LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

CAPRICORN NORTH DISTRICT

GRADE 11

PHYSICAL SCIENCES

CONTROLLED TEST 2

SEPTEMBER 2023

MARKS: 100

TIME: 2 HOURS

THIS PAPER CONSISTS OF 10 PAGES INCLUDING THE INFORMATION SHEETS

INSTRUCTIONS

1. Write your name and surname on the answer sheet
2. This question paper consists of SEVEN Questions. Answer all the questions in your answer book.
3. Start every new question on a new page.
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 Question 2.1 and Question 2.2.
6. You may use a non-programmable calculator.
7. You are advised to use the attached data sheets.
8. SHOW ALL Formulae and substitutions in ALL calculations.
9. Round off your final numerical answers to TWO decimal places.
10. Write neatly and legibly.

QUESTION1

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.6) in the ANSWER BOOK, e.g 1.1 A

1.1 Two moles of H_2 gas at STP occupy a volume of ...

A. 2 dm^3
B. 11,2 dm^3
C. 22,4 dm^3
D. 44,8 dm^3 (2)

1.2 X g of Mg reacts with 2x g of HCl according to the following balanced equation:
$Mg + 2HCl \rightarrow MgCl_2 + H2$
Which one of the following statements is CORRECT

A. x g of H_2 is formed.
B. 2x g of $MgCl_2$ is formed.
C. Mg is the limiting reagent.
D. HCl is a limiting reagent. (2)

1.3 Which ONE of the following statements CORRECTLY describes the characteristics of an endothermic reaction?

A. ΔH is positive and the products have less potential energy than the reactants
B. ΔH is positive and the products have more potential energy than the reactants.
C. ΔH is negative and the products have less potential energy than the reactants.
D. ΔH is negative and the products have more potential energy than the reactants. (2)

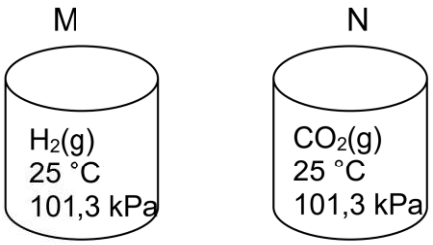
1.4 Bromothymol Blue turns _____ in acids and _____ in bases.

A. red; blue
B. yellow; red
C. orange ; yellow
D. Colourless; reddish pink (2)

1.5 Bronsted-Lowrey acid is

A. an electron Donor
B. an electron acceptor
C. a proton donor
D. a proton acceptor (2)

1.6 Two identical containers, M and N, are shown below. Container M contains $H_2(g)$ and container N contains $CO_2(g)$. Both gases are at a temperature of 25 °C and a pressure of 101,3 kPa.



Consider the following statements:

(i) The average kinetic energy of the molecules is the same in both containers.
(ii) Container M contains more gas molecules than container N.
(iii) The mass of the gas in container N is greater than the mass of the gas in container M.

Which of the above statements is/are CORRECT?
A. (i) only
B. (iii) only
C. (i) and (ii) only
D. (i) and (iii) only (2)

[12]

QUESTION 2 (start on a new page)

Fructose is a type of sugar that is present in many plants. It consists of 40% carbon 6.67% hydrogen and 53.33% oxygen.

2.1 Define the term empirical formula. (2)

2.2 Determine the empirical formula of fructose. (7)

2.3 If the molar mass of fructose is 180g.mol^{-1} determine the molecular formula of fructose. (3)

[12]

QUESTION 3 (start on a new page)

A learner finds 7.00g of shells on a school field trip. She is curious about the amount of calcium carbonate present in the shells. She adds 1350cm^3 sulfuric acid with a concentration of 0.05mol.dm^{-3}. The unbalanced equation for the reaction is:

$$CaCO_{3(s)} + H_2SO_{4(aq)} \rightarrow CaSO_{4(aq)} + H_2O_{(l)} + CO_{2(g)}$$

3.1 Define one mole of a substance. (2)

3.2 The learner then neutralizes the unreacted acid with 3.00g of NaOH according to the following reaction.

$$H_2SO_{4(aq)} + 2NaOH_{(aq)} \rightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)}$$

