LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

MOGALAKWENA DISTRICT

PHYSICAL SCIENCES

NATIONAL SENIOR CERTIFICATE

TERM 3 CONTROLLED TEST
08 SEPTEMBER 2023
GRADE 11

MARKS: 100 **TIME: 2 hours**

This question paper consists of 15 pages including this one

INSTRUCTIONS

1. This question paper consists of 15 pages including the cover page
2. Answer all the questions in the answer book
3. You are advised to use the attached DATA SHEETS.
4. Round off your final answer to a minimum of TWO decimal places
5. Show all your calculations including formulae where applicable.
6. Candidates may use non-programmable calculators.
7. 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) next to the question number (1.1 - 1.10) in the ANSWER BOOK

1.1 According to the Arrhenius theory, all bases …

A are proton donors.

B are proton acceptors.

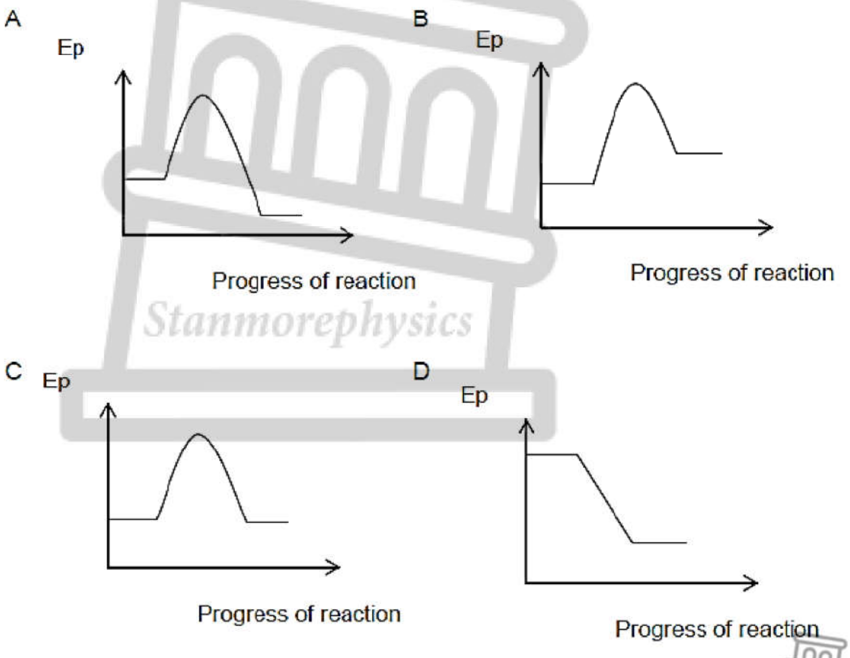
C form H3O+ ions in solution

D form OH^- ions in solution (2)

1.2 Cellular respiration occurs inside the cells of all living organisms. Oxygen reacts with glucose in cellular respiration to produce the following compounds according to the balanced equation below:

$C_6H_{12}O_6(aq) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(\ell)$ $\Delta H = -2\ 830$ kJ

The potential energy versus progress of reaction diagram for this



(2)

