

education

MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

NATIONAL
SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES: CHEMISTRY(P2)

JUNE 2023

Stanmorephysics

MARKS: 100

TIME: 2 HOURS

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

INSTRUCTIONS AND INFORMATION

1. Write your name and class (for example 10 A) in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of 8 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 sub-questions, 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 SHEET.
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. Choose the correct answer and write only the letter (A–D) next to the question numbers

(1.1–1.5) in the ANSWER BOOK, for example 1.6 E.

- 1.1 Only two electrons that spin in the opposite direction can exist in an orbital.
- A Pauli's exclusion principle.
- B Hund's rule.
- C Heiselberg's principle.
- D None of the above. (2)
- 1.2 In a physical change, which one of the following statements is true?
- A The number of molecules remains constant during the reaction.
- B The mass is not conserved but the number of molecules is conserved.
- C The mass is conserved but not the number of atoms.
- D The atoms are rearranged but remains conserved. (2)
- 1.3 Which one of the following is the correct formula for lithium carbonate?
- A Li_2CO_3
- B Li_3CO_2
- C $Li_2(CO_3)_3$
- D $LiCO_3$ (2)



1.4 The formula mass of $C_2O_4H_2 \cdot 2H_2O$ is:

- A 110
B 126
C 90
D 108

(2)

1.5 Four gases and their corresponding temperatures are given below.
Which ONE of the four will have the greatest **KINETIC ENERGY**?

	Gas	Temperature ($^{\circ}C$)
A	Y_2	53
B	X_2	12
C	Q_2	68
D	R_2	6

(2)

[10]

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QUESTION 2

ELEMENTS OF A SMART WATCH

Screen


Al Si O K

The glass used on most smart watches is an aluminosilicate glass composed of a mixture of alumina (Al_2O_3) and silica (SiO_2). The glass also contains potassium ions, which help strengthen it.

Most watches use lithium-ion batteries which are composed of lithium cobalt oxide as a positive electrode and graphite as the negative electrode. The battery's casing is made of aluminum.

Battery

Li Co O C Al



Electronics

Cu Ag Au Si Sn Pb

Copper is used for wiring in the watch whilst copper, gold and silver are the major metals from which micro electrical components are fashioned. Pure silicon is used to manufacture the chip in the watch. Tin and lead are used to solder electronics in the watch. Newer lead-free solders use a mix of tin, copper and silver.

Plastics will also include flame retardant compounds, some of which contain bromine, whilst nickel can be included to reduce electromagnetic interference.

Casing

Br Ni C

- 2.1 Define the term *compound*. (2)
- 2.2 Draw the Lewis diagram of an oxygen molecule. (2)
- 2.3 Name the group of the periodic table to which the elements potassium and lithium belong to. (1)
- 2.4 Name one ferromagnetic substance referred to in the extract. (1)
- 2.5 Name a substance from the extract that would be classified as an electrical conductor. (1)

- 2.6 Give the symbol of the element from the extract with the greatest electron negativity. (1)
- 2.7 In one of the substances named in the extract, the conductivity increases with an increase in temperature. Give the NAME of this substance. (1)
- 2.8 Complete the following table for the bromine ion by ONLY writing down the question number (2.8.1 – 2.8.3) and the CORRECT answer.

