



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES: CHEMISTRY (P2)

EXEMPLAR 2012

MARKS: 150

TIME: 2 hours

This question paper consists of 15 pages, 1 data sheet, a periodic table and an answer sheet.

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of NINE questions. Answer ALL the questions.
3. You may use a non-programmable calculator.
4. You may use appropriate mathematical instruments.
5. YOU ARE ADVISED TO USE THE ATTACHED DATA SHEETS.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Write neatly and legibly.

QUESTION 1**INSTRUCTIONS**

1. Answer this question on the ANSWER SHEET. [NOTE: The ANSWER SHEET may either be a separate sheet provided as part of your question paper, or printed as part of the ANSWER BOOK.] Write your name in the appropriate space, if a separate ANSWER SHEET is used.
2. Various options are provided as possible answers to the following questions. Choose the answer and make a cross (X) in the block (A–D) next to the question number (1.1–1.10) on the ANSWER SHEET.
3. Do NOT make any other marks on the ANSWER SHEET. Any calculations or writing that may be necessary when answering this question should be done in the ANSWER BOOK and must be deleted clearly by means of a line drawn across the page.
4. If more than ONE block is marked per question, no marks will be awarded for that answer.

PLACE THE COMPLETED ANSWER SHEET INSIDE THE FRONT COVER OF THE ANSWER BOOK, IF A SEPARATE ANSWER SHEET HAS BEEN USED.

EXAMPLE:

QUESTION: The SI unit of time is ...

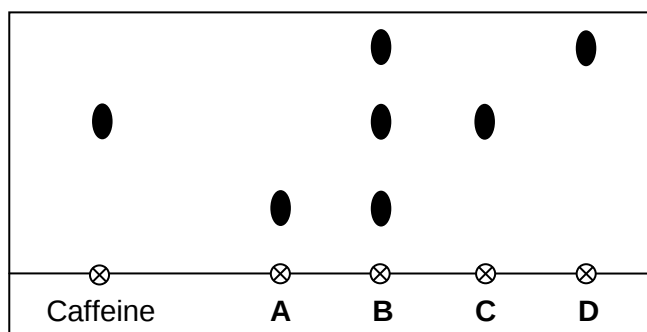
- A t.
- B h.
- C s.
- D m.

ANSWER:

A	B	C	D
---	---	--------------	---

[NOTE: This layout may vary, depending on the type of ANSWER SHEET used by the province.]

- 1.1 Caffeine is a compound found in coffee beans. The diagram below shows a chromatogram of caffeine and four different drinks, **A** to **D**.



Which ONE of the above drinks contains caffeine?

A A

B B

C C

D D

(2)

- 1.2 Natural nitrogen occurs as the two isotopes ^{14}N and ^{15}N .

How many different types of nitrogen molecules will occur in air as a result of the combination of the above atoms?

A 1

B 2

C 3

D 4

(2)

- 1.3 In which ONE of the following compounds do BOTH ions have the same electron configuration as argon?

A Calcium sulphide

B Magnesium oxide

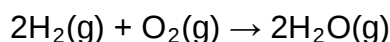
C Sodium sulphide

D Calcium bromide

(2)

- 1.4 When an atom X of an element in Group 1 reacts to become X^+ , the ...
- A mass number of X increases.
 - B atomic number of X decreases.
 - C charge of the nucleus increases.
 - D number of filled energy levels decreases. (2)
- 1.5 In which ONE of the following does 'energy' represent the first ionisation energy of sodium?
- A $\text{Na(s)} + \text{energy} \rightarrow \text{Na}^+(\text{g}) + \text{e}^-$
 - B $\text{Na(g)} + \text{energy} \rightarrow \text{Na}^+(\text{g}) + \text{e}^-$
 - C $\text{Na(s)} + \text{energy} \rightarrow \text{Na}^+(\text{s}) + \text{e}^-$
 - D $\text{Na(s)} + \text{e}^- \rightarrow \text{Na}^+(\text{g}) + \text{energy}$ (2)
- 1.6 The correct chemical formula for potassium permanganate is ...
- A KMnO_4
 - B KMnO_2
 - C CaMnO_4
 - D $\text{Ca}(\text{MnO}_4)_2$ (2)
- 1.7 The number of atoms in ONE formula-unit of copper(II)sulphate (CuSO_4) is ...
- A 4.
 - B 6.
 - C 16.
 - D 12. (2)
- 1.8 Which ONE of the following represents one mole of gas at STP?
- A $22,4 \text{ dm}^3 \text{ Ar}$
 - B $28 \text{ dm}^3 \text{ N}_2$
 - C $32 \text{ dm}^3 \text{ H}_2$
 - D $44,8 \text{ dm}^3 \text{ He}$ (2)