1.3 Which ONE of the following balanced equations represents a redox reaction?

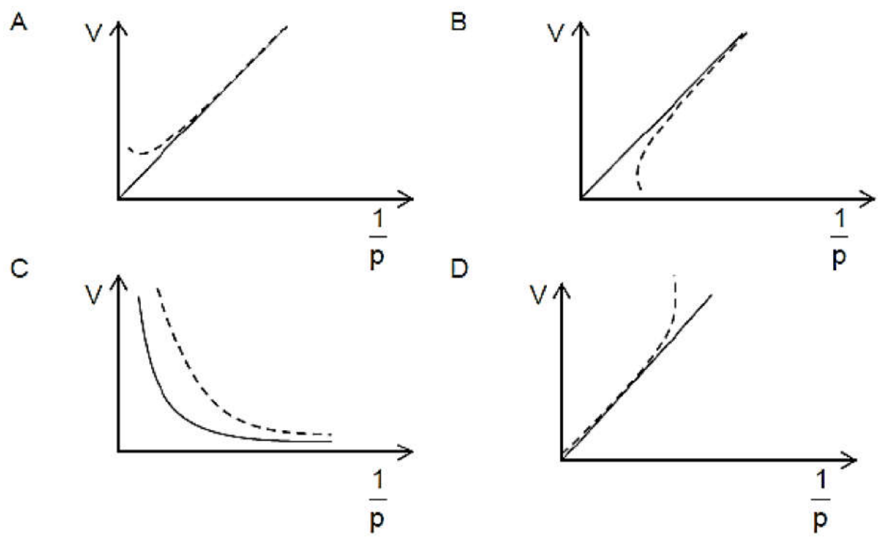
A $H^+(aq) + OH^-(aq) \rightarrow H_2O(\ell)$

B $Mg(s) + CuSO_4(aq) \rightarrow Cu(s) + MgSO_4(aq)$

C $2NaC\ell(aq) + Pb(NO_3)_2(aq) \rightarrow 2NaNO_3(aq) + PbC\ell_2(s)$

D $H2SO_4(aq) + Ba(NO_3)_2(aq) \rightarrow BaSO_4(s) + 2HNO_3(aq)$ (2)

1.4 Which ONE of the graphs below CORRECTLY represents the deviation of a real gas from ideal gas behaviour at very high pressures? The dotted line represents the graph of the real gas.



(2)

1.5 The oxidation number of phosphorus in H_3PO_4 is …

A +3

B -2

C +2

D +5 (2)

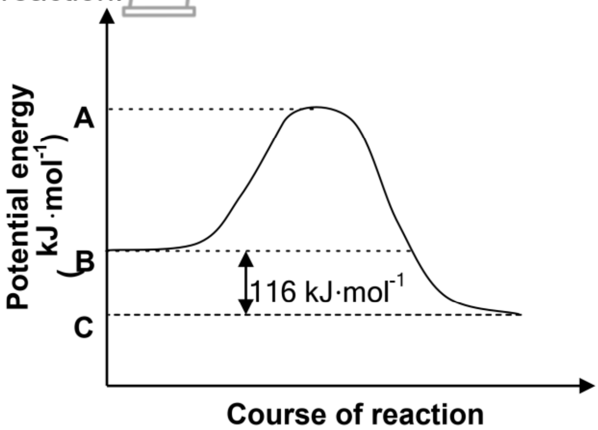
[10]

QUESTION 2 (START ON A NEW PAGE)

A barium hydroxide solution, $Ba(OH)_2(aq)$, reacts with a nitric acid solution, $HNO_3(aq)$, according to the following balanced equation:

$Ba(OH)_2(aq) + 2HNO_3(aq) \rightarrow Ba(NO_3)_2(aq) + 2H_2O(\ell)$

The potential energy graph below shows the change in potential energy for this reaction.



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

2.2 Use energy values A, B and C indicated on the graph and write down an expression for each of the following:

2.2.1 The energy of the activated complex (1)

2.2.2 The activation energy for the forward reaction (1)

2.2.3 Potential energy of the products for the forward reaction (1)

2.2.3 ∆H for the reverse reaction (1)

2.3 Calculate the amount of energy released during the reaction if 0,18 moles of $Ba(OH)_2(aq)$ reacts completely with the acid. (3)

[9]

QUESTION 3 (START ON A NEW PAGE)

The fizz produced when an antacid dissolves in water is caused by the reaction between sodium hydrogen carbonate ($NaHCO_3$) and citric acid ($H_3C_6H_5O_7$). The balanced equation for the reaction is:

$$3NaHCO_3(aq) + H_3C_6H_5O_7(aq) \rightarrow Na_3C_6H_5O_7(aq) + 3CO_2(g) + 3H_2O(\ell)$$

3.1 Write down the FORMULA of the substance that causes the fizz when the antacid dissolves in water. (1)

A certain antacid contains 1,8 g of $H_3C_6H_5O_7$ and 3,36 g of $NaHCO_3$. The antacid is dissolved in 100 cm^3 distilled water in a beaker.