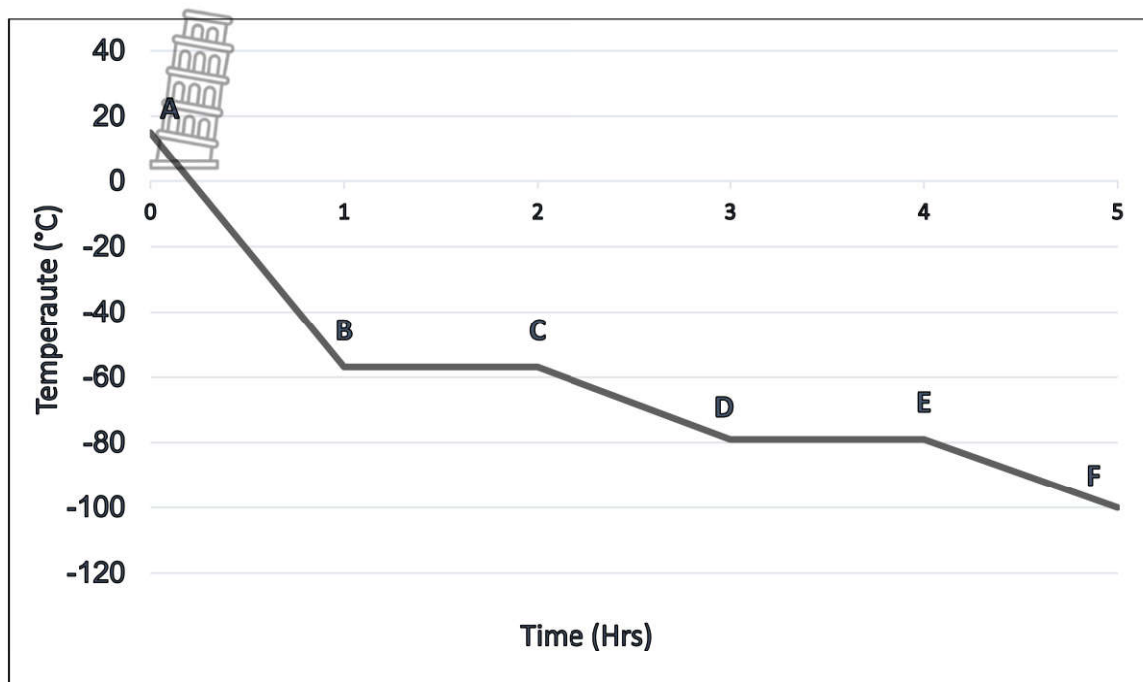
Symbol of ion	Atomic number	Mass number	Protons	Neutrons	Electrons
2.8.1	35	80	35	2.8.2	2.8.3

(3)

[12]

QUESTION 3

The diagram below shows the cooling curve of carbon dioxide gas.




- 3.1 In which phase is carbon dioxide at -40°C ? (1)
- 3.2 At which temperature will carbon dioxide freeze? (1)
- 3.3 At which point on the graph does the substance have a definite shape and the molecules are close to one another in an orderly pattern? (1)
- 3.4 At which point on the graph does the substance undergo condensation? (1)
- 3.5 Refer to line BC to answer the following questions.
- 3.5.1 Name the phase change that takes place at BC. (1)
- 3.5.2 Name the change of state that takes place at BC. (1)
- 3.5.3 Explain the change in phase that takes place at BC by referring to the intermolecular forces and energy of the substance. (3)

[09]

QUESTION 4

Element X has three isotopes in nature, the table below shows the percentage abundance of each isotope.




Isotope	Percentage abundance
^{24}X	78.99
^{25}X	10.00
^{26}X	11.01

- 4.1 Define the term *isotope*. (2)
- 4.2 Calculate the relative atomic mass of element X and name the element. (4)
- 4.3 Calcium reacts with iodine.
- 4.3.1 Write down the symbol of the calcium ion. (1)
- 4.3.2 Write the sp-notation of the calcium ion. (2)
- 4.3.3 Draw the Aufbau diagram for the calcium ion. (3)
- 4.3.4 Name the type of bond formed when calcium reacts with iodine. (1)
- 4.3.5 Indicate the formation of the bond by making use of Lewis diagrams to show the chemical equation. (4)

[17]

QUESTION 5

The first ionization energy and atomic number of each of the first 18 elements of the periodic table is given below.



