its molar mass   (2)

     5.3.2   Its percentage composition   (3)

     5.3.3   The number of moles present in 85,5 g   (3)

     5.3.4   The number of aluminium atoms present in 85,5 g   (3)

5.4   Particles of $A\ell_2(SO_4)_3$ are bonded in a crystal lattice.

     Write down the following for this crystal lattice:

     5.4.1   The name   (1)

     5.4.2   The particles of which it consists   (2)

     5.4.3   TWO physical properties   (2)

5.5   500 g of $A\ell_2(SO_4)_3$ is dissolved in 2 dm^3 water.

     5.5.1   Define the term *concentration*.   (2)

     5.5.2   Calculate the concentration of the solution.   (4)

[25]

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QUESTION 6 (Start on a new page.)

6.1 The first step in the extraction of zinc from zinc sulphide (ZnS) is the combustion of ZnS in oxygen. The balanced equation for the reaction is:

$$2ZnS(s) + 3O_2(g) \rightarrow 2ZnO(s) + 2SO_2(g) + energy$$

6.1.1 Is the reaction above EXOTHERMIC or ENDOTHERMIC? Give a reason for the answer. (2)

Oxygen gas consists of oxygen molecules.

6.1.2 Define the term *molecule*. (2)

6.1.3 Draw the Lewis dot diagram of the oxygen molecule (O_2). (2)

During the reaction above, 7 g ZnS reacts completely with oxygen gas.

Calculate the:

6.1.4 Number of moles of ZnS that has reacted (3)

6.1.5 Mass O_2 needed (3)

6.1.6 Volume of $SO_2(g)$ produced at STP (4)

6.2 Consider the incomplete equation for the chemical reaction below.

$$Zn(s) + H_2SO_4(aq) \rightarrow \mathbf{X} + H_2(g)$$

6.2.1 Write down the NAME of the acid in the equation above. (1)

6.2.2 Write down the FORMULA of product **X**. (2)

6.2.3 Name the type of reaction illustrated above. Choose from ACID-BASE REACTION, PRECIPITATION REACTION or REDOX REACTION. Explain the answer. (3)

6.2.4 Briefly describe a test that can be used to verify the formation of hydrogen gas during the reaction above. (2)

[24]

QUESTION 7 (Start on a new page.)

7.1   The relationship between conductivity and the concentration of ions in two electrolytes, NaCℓ(aq) and CaCℓ$_2$(aq), of the SAME concentration are investigated.

    7.1.1   Define the term *electrolyte*.   (2)

    7.1.2   Is the water molecule POLAR or NON-POLAR? Give a reason for the answer.   (2)

    7.1.3   For this investigation, write down the:

        (a)   Independent variable   (1)

        (b)   Dependant variable   (1)

The NaCℓ(aq) is added dropwise to distilled water in a beaker and the conductivity of the solution is measured after the addition of each drop. The experiment is repeated for the CaCℓ$_2$(aq). The results obtained are shown in the table below.

NUMBER OF DROPS	0	1	2	3	4	5	6	7
Conductivity of NaCℓ(aq) (mA)	0,18	0,34	0,55	0,74	0,92	1,10	1,29	1,47
Conductivity of CaCℓ$_2$(aq) (mA)	0,18	0,55	0,91	1,29	1,47	1,84	2,21	2,21

    7.1.4   Write down a balanced equation for the dissociation of NaCℓ(s) in water.   (3)

    7.1.5   Which electrolyte, NaCℓ(aq) or CaCℓ$_2$(aq), has the higher conductivity? Give a reason for the answer.   (2)

7.2   A learner is supplied with two unlabelled bottles containing potassium salts. She knows that one bottle contains a SULPHATE and the other a CARBONATE.

To distinguish between the two salts she adds a few drops of barium nitrate, $Ba(NO_3)_2(aq)$, to a solution of each salt in two separate test tubes, **A** and **B**, as shown below.
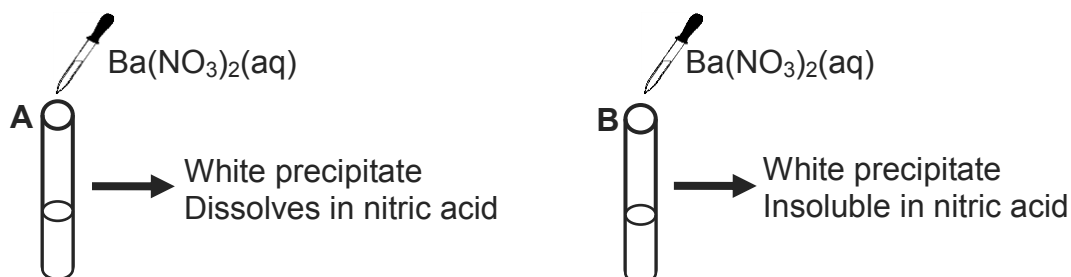
The learner finds that a white precipitate forms in each test tube. After the addition of nitric acid, the precipitate in test tube **A** dissolves to release a gas, while the precipitate in test tube **B** remains.