3.2 Define *1 mole of a substance.* (2)

3.3 Calculate the number of moles of $NaHCO_3$ in the antacid. (3)

3.4 Determine, using calculations, which substance is the limiting reagent. (4)

3.5 Calculate the mass of the reactant in excess. (3)

3.6 Calculate the mass decrease of the beaker contents on completion of the reaction. (3)

[16]

QUESTION 4 (START ON A NEW PAGE)

4.1 Define the term *concentration.* (2)

4.2 Eight (8) grams of $Na_2S_2O_3$ is dissolved in water to prepare 500 cm^3 of solution. Calculate the concentration of the $Na_2S_2O_3$ solution. (3)

4.3 A 10 g sample of a compound contains 2,66 g of potassium, 3,54 g of chromium and 3,81 g of oxygen.

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

4.3.2 Determine the empirical formula of this compound. (7)

[14]

QUESTION 5 (START ON A NEW PAGE)

A certain amount of gas is sealed in a container of which the volume can change. The relationship between the pressure and volume of the gas at 20 ºC is investigated. The results of the experiment are given in the table below.

PRESSURE (kPa)	VOLUME (dm^3)
140	348
190	256
260	187,2
330	148
410	118
480	102
520	94

5.1 Name the gas law that is represented by the results of the experiment. (1)

5.2 Write down a hypothesis for the investigation. (2)

5.3 Draw a graph of volume versus pressure on the ANSWER SHEET attached. (4)

5.4 Calculate the volume of the gas at 600 kPa. (3)

5.5 When the volume of the gas is measured at 600 kPa, it is 88 dm^3. Explain why the measured volume differs from the volume calculated in QUESTION 5.4. (2)

5.6 Which temperature condition will cause a gas to deviate from ideal behavior? Write only **HIGH or LOW**. (1)

5.7 Explain the answer to QUESTION 5.6. (2)

5.8 Calculate the number of moles of the gas in the container at the INITIAL pressure and volume. (4)

[19]

QUESTION 6 (START ON A NEW PAGE)

Acids and bases play a large part in industrial chemistry and in everyday life. Almost every biological chemical process is tightly bound up with acid-base equilibria in the organism, and the acidity or alkalinity of the soil and water are of great importance for the plants or animals living in them.

6.1 Define an *acid* in terms of the Lowry-Brønsted theory. (2)

6.2 Predict the products and write a balanced equation for the following chemical reaction:

$$H_2SO_4 + MgCO_3 \rightarrow$$ (2)

6.3 Identify the Bronsted-Lowry acid and base and their conjugate pair in the following reaction: (4)

$$NaCN(aq) + HBr(aq) \rightarrow NaBr(aq) + HCN(aq)$$

6.4 What is a term used to describe a substance that can act as either acid or Base (1)

6.5 A few drops of bromothymol blue indicator are added to a potassium hydroxide solution in a beaker. A dilute sulphuric acid solution is now gradually added to this solution until the colour of the indicator changes.

Write down the:

6.5.1 Type of reaction that takes place (Write down only REDOX, PRECIPITATION or NEUTRALISATION.) (1)

6.5.2 Balanced equation for the reaction that takes place (3)

6.5.3 Colour change of the indicator (2)

6.5.4 NAME of the salt formed in this reaction (1)

[14]

QUESTION 7 (START ON A NEW PAGE)

7.1 Oxidation numbers make it easier to determine whether an element or a substance is oxidised or reduced during a chemical reaction.