1312	← First ionization energy in $\text{kJ}\cdot\text{mol}^{-1}$
H	
1	

1312							2372
H							He
1							2
520	900	801	1086	1402	1314	1681	2081
Li	Be	B	C	N	O	F	Ne
3	4	5	6	7	8	9	10
496	738	578	786	1012	1000	1251	1520
Na	Mg	Al	Si	P	S	Cl	Ar
11	12	13	14	15	16	17	18

- 5.1 Define the term *first ionization energy*. (2)
- 5.2 Why does helium, neon and argon have such high ionization energies? (2)
- 5.3 Explain why fluorine has higher ionization energy than oxygen. (2)
- 5.4 Which atom between beryllium and magnesium has the biggest atomic radius? (1)
- 5.5 Explain the answer to QUESTION 5.4. (2)
- 5.6 How does electronegativity change down a group? Only write down INCREASE, DECREASE or REMAIN THE SAME. (1)

[10]

QUESTION 6

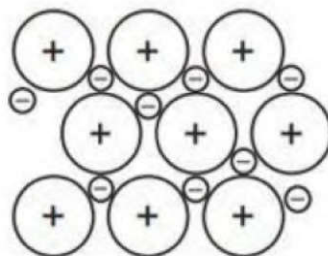
6.1 HCl occurs as a colorless, nonflammable aqueous solution or gas. It is used in several industries around the world.

6.1.1 Give the chemical name of HCl. (1)

6.1.2 Name and define the type of chemical bonding that exist between the molecules of HCl. (3)

6.1.3 Which atom in the HCl molecule has the highest electron affinity? (1)

6.2 Study the diagram below.



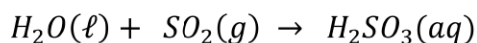
6.2.1 Which type of chemical bonding is represented by the diagram above. (1)

6.2.2 Name the particles between which the above mentioned chemical bond is formed. (2)

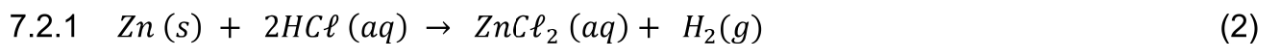
[08]

QUESTION 7

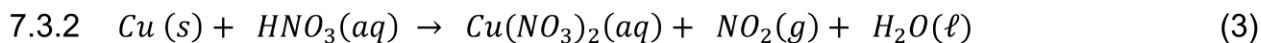
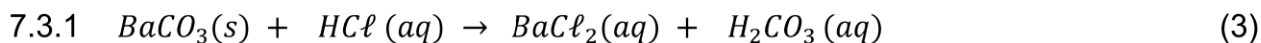
- 7.1 When sulphur dioxide gas dissolves in rainwater, acid rain is formed. This is a form of air pollution that causes widespread damage to the environment.



- 7.1.1 Is this a physical or a chemical change? (1)
- 7.1.2 Explain the answer in QUESTION 7.1.1. (2)
- 7.1.3 State the *Law of conservation of mass* in words. (2)
- 7.1.4 Is the mass conserved in the reaction? Make use of relative atomic masses to explain your answer by doing a calculation. (4)
- 7.2 Classify the following chemical reactions as synthesis, decomposition or ion-exchange reactions.

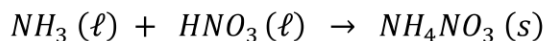
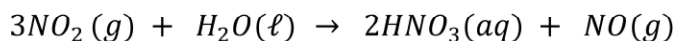


- 7.3 Balance the following equations:

**[19]**

QUESTION 8

There are several steps in the production of fertilizers. In the third step, nitrogen dioxide is absorbed by water to produce nitric acid. Nitric acid and ammonia can react together in an acid-base process to form the salt, ammonium nitrate, which is soluble in water.



- 8.1 Give the scientific name of nitric acid. (1)
- 8.2 Calculate the relative molecular mass of ammonium nitrate. (2)
- 8.3 Calculate the number of moles of ammonium nitrate if 15 g of it was formed. (3)
- 8.4 Calculate the volume of 12 g of nitrogen oxide at STP. (5)
- 8.5 Calculate the number of nitrogen atoms present in 2 moles of ammonium nitrate. (4)

[15]**GRAND TOTAL 100**

DATA FOR PHYSICAL SCIENCES GRADE 10

CHEMISTRY



GEGEWENS VIR FISIESE WETENSAPPE GRAAD 10

CHEMIE

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Avogadro's constant <i>Avogadro-konstante</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$
Molar gas constant <i>Molêre gaskonstante</i>	R	$8,31 \text{ J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$
Standard pressure <i>Standaarddruk</i>	p^\ominus	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	V_m	$22,4 \text{ dm}^3\cdot\text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T^\ominus	273 K