1.9 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 4 atoms of hydrogen gas react with 2 molecules of oxygen gas to form 2 moles of water vapour.
- C 2 moles of hydrogen gas react with 1 mole 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)

1.10 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]

ANSWER QUESTIONS 2–12 IN THE ANSWER BOOK.

INSTRUCTIONS AND INFORMATION

1. Start EACH question on a NEW page in the ANSWER BOOK.
2. Leave ONE line between two subquestions, for example between QUESTION 2.1 and QUESTION 2.2.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Show ALL formulae and substitutions in ALL calculations.
5. Round off your FINAL numerical answers to a minimum of TWO decimal places.
6. Give brief motivations, discussions, et cetera where required.

QUESTION 2 (Start on a new page.)

- 2.1 Choose an item from COLUMN B that best matches a description/item in COLUMN A. Each item in COLUMN B may be used only ONCE. Write only the letter (A–G) next to the question number (2.1.1–2.1.7) in the ANSWER BOOK.

COLUMN A		COLUMN B	
2.1.1	Potassium chloride crystals	A	heterogeneous mixture
2.1.2	A good conductor of electricity	B	homogeneous mixture
2.1.3	A non-metal element	C	silicon
2.1.4	Sugar dissolved in water	D	density
2.1.5	Blood	E	sulphur
2.1.6	Increasing conductivity with increase in temperature	F	compound
2.1.7	Mass per volume	G	Cu

(7 x 1) (7)

- 2.2 Solid carbon dioxide is sometimes known as dry ice. Under normal circumstances dry ice sublimates as it warms up.

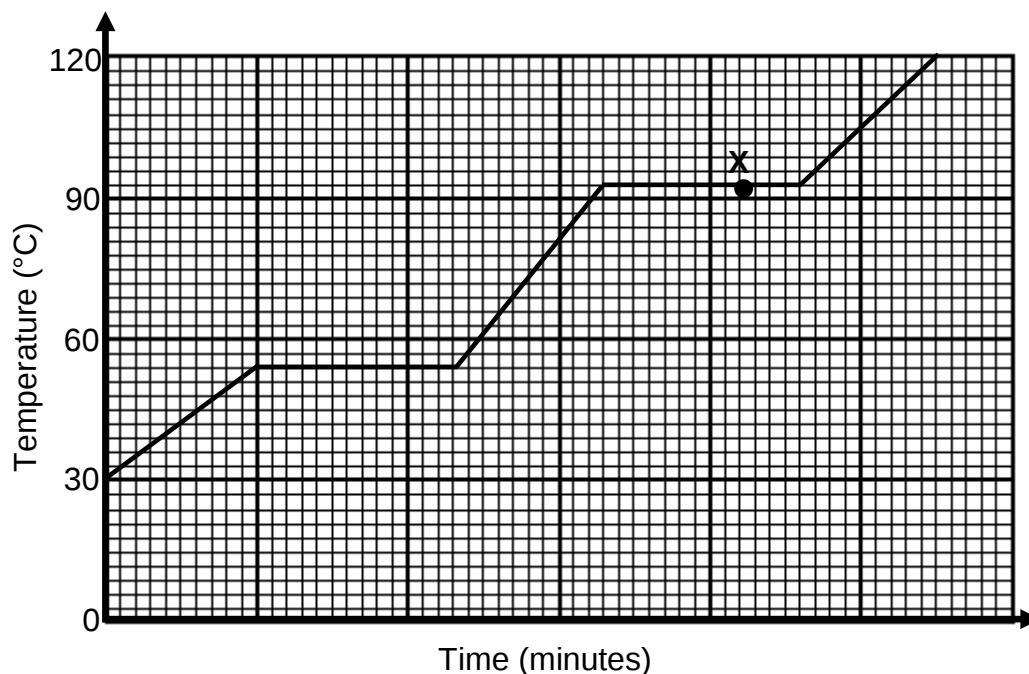
Define the term *sublimation*. (2)

- 2.3 When you take a block of butter out of the fridge, it is hard. However, after 15 minutes at room temperature it is soft enough to spread.