7.1.1 Define the term *oxidation* with reference to oxidation numbers. (2)

7.1.2 Calculate the oxidation number of chromium in $Cr_2O_7^{2-}$. (2)

7.1.3 Calculate the oxidation number of oxygen in H_2O_2. (2)

7.2 Consider the UNBALANCED equation below:

$$Mg(s) + I_2(s) \rightarrow Mg^{2+}(aq) + I^-(aq)$$

7.2.1 Define the term REDUCING AGENT in terms of exidation numbers. (2)

7.2.2 Identify the reducing agent in the above reaction. (1)

7.2.3 Write down the FORMULA of the substance that is reduced. (1)

Write done the balanced equation for:

7.2.4 Oxidation half-reaction (2)

7.2.5 Reduction half-reaction (2)

7.2.6 Balanced net redox reaction (2)

[16]

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

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

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$	$pV = nRT$
$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$n = \frac{V}{V_m}$	$c = \frac{n}{V}$ OR/*OF* $c = \frac{m}{MV}$

TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD-REDUKSIEPOTENSIALE

Half-reactions/*Halfreaksies*			E^θ (V)
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+ 0,40
$Cu^{2+} + 2e^-$	⇌	Cu	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$\mathbf{2H^+ + 2e^-}$	⇌	$\mathbf{H_2(g)}$	**0,00**
$Fe^{3+} + 3e^-$	⇌	Fe	− 0,06
$Pb^{2+} + 2e^-$	⇌	Pb	− 0,13
$Sn^{2+} + 2e^-$	⇌	Sn	− 0,14
$Ni^{2+} + 2e^-$	⇌	Ni	− 0,27
$Co^{2+} + 2e^-$	⇌	Co	− 0,28
$Cd^{2+} + 2e^-$	⇌	Cd	− 0,40
$Cr^{3+} + e^-$	⇌	Cr^{2+}	− 0,41
$Fe^{2+} + 2e^-$	⇌	Fe	− 0,44
$Cr^{3+} + 3e^-$	⇌	Cr	− 0,74
$Zn^{2+} + 2e^-$	⇌	Zn	− 0,76
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	− 0,83
$Cr^{2+} + 2e^-$	⇌	Cr	− 0,91
$Mn^{2+} + 2e^-$	⇌	Mn	− 1,18
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	− 1,66
$Mg^{2+} + 2e^-$	⇌	Mg	− 2,36
$Na^+ + e^-$	⇌	Na	− 2,71
$Ca^{2+} + 2e^-$	⇌	Ca	− 2,87
$Sr^{2+} + 2e^-$	⇌	Sr	− 2,89
$Ba^{2+} + 2e^-$	⇌	Ba	− 2,90
$Cs^+ + e^-$	⇌	Cs	- 2,92
$K^+ + e^-$	⇌	K	− 2,93
$Li^+ + e^-$	⇌	Li	− 3,05

↑ Increasing oxidising ability/*Toenemende oksiderende vermoë*

↓ Increasing reducing ability/*Toenemende reduserende vermoë*

TABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE

Half-reactions/*Halfreaksies*			**E^{θ} (V)**
$Li^+ + e^-$	⇌	Li	− 3,05
$K^+ + e^-$	⇌	K	− 2,93
$Cs^+ + e^-$	⇌	Cs	− 2,92
$Ba^{2+} + 2e^-$	⇌	Ba	− 2,90
$Sr^{2+} + 2e^-$	⇌	Sr	− 2,89
$Ca^{2+} + 2e^-$	⇌	Ca	− 2,87
$Na^+ + e^-$	⇌	Na	− 2,71
$Mg^{2+} + 2e^-$	⇌	Mg	− 2,36
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	− 1,66
$Mn^{2+} + 2e^-$	⇌	Mn	− 1,18
$Cr^{2+} + 2e^-$	⇌	Cr	− 0,91
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	− 0,83
$Zn^{2+} + 2e^-$	⇌	Zn	− 0,76
$Cr^{3+} + 3e^-$	⇌	Cr	− 0,74
$Fe^{2+} + 2e^-$	⇌	Fe	− 0,44
$Cr^{3+} + e^-$	⇌	Cr^{2+}	− 0,41
$Cd^{2+} + 2e^-$	⇌	Cd	− 0,40
$Co^{2+} + 2e^-$	⇌	Co	− 0,28
$Ni^{2+} + 2e^-$	⇌	Ni	− 0,27
$Sn^{2+} + 2e^-$	⇌	Sn	− 0,14
$Pb^{2+} + 2e^-$	⇌	Pb	− 0,13
$Fe^{3+} + 3e^-$	⇌	Fe	− 0,06
$2H^+ + 2e^-$	⇌	**$H_2(g)$**	**0,00**
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + 2e^-$	⇌	Cu	+ 0,34
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+ 0,40
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+ 0,45
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87