TABLE 2: FORMULAE/TABEL 2: FORMULES

$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$	$pV = nRT$
$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$n = \frac{V}{V_m}$	$c = \frac{n}{V}$ OR/OF $c = \frac{m}{MV}$



TABLE 3: THE PERIODIC TABLE OF ELEMENTS

		KEY/SLEUTEL															
		Atomic number Atoomgetal															
		Electronegativity Elektronnegatiwiteit															
		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)
1 H 1	2 He 4	3 Li 7	4 Be 9	5 B 11	6 C 12	7 N 14	8 O 16	9 F 19	10 Ne 20	11 Na 23	12 Mg 24	13 Al 27	14 Si 28	15 P 31	16 S 32	17 Cl 35.5	18 Ar 40
19 K 39	20 Ca 40	21 Sc 45	22 Ti 48	23 V 51	24 Cr 52	25 Mn 55	26 Fe 56	27 Co 59	28 Ni 58.7	29 Cu 63.5	30 Zn 65	31 Ga 70	32 Ge 73	33 As 75	34 Se 79	35 Br 80	36 Kr 84
37 Rb 85	38 Sr 88	39 Y 89	40 Zr 91	41 Nb 93	42 Mo 96	43 Tc 98	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131
55 Cs 133	56 Ba 137	57 La 139	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	81 Tl 204	82 Pb 207	83 Bi 209	84 Po 209	85 At 210	86 Rn 222
87 Fr 226	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 231	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		



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GRADE/GRAAD 10

PHYSICAL SCIENCES: CHEMISTRY P2

FISIESE WETENSKAPPE: CHEMIE V2

JUNE/JUNIE 2023

MARKING GUIDELINE/NASIENRIGLYNE

MARKS: 100

This marking guideline consists of 9 pages.

Hierdie nasienriglyne bestaan uit 9 bladsye.

QUESTION/VRAAG 1

- 1.1 D ✓✓ (2)
- 1.2 A ✓✓ (2)
- 1.3 A ✓✓ (2)
- 1.4 B ✓✓ (2)
- 1.5 C ✓✓ (2)



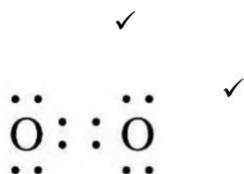
[10]

QUESTION/VRAAG 2

- 2.1 Chemical substance that forms when two or more atoms of different elements combine in a fixed ratio. ✓✓ (2)

Chemiese stof wat vorm wanneer twee of meer atome van verskillende elemente in 'n vaste verhouding bind. ✓✓

2.2



Marking criteria/Nasienkriteria:

- One mark for double bond.
- One mark for whole structure correct.
- Een punt vir dubbelbinding.
- Een punt vir die hele struktuur korrek

(2)

- 2.3 Alkali metals/Alkali metale ✓ (1)
- 2.4 Cobalt / Nickle ✓ (1)
- Kobalt/Nikkel ✓
- 2.5 Copper/koper ✓ (1)
- 2.6 O ✓ (1)
- 2.7 Silicon/silikon ✓ (1)
- 2.8.1 Br^{-1} ✓ (1)



2.8.2 45 ✓ (1)

2.8.3 36 ✓ (1)

QUESTION/VRAAG 3



[12]

3.1 Gas ✓ (1)

3.2 $-80\text{ }^{\circ}\text{C}$ ✓ (1)

3.3 Point/punt EF ✓ (1)

3.4 Point/punt BC ✓ (1)

3.5.1 Condensation/kondensasie ✓ (1)

3.5.2 Gas to liquid. ✓ (1)

Gas na 'n vloeistof. ✓

3.5.3 At BC the temperature stays constant. ✓ The energy released causes an increase in intermolecular forces ✓ so that the gas changes into a liquid. ✓ (3)

By BC bly die temperatuur konstant. ✓ Die energie wat vrygestel word veroorsaak 'n toename in intermolekulêre kragte ✓ sodat die gas in 'n vloeistof verander. ✓

[09]



QUESTION/VRAAG 4

4.1 Atoms of elements with the same atomic number/number of protons, but different mass numbers/numbers of neutrons. ✓✓ (2)

Atome van elemente met dieselfde atoomgetal/getal protone, maar verskillende massagetalle/getal neutrone.