Use the kinetic theory to explain the above observation. (3)
[12]

QUESTION 3 (Start on a new page.)

The heating curve for a pure substance at atmospheric pressure is shown in the graph below.



3.1 Write down the following for this pure substance:

3.1.1 Melting point (1)

3.1.2 Boiling point (1)

3.2 Is this pure substance water? Give a reason for the answer. (2)

3.3 What is the physical state of the substance at:

3.3.1 Point X shown on the graph (2)

3.3.2 Room temperature (1)

3.4 What happens to the temperature while the substance melts? Explain this observation. (3)

[10]

QUESTION 4 (Start on a new page.)

Sodium reacts with chlorine to form sodium chloride, a substance used in all households.

- 4.1 Write down the:
- 4.1.1 Household name of sodium chloride (1)
 - 4.1.2 Chemical formula of sodium chloride (1)
- 4.2 For the chlorine atom:
- 4.2.1 Draw its Aufbau diagram (3)
 - 4.2.2 Write down its number of valence electrons (1)
- 4.3 For the sodium atom, write down its:
- 4.3.1 sp notation (2)
 - 4.3.2 Number of protons (1)
- 4.4 Represent the formation of sodium chloride from sodium and chlorine with the aid of Lewis diagrams. (4)
- 4.5 Name the type of crystal lattice of which sodium chloride is an example. (1)
- 4.6 A chlorine atom can also bond to another chlorine atom to form a molecule.
- 4.6.1 Define the term *molecule*. (2)
 - 4.6.2 Name the type of bond that forms between TWO chlorine atoms. (1)
 - 4.6.3 Represent the chlorine molecule with a Lewis diagram. (2)
- [19]**

QUESTION 5 (Start on a new page.)

Information of six elements, represented as **P, Q, R, S, T** and **Y**, are given in the table below.

ELEMENT	ATOMIC NUMBER	MASS NUMBER	ELECTRON STRUCTURE
P	16	32	$1s^2 2s^2 2p^6 3s^2 3p^4$
Q	3	7	$1s^2 2s^1$
R	20	40	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
S	18	40	$1s^2 2s^2 2p^6 3s^2 3p^6$
T	17	37	$1s^2 2s^2 2p^6 3s^2 3p^5$
Y	19	39	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

- 5.1 Which element (**P, Q, R, S, T** or **Y**):
- 5.1.1 Has 22 neutrons in each atom (1)
- 5.1.2 Is a noble gas (1)
- 5.1.3 Has TWO core electrons in each atom (1)
- 5.2 Two of the above elements are in the same group of the periodic table. Write down:
- 5.2.1 The letters representing these TWO elements (2)
- 5.2.2 Their group number on the periodic table (1)
- 5.3 ONE of the elements represented above is calcium. Write down the:
- 5.3.1 Letter representing it (1)
- 5.3.2 Flame colour that would be produced by calcium salts (1)
- 5.4 Write down the formula of the compound formed by the combination of elements:
- 5.4.1 **Q** and **P** (1)
- 5.4.2 **R** and **T** (1)
- 5.5 Identify element **T** and write down its A_ZX notation. (3)
- 5.6 Another element, **X**, occurs in nature as two isotopes, X-23 and X-25. The drawing shown below represents a sample of this element.



○ = X-25
● = X-23

- 5.6.1 Define the term *isotope*. (2)
- 5.6.2 Use the above information to calculate the relative atomic mass of element **X**. (4)

[19]

QUESTION 6 (Start on a new page.)