Increasing oxidising ability/*Toenemende oksiderende vermoë* (↓)

Increasing reducing ability/*Toenemende reduserende vermoë* (↑)

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

KEY/*SLEUTEL*

Atomic number / *Atoomgetal*	Electronegativity / *Elektronegatiwiteit*	Symbol / *Simbool*	Approximate relative atomic mass / *Benaderde relatiewe atoommassa*
29	1,9	Cu	63,5

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															

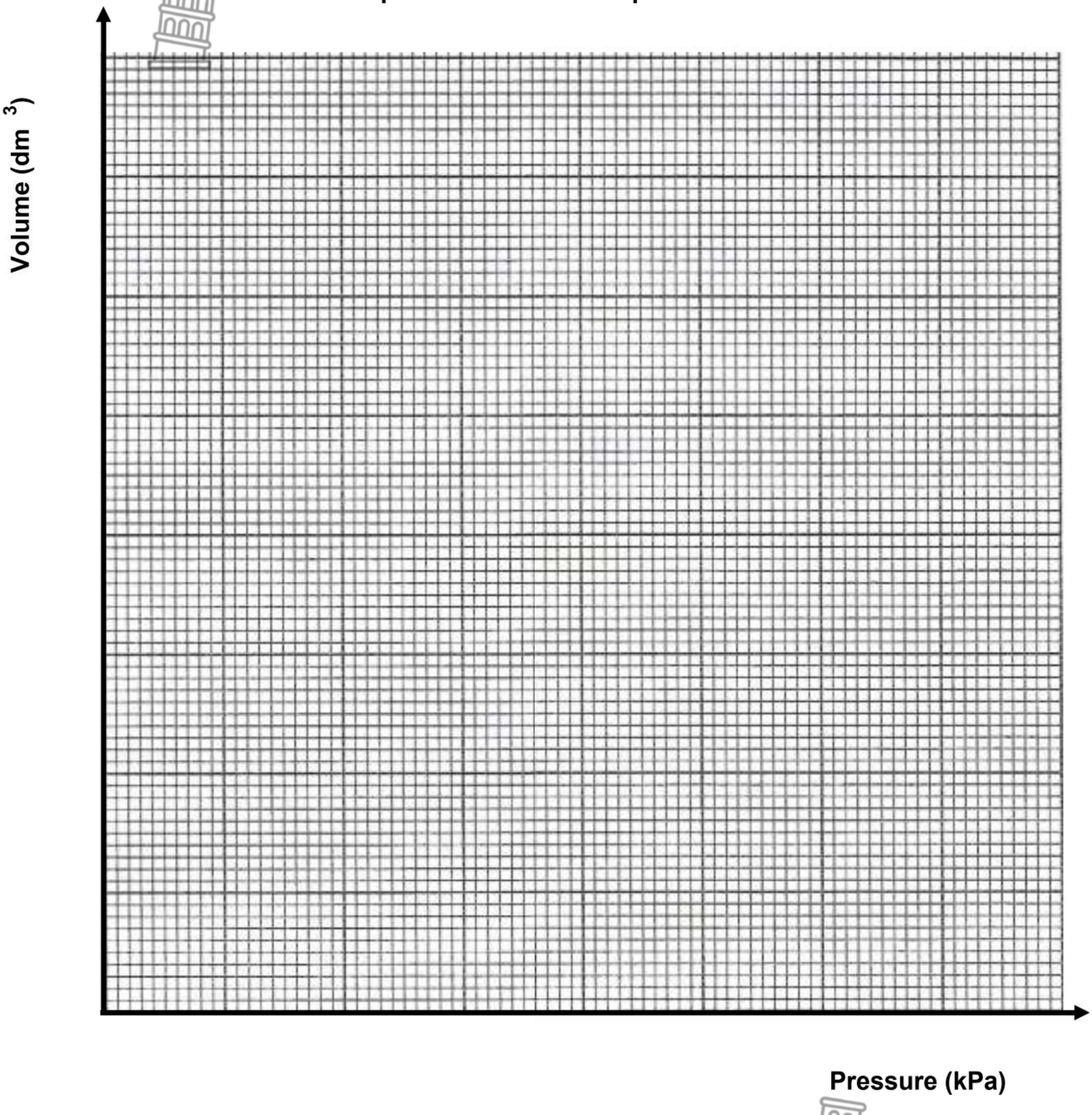
58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