3.2.1 Calculate the volume of excess sulfuric acid which was neutralized. (6)

3.2.2 Calculate the mass of calcium carbonate that was present in the shells. (6)

3.2.3 Calculate the percentage purity of the calcium carbonate in the shells. (3)

[17]

QUESTION 4 (Start on a new page)

The following equation shows the formation of silver from silver oxide.

$$Ag_2O_{(s)} + C_{(s)} \rightarrow Ag_{(s)} + CO_{2(g)}$$

4.1 Balance the given chemical reaction equation. (2)

4.2 151.91g of silver oxide is added to 3g of carbon.

4.2.1 Determine the limiting reagent in the reaction. (4)

4.2.2 Calculate the theoretical yield of silver. (4)

4.2.3 Calculate the percentage yield if the actual yield is 92g. (3)

[13]

QUESTION 5 (Start on a new page)

The combustion of natural gas (methane) produces carbon dioxide and water according to the given equation

$$CH_{4(g)} + 2O_{2(g)} \rightarrow 2H_2O_{(g)} + CO_{2(g)} \quad \Delta H < 0$$

5.1 Define the term activation energy. (2)

5.2 Is the above reaction endothermic or exothermic? Give a reason for your answer. (2)

5.3 Draw a sketch of the potential energy vs course of the reaction for the reaction above.

Clearly indicate the following on the graph

- Activation energy
- Heat of reaction
- Reactants and Products (3)

[7]

QUESTION 6 (start on a new page)

When sulfuric acid reacts with water it ionizes in two steps as shown in the balanced equation below.

1: $H_2SO_{4(aq)} + H_2O_{(l)} \rightarrow H_3O^+_{(aq)} + HSO^-_{4(aq)}$

2: $HSO^-_{4(aq)} + H_2O_{(l)} \rightarrow H_3O^+_{(aq)} + SO_4^{2-}{}_{(aq)}$

6.1 What do you understand by the term ampholyte? (2)

6.2 Write down the FORMULA for

6.2.1 the conjugate base of HSO^-_4 (1)

6.2.2 the conjugate acid of HSO^-_4 (1)

6.2.3 a substance that acts as an Ampholyte in these reactions. (1)

6.3 $20cm^3$ of HCl of concentration $0.5mol.dm^{-3}$ is dissolved in water.

6.3.1 Define an acid according to the Arrhenius theory (2)

6.3.2 Write the balanced equation for the above reaction (3)

6.3.3 Calculate the volume of the new solution if the concentration is $0.015mol.dm^{-3}$. (3)

6.4 6 g of KOH are dissolved in 200ml of water to make a standard solution You are asked to determine the concentration of $150cm^3$ of a HCl solution.

$$KOH_{(aq)} + HCl_{(aq)} \rightarrow KCl_{(aq)} + H_2O_{(aq)}$$

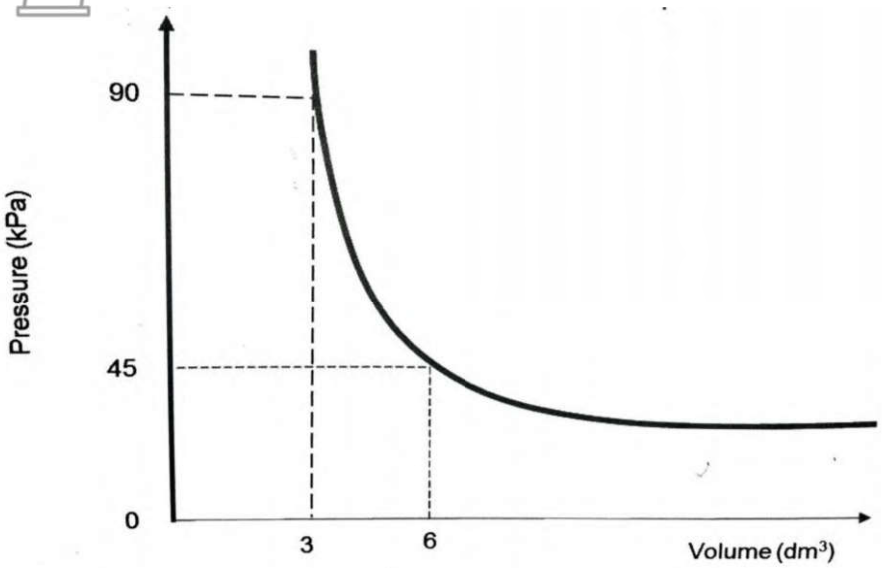
If $20cm^3$ of the standard solution neutralizes $25cm^3$ of the acid, calculate