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



(ii) Calcium carbonate $\rightarrow$ calcium oxide + carbon dioxide

6.1 Which ONE of the above equations (**i** or **ii**) represents a:

6.1.1 Decomposition reaction (1)

6.1.2 Synthesis reaction (1)

6.2 What does (g) represent in equation **(i)** above? (1)

6.3 Write down a balanced chemical equation for the word equation **(ii)**. Show the phases of ALL reactants and products. (4)

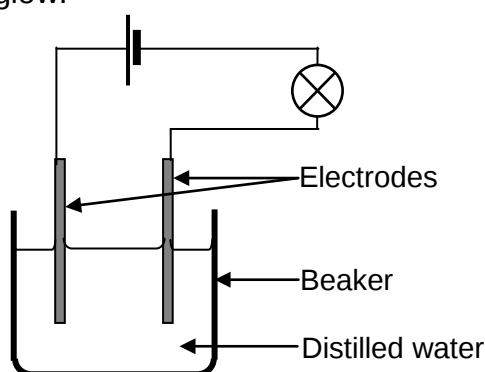
6.4 Rewrite equation **(i)** in the ANSWER BOOK and balance the equation. (1)

6.5 Name the chemical law that a balanced equation illustrates. (1)

6.6 Using equation **(i)** above, show that mass is conserved during the reaction. (3)
[12]

QUESTION 7 (Start on a new page.)

7.1 The arrangement below is used in a class to investigate the conductivity of a solution. The beaker is initially filled with 250 ml distilled water. It is observed that the bulb does not glow.



7.1.1 Give a reason why the bulb does NOT glow. (1)

A 15 g sample of ammonium nitrate is now dissolved in the distilled water. It is observed that the bulb glows brightly.

7.1.2 Write down the general name given to an aqueous solution that conducts electricity. (1)

7.1.3 Write down the formulae of the ions present in this solution. (1)

7.1.4 Calculate the concentration of the ammonium nitrate solution. (5)

7.2 Learners are given two bottles labelled **A** and **B**. It is known that one bottle contains a MgSO_4 solution and the other one contains a BaCl_2 solution.

They pour a sample from bottle **A** into a test tube and perform two tests to identify its contents. They record their findings in the table below.

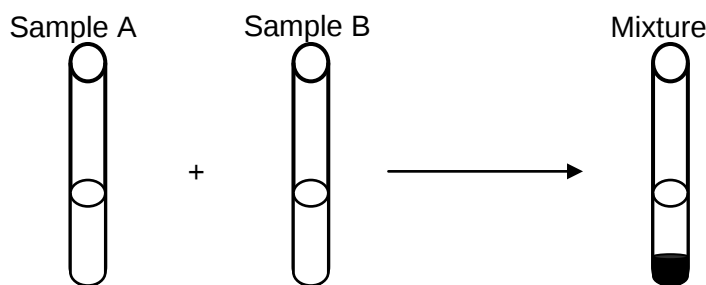
TEST	OBSERVATION
Add a small amount of $\text{Ba}(\text{NO}_3)_2(\text{aq})$ to a sample from bottle A in a test tube.	A white precipitate forms.
Add a few drops of dilute nitric acid (HNO_3) to the contents of the test tube.	The white precipitate does not dissolve.

7.2.1 Write down the NAME and FORMULA of the white precipitate that forms in the test tube. (2)

7.2.2 Give a reason why it is necessary to add nitric acid to the contents of the test tube after the white precipitate forms. (2)

7.2.3 Which bottle (**A** or **B**) contains the BaCl_2 solution? (2)

7.3 The learners now pour a sample from each of bottles **A** and **B** into two separate test tubes and then mix the contents of the two test tubes. They observe a white precipitate.

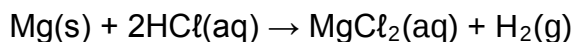


7.3.1 Write down a balanced equation for the reaction that takes place in the test tube after mixing the two samples. Show ALL phases of reactants and products. (4)

7.3.2 Name the type of reaction that takes place. (1)
[19]

QUESTION 8 (Start on a new page.)

- 8.1 The reaction between magnesium and dilute hydrochloric acid is represented by the balanced equation below.



During an experiment, 1,5 g of magnesium reacts with excess dilute hydrochloric acid to produce hydrogen gas at STP.