SUBMIT THIS SHEET WITH THE ANSWER BOOK.

NAME ____CLASS____

QUESTION 5.3

Graph of volume versus pressure



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08 SEPTEMBER 2023
GRADE 11
MEMORANDUM

MARKS: 100

This question paper consists of 8 pages including this one

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

1.1 D ✓✓

1.2 A ✓✓

1.3 B ✓✓

1.4 A ✓✓

1.5 D✓✓

[12]

QUESTION 2

2.1 Exothermic✓
Reactants at higher energy than products./Products at lower energy than reactants./Energy is released./ΔH < 0. ✓
(2)

2.2

2.2.1 A ✓ (1)

2.2.2 A - B ✓ (1)

2.2.3 B ✓ (1)

2.2.4 B - C ✓ (1)

2.3 1 mol $Ba(OH)_2$ releases: 116 kJ ✓
0,18 mol $Ba(OH)_2$ release: 0,18 x 116 ✓ = 20,88 kJ ✓
(Accept answers in range: 20,3 – 20,88 kJ) (3)

[9]

QUESTION 3

3.1 CO_2 ✓ (1)

3.2 The amount of substance ✓ having the same number of particles as there are atoms in 12 g carbon-12. ✓ (2)

3.3

$n(NaHCO_3) = \frac{m}{M}$ ✓

$= \frac{3,36}{84}$ ✓

$= 0,04$ mol ✓ (3)

3.4 **POSITIVE MARKING FROM QUESTION 3.3.**

$n(H_3C_6H_5O_7) = \frac{m}{M}$

$= \frac{1,8}{192}$ ✓

$= 0,01$ mol ($9,38 \times 10^{-3}$ mol)

$n(NaHCO_3 \text{ needed}) = 3n(H_3C_6H_5O_7)$

$= 3(0,01)$ mol ✓

$= 0,03$ mol ✓

$n(NaHCO_3) < n(NaHCO_3$ in antacid

$H_3C_6H_5O_7$/citric acid is the limiting reactant. ✓

(4)

3.5 **POSITIVE MARKING FROM QUESTION 3.3 & 3.4.**

$n(NaHCO_3 \text{ in excess}) = 0,04 - 0,03$ ✓

$= 0,01$ mol

$m(NaHCO_3 \text{ in excess}) = nM$

$= (0,01)(84)$ ✓

$= 0,84$ g ✓ (3)

3.6 **POSITIVE MARKING FROM QUESTION 3.4.**

$n(CO_2) = \frac{m}{M}$

$\therefore 0,03 ✓ = \frac{m}{44}$ ✓

$\therefore m(CO_2) = 1,32$ g ✓ (3)

Marking criteria:

- Using $M(CO_2)$= 44 g·mol^{-1}
- $3(CO_2) = n(NaHCO_3)$
- Final answer: 1,32 g

[16]

QUESTION 4

4.1 Amount of solute per litre of solution.✓✓

(2)

4.2

$C = \frac{m}{MV}$ ✓

$c = \frac{8}{(156)(0,5)}$ ✓

c = 0,10 mol.dm^{-3} ✓

(3)