Write down the:

7.2.1   FORMULA of the POTASSIUM SALT in test tube **A**   (2)

7.2.2   FORMULA of the precipitate that forms in test tube **B**   (2)

7.2.3   Balanced equation for the reaction that explains why the precipitate dissolves in test tube **A** after the addition of nitric acid   (3)

[18]

QUESTION 8 (Start on a new page.)

The simplified diagram below represents the water cycle. Condensation and evaporation are two of the processes in the water cycle.
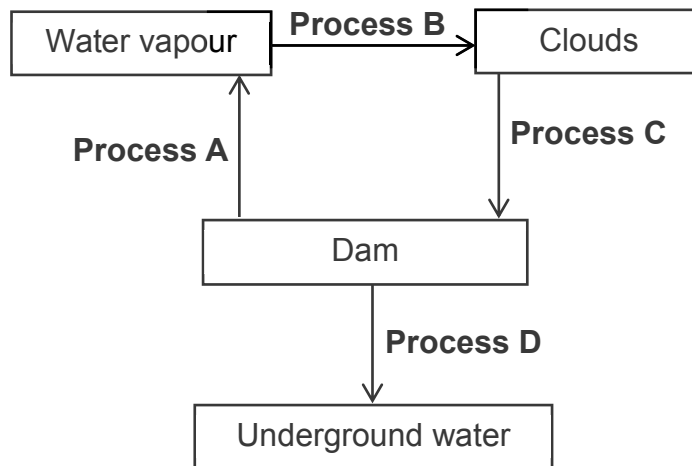
8.1   Define the term:

        8.1.1   Condensation   (2)

        8.1.2   Evaporation   (2)

8.2   Write down the name of:

        8.2.1   Process **A**   (1)

        8.2.2   Process **B**   (1)

        8.2.3   Process **C**   (1)

        8.2.4   Process **D**   (1)

8.3   Describe the term *hydrosphere* with reference to the different phases present.   (2)
                                                                                          [10]

                                                                          TOTAL: 150
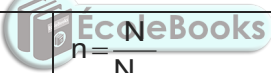
DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 2 (CHEMISTRY)

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	$1,013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	$22,4$ dm^3·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-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/*OF* $c = \dfrac{m}{MV}$	$n = \dfrac{V}{V_m}$

Please turn over

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

KEY/SLEUTEL

Atomic number
Atoomgetal

Symbol
Simbool

Electronegativity
Elektronegatiwiteit

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

Approximate relative atomic mass
Benaderde relatiewe atoommassa

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 1 H 1																	2 He 4
1,0 3 Li 7	1,5 4 Be 9											2,0 5 B 11	2,5 6 C 12	3,0 7 N 14	3,5 8 O 16	4,0 9 F 19	10 Ne 20
0,9 11 Na 23	1,2 12 Mg 24											1,5 13 Aℓ 27	1,8 14 Si 28	2,1 15 P 31	2,5 16 S 32	3,0 17 Cℓ 35,5	18 Ar 40
0,8 19 K 39	1,0 20 Ca 40	1,3 21 Sc 45	1,5 22 Ti 48	1,6 23 V 51	1,6 24 Cr 52	1,5 25 Mn 55	1,8 26 Fe 56	1,8 27 Co 59	1,8 28 Ni 59	1,9 29 Cu 63,5	1,6 30 Zn 65	1,6 31 Ga 70	1,8 32 Ge 73	2,0 33 As 75	2,4 34 Se 79	2,8 35 Br 80	36 Kr 84
0,8 37 Rb 86	1,0 38 Sr 88	1,2 39 Y 89	1,4 40 Zr 91	41 Nb 92	1,8 42 Mo 96	1,9 43 Tc	2,2 44 Ru 101	2,2 45 Rh 103	2,2 46 Pd 106	1,9 47 Ag 108	1,7 48 Cd 112	1,7 49 In 115	1,8 50 Sn 119	1,9 51 Sb 122	2,1 52 Te 128	2,5 53 I 127	54 Xe 131
0,7 55 Cs 133	0,9 56 Ba 137	57 La 139	1,6 72 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 81 Tℓ 204	1,8 82 Pb 207	1,9 83 Bi 209	2,0 84 Po	2,5 85 At	86 Rn
0,7 87 Fr	0,9 88 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