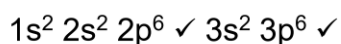
4.2 $Relative\ atomic\ mass = \frac{(24 \times 78.99) + (25 \times 10) + (26 \times 11.01)}{100}$ ✓
 $= 24.32\ u$ ✓ (4)

The element is magnesium. ✓

Die element is magnesium. ✓

4.3.1 Ca^{2+} ✓ (1)

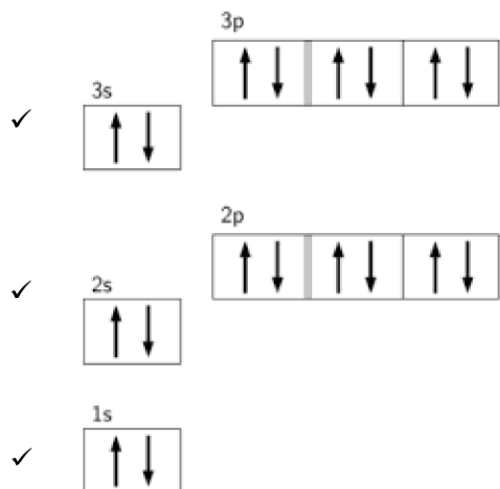
4.3.2



Marking criteria/Nasienkriteria

- One mark for level one and two.
- One mark for level three
- Een punt vir vlak een en twee.
- Een punt vir vlak drie.

4.3.3



Marking criteria/Nasienkriteria:

- One mark for level one.
- One mark for level two.
- One mark for level three
- Een punt vir vlak een.
- Een punt vir vlak twee.
- Een punt vir vlak drie

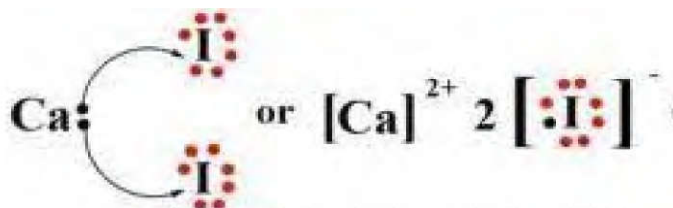
(3)

4.3.4 Ionic bond ✓ (1)

4.3.5



OR



[17]

QUESTION/VRAAG 5


5.1 The energy needed to remove the electron that is held the weakest by an atom in the gaseous phase. ✓✓ (2)

Die energie wat nodig is om die elektron te verwyder wat die swakste deur 'n atoom in die gasfase gehou word. ✓✓

5.2 They have filled energy levels (a full octet configuration) ✓ and are therefore very stable. ✓ (2)

Hulle het gevulde energievlakke ('n volle oktetkonfigurasie) ✓ en is dus baie stabiel. ✓

5.3 As you move across a period the atoms become smaller and therefore the electrons are closer to the nucleus. ✓ The size of the positive nucleus becomes bigger, and the electrons are attracted stronger which requires more energy to remove them. ✓ Therefore, fluorine has higher ionization energy than oxygen. (2)



Soos jy oor 'n periode beweeg, word die atome kleiner en daarom is die elektrone nader aan die kern. ✓ Die grootte van die positiewe kern word groter, en die elektrone word sterker aangetrek wat meer energie benodig om hulle te verwyder. ✓ Fluor het dus hoër ionisasie-energie as suurstof.

5.4 Magnesium / Mg ✓ (1)

5.5 As you move down a group new energy levels are added to the atoms ✓ and therefore the radius becomes bigger since there are more electrons. ✓ (2)

Soos jy afbeweeg in 'n groep word nuwe energievlakke by die atome gevoeg ✓ en daarom word die radius groter aangesien daar meer elektrone is. ✓

5.6 Decrease/verminder ✓ (1)

[10]

QUESTION/VRAAG 6

6.1.1 Hydrogen chloride ✓ (1)

Waterstofchloried ✓

6.1.2 A covalent bond ✓ is formed when electrons are shared between two non-metal atoms. ✓✓ (3)

'n Kovalente binding ✓ word gevorm wanneer elektrone tussen twee nie-metaalatome gedeel word. ✓✓