4.3.1 Empirical formula is the simplest whole number ratio between the elements in a compound.✓✓

(2)

4.3.2

Element	$\frac{g}{100g}$	$n = \frac{m}{M}$	Simplest ratio
K	26,58	26,58/39 = 0,68✓	1 x 2 = 2✓
Cr	35,35	35,35/52 = 0,68✓	1 x 2 = 2✓
O	38,07	38,07/16 = 2,38✓	3,5 x 2 = 7✓

Empirical formula= $K_2Cr_2O_7$✓

(7)

[14]

QUESTION 5

5.1 Boyle's law✓ (1)

5.2

Criteria for hypothesis	
The dependent and independent variables are stated correctly.	✓
State the relationship between the dependent and independent variables.	✓
Dependent variable : volume Independent variable : pressure	

Example:

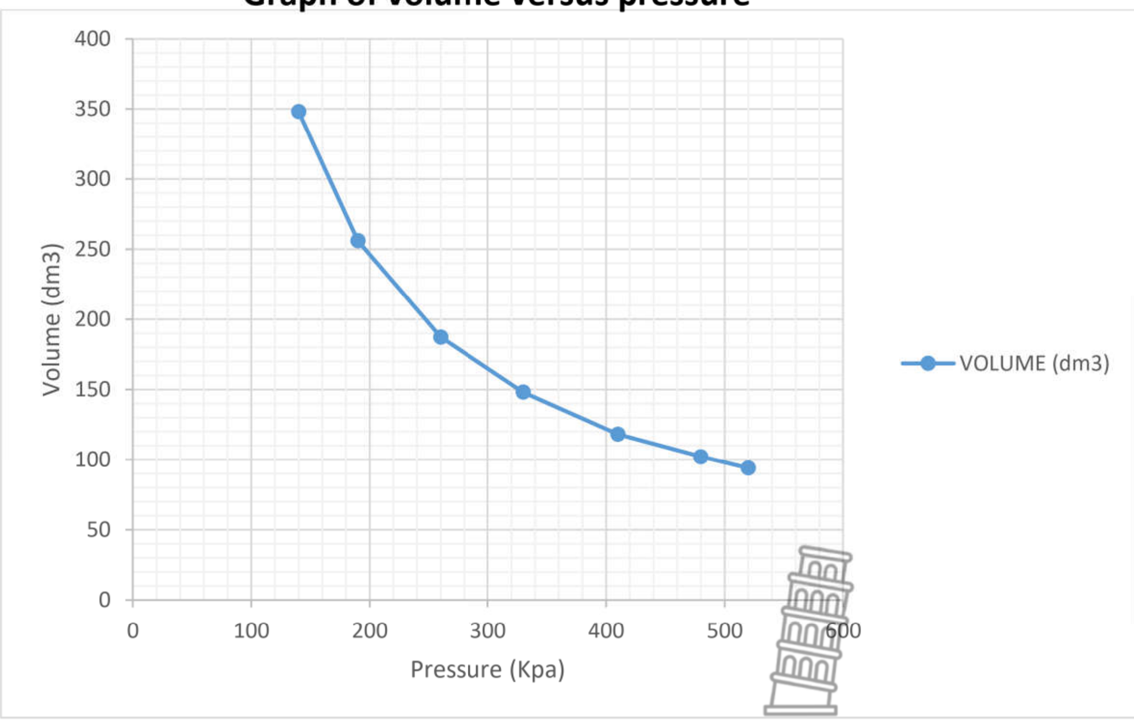
If the pressure of and enclosed gas increases the volume will decreases at constant temperature.

The pressure of an enclosed gas is inversely proportional to the volume it occupies if the temperature is kept constant.