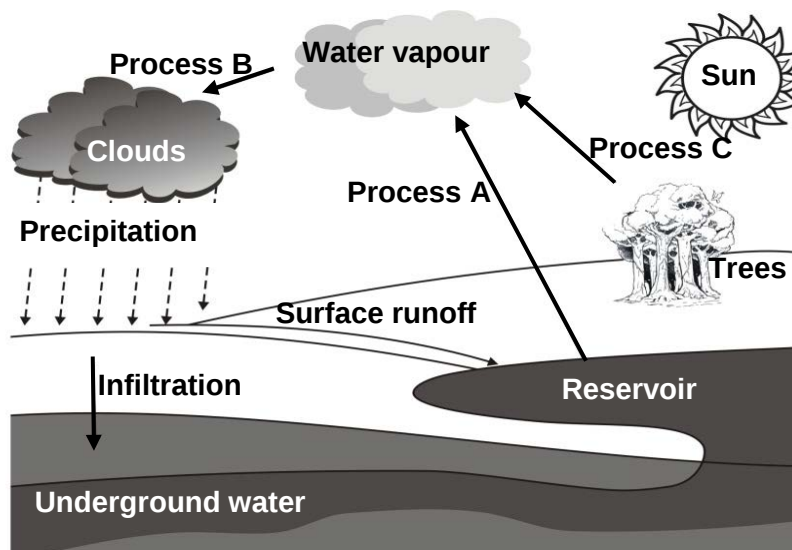
Calculate the:

- 8.1.1 Mass (in gram) of hydrogen gas produced (5)
- 8.1.2 Volume (in dm³) of hydrogen gas produced at STP (3)
- 8.1.3 Mass (in gram) of MgCl₂ produced (4)
- 8.1.4 Number of chlorine atoms present in the MgCl₂ produced (3)
- 8.2 The molar mass of hydrated sodium carbonate is found to be 268 g·mol⁻¹. The formula of the hydrated sodium carbonate is Na₂CO₃·xH₂O.
- Calculate the number of moles water of crystallisation (x) in the compound. (4)
- 8.3 The empirical formula of a certain compound is to be determined. On analysis of a sample of the compound it was found to contain 71,65% Cl, 24,27% C and 4,07% H.
- 8.3.1 Define the term *empirical formula*. (2)
- 8.3.2 Determine the empirical formula of the compound. Show ALL calculations. (5)
- [26]**

QUESTION 9 (Start on a new page.)

Two-thirds of our planet is covered with water. Much of the water is found in lakes, rivers and oceans. Water also occurs underground.

The diagram below shows how water is constantly recycled on earth.



9.1 Write down the name of process:

9.1.1 **A** (1)

9.1.2 **B** (1)

9.1.3 **C** (1)

9.2 Due to industrialisation, acid rain is common in certain areas.

A laboratory technician tests the acidity of three water samples collected during precipitation. The results obtained are shown in the table below.

Sample	1	2	3
pH	4,5	6,9	7,2

9.2.1 Which ONE of the samples (**1**, **2** or **3**) is NOT safe for human consumption? Give a reason for the answer. (2)

9.2.2 Sulphur dioxide is one of the gases responsible for acid rain. Write a balanced equation for the reaction that takes place when sulphur dioxide dissolves in water to form sulphurous acid. (3)

9.2.3 State ONE negative effect of acid rain on the environment. (1)

9.3 Chlorine is used during water purification. However, in large amounts chlorine can be harmful for human consumption.

9.3.1 Give a reason why chlorine is added to drinking water. (2)

A certain compound **X** is acidified with nitric acid and added to a water sample to test for the presence of chlorides in the water. A white precipitate forms.

9.3.2 Write down the NAME or FORMULA of compound **X**. (2)
[13]

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

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)
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	

KEY/ISLEUTEL

Atomic number

Atoomgetal

Electronegativity
ElektronegatiwiteitSymbol
SimboolApproximate relative atomic mass
Benaderde relatiewe atoommassa

ANSWER SHEET**LEARNER'S NAME:**1.1

A

B

C

D

1.2

A

B

C

D

1.3

A

B

C

D

1.4

A

B

C

D

1.5

A

B

C

D

1.6

A

B

C

D

1.7

A

B

C

D

1.8

A

B

C

D

1.9

A

B

C

D

1.10

A

B

C

D

For the use of the marker <i>Vir die gebruik van die nasiener</i>	
Marks obtained <i>Punte behaal</i>	
Marker's initials <i>Nasiener se paraaf</i>	
Marker's number <i>Nasiener se nommer</i>	

(10 x 2) **[20]**