6.1.3 Chlorine /Chloor/ Cl ✓ (1)

6.2.1 Metallic bonding/metaalbinding ✓ (1)

- 6.2.2
- Sea of delocalized electrons ✓
 - Positive metal atoms. ✓
 - See van gedelokaliseerde elektrone ✓
 - Positiewe metaalatom ✓



[08]

QUESTION/VRAAG 7

7.1.1 Chemical change/Chemiese verandering ✓ (1)

7.1.2 The atoms have rearranged to form new products ✓ with new properties. ✓ (2)

Die atome het herraangskik om nuwe produkte te vorm ✓ met nuwe eienskappe. ✓

7.1.3 The total mass of substances in a closed system stays constant in any physical process. ✓✓

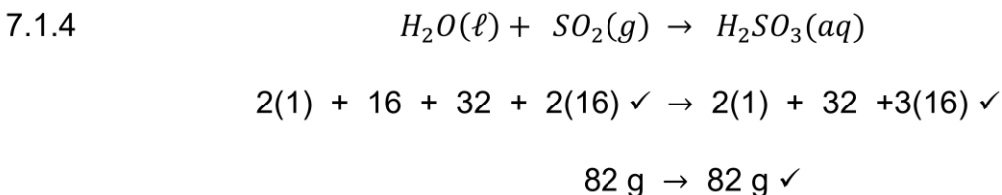
Or

In a chemical reaction the sum of the mass of the reactants equals the sum of the mass of the products. (2)

Die totale massa van stowwe in 'n geslote sisteem bly konstant in enige fisiese proses. ✓✓

Of

In 'n chemiese reaksie is die som van die massa van die reaktante gelyk aan die som van die massa van die produkte.



Mass is conserved ✓ (4)

Massa bly behoue ✓

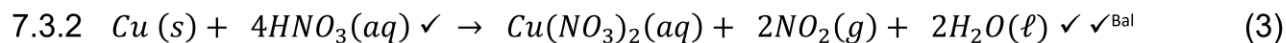
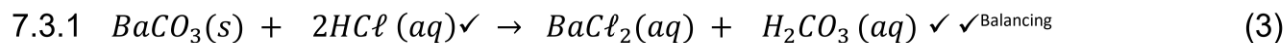
7.2.1 Ion-exchange reaction ✓✓ (2)

Ioön-uitruiling reaksie ✓✓

7.2.2 Decomposition reaction ✓✓ (2)

Ontbindings reaksie ✓✓





Marking criteria for question 7.3.1 & 7.3.2 /Nasienkriteria vir vraag 7.3.1 & 7.3.2

Reactants/Reaktante 1 mark/punt

Products/produkte 1 mark/punt

Balancing/balanseer 1 mark/punt

[19]

QUESTION/VRAAG 8

8.1 Hydrogen nitrate \checkmark (1)

Waterstof nitraat \checkmark

8.2 $M_r(NH_4NO_3) = 14 + 4(1) + 14 + (3)(16) \checkmark$
 $= 80 \text{ g} \cdot \text{mol}^{-1} \checkmark$ (2)

8.3 $n = \frac{m}{M} \checkmark$
 $= \frac{15}{80} \checkmark$
 $= 0.19 \text{ mol} \checkmark$ (3)

8.4 $M_r(NO) = 14 + 16$
 $= 30 \text{ g} \cdot \text{mol}^{-1} \checkmark$
 $n = \frac{m}{M}$
 $= \frac{12}{30} \checkmark$
 $= 0.4 \text{ mol} \checkmark$
 $V = nV_m \checkmark$
 $= (0.4)(22.4)$
 $= 8.96 \text{ dm}^3 \checkmark$ (5)



8.5 $N = nN_A$ ✓

$= (2)(6.02 \times 10^{23})$ ✓(2) ✓

$= 2.41 \times 10^{24}$ nitrogen atoms – stikstof atome ✓ (4)



[15]

GRAND TOTAL/GROOT TOTAAL 100