(2)

5.3

Graph of volume versus pressure



Criteria for marking the graph	
Use of correct scale on both axis (If learners used table values as scale values maximum 1/3 for line drawn) *Clearly indicated pressure on the x-axis and volume on the y-axis with the correct S.I unit*	✓✓
At least five (5) points plotted correctly	✓
Curve is drawn	✓

(4)

5.4 Any set of values can be used from the table :

$p_1V_1 = p_2V_2$ ✓

$140 (348) = 600V_2$

$V_2 = 81,20 \text{ dm}^3$ ✓

(Accept : $80,64 – 81,60 \text{ dm}^3$) (3)

5.5 At high pressure a gas starts to deviate from ideal gas behaviour ✓ because the volume of the molecules of a gas and the intermolecular forces start to influence the measured value, causing it to be greater than the theoretical value calculated/Forces of repulsion between the gas particles prevents them from moving closer ✓ (2)

5.6  Low✓

(1)

5.7 Temperature is an indication of the average kinetic energy of the molecules of a gas. If the temperature of a gas decreases, the molecules <u>move slower and</u> <u>closer together</u> ✓up to a point where the gas will start to <u>condense</u> ✓ and not behave like an ideal gas.

OR

The intermolecular forces of attraction becomes significant ✓ then the gas condenses. ✓ (2)

5.8 $pV = nRT$ ✓

$(140\ 000)(348 \times 10^{-3})$ ✓ $= n(8,31)(293)$ ✓

$n = 20$ moles ✓ (4)

[18]

QUESTION 6

6.1 An acid is a proton donor. ✓✓ (2)

6.2 $H_2SO_4 + MgCO_3 \rightarrow MgSO_4$ ✓+ [$H_2O + CO_2$] ✓ (2)

6.3

- Bronsted-Lowry acid: HBr, ✓ Conjugate base is Br^-/NaBr ✓
- Bronsted-Lowry base: CN^- (NaCN),✓ Conjugate base is HCN ✓ (4)

6.4 Ampholyte Accept: Amphiprotic ✓ (1)

6.5

6.5.1 Neutralisation ✓ (1)

6.5.2 $H_2SO_4(aq) + KOH(aq)$ ✓ $\rightarrow K_2SO_4(aq) + 2H_2O(\ell)$ ✓ Bal. ✓

Notes:
- Reactants ✓ Products ✓ Balancing: ✓
- Ignore double arrows.
- Marking rule

(3)

6.5.3 Blue ✓to yellow ✓ (2)

6.5.4 Potassium sulphate ✓ (1)

[14]

QUESTION 7

7.1

7.1.1 Oxidation is an <u>increase in oxidation number</u>.✓✓ (2)

7.1.2 2Cr + 7O = -2 √
2Cr + (-14) = 2
Cr = +6 ✓ (2)

7.1.3 2H + 2O = 0 √
2 + 2O = 0
O = -1 ✓ (2)

7.2

7.2.1 A substance whose oxidation number increases. ✓✓ (2)

7.2.2 Mg/ Magnesium ✓ (1)

7.2.3 I_2 ✓ (1)

7.2.4 $Mg (s) \rightarrow Mg^{2+} + 2e^-$ ✓✓

Marking guidelines:	
• $Mg \rightleftharpoons Mg^{2+} + 2e^-$ $\frac{1}{2}$	$Mg^{2+} + 2e^- \rightleftharpoons Mg$ $\frac{0}{2}$
• $Mg^{2+} + 2e^- \leftarrow Mg$ $\frac{2}{2}$	Mg2+ + 2e- $\rightleftharpoons$ Mg $\frac{0}{2}$

(2)

7.2.5 $I_2 + 2e^- \rightarrow 2I^-$ ✓✓

Marking guidelines:	
• $I_2 + 2e^- \rightleftharpoons 2I^-$ $\frac{1}{2}$	$2I^- \rightleftharpoons I_2 + 2e^-$ $\frac{0}{2}$
• $2I^- \leftarrow I_2 + 2e^-$ $\frac{2}{2}$	$2I^- \rightarrow I_2 + 2e^-$ $\frac{0}{2}$

(2)

7.2.6 $Mg(s) + I_2(s) \rightarrow Mg^{2+}(aq) + 2I^-$ ✓✓

Notes: Ignore double arrows.

(2)
[16]

[100]