6.4.1 The concentration of the HCl solution. (6)

[19]

QUESTION 7 (start on a new page)

The graph below represents the relationship between the pressure and the volume of oxygen gas at constant temperature.



7.1 State Boyle's law in words. (2)

7.2 Write down the mathematical expression, in symbols, for the relationship between the variables on the graph. (1)

7.3 Write down two variables that must be kept constant during this investigation. (2)

7.4 Define the Pressure exerted by a gas. (2)

7.5 Calculate the Pressure, in kPa, exerted on the gas when it is compressed to 5dm^3. (4)

7.6 State the conditions under which real gases approach ideal gas behavior. (2)

7.7 Tabulate the difference between ideal gases and real gases. (6)

7.8 Give a reason why oxygen gas deviates from ideal gas behavior at low temperatures. (1)

[20]

4.3 Information sheets – Paper 2 (Chemistry)

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* $c=\frac{m}{MV}$

KEY/SLEUTEL

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

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PHYSICAL SCIENCES

GRADE 11 CONTROLLED TEST 2
MARKING GUIDELINE

SEPTEMBER 2023

MARKS: 100

QUESTION 1

1.1 D✓✓
1.2 D✓✓
1.3 B✓✓
1.4 B✓✓
1.5 C✓✓
1.6 D✓✓ **[12]**

QUESTION 2

2.1 Empirical formula is the simplest whole number ratio of the elements that make up a compound. ✓✓ (2)

2.2

ELEMENT	MASS (g)	$n=\frac{m}{M}$ (mol)		Ratio
C	40	$\frac{40}{12}$=3.33✓	$\frac{3.33}{3.33}$	1
H	6.67	$\frac{6.67}{1}$=6.67✓	$\frac{6.67}{3.33}$	2
O	53.33	$\frac{53.33}{16}$=3.33✓	$\frac{3.33}{3.33}$	1
	✓		✓	✓

CH_2O✓ (7)

2.3 M_{CH2O} = 12+ 2 +16 = 30g.mol^{-1}✓

$\frac{180}{30}$ =6 ✓

Molecular formula:$C_6H_{12}O_6$ ✓ (3)
[12]

QUESTION 3

3.1 One mole is the amount of a substance having the same number of particles as there are atoms in 12g of carbon-12 ✓✓ (2)

3.2.1 $n_{NaOH} = \frac{m✓}{M}$

$= \frac{3✓}{40}$
= 0.075mol ✓

$\frac{n_{NaOH}}{n_{H2SO4}} = \frac{2}{1}$

$\frac{0.075}{n_{H2SO4}} = \frac{2}{1}$

$\therefore n_{H2SO4}$ =0.0375mol ✓ (for using ratio)

$$c = \frac{n}{V}$$

$$0.05 = \frac{0.0375✓}{V}$$

V= 0.75 dm^3✓ (6)

3.2.2 1.35-0.75=0.6 dm^3✓

$$c = \frac{n✓}{V}$$

$$0.05 = \frac{n✓}{0.6}$$

n = 0.03 mol.

$$\frac{n_{CaCO3}}{n_{H2SO4}} = \frac{1}{1}$$

$\therefore n_{CaCO3} = 0.03$mol ✓

$$n_{CaCO3} = \frac{m}{M}$$

$$0.03 = \frac{m}{100✓}$$

m = 3g✓ (6)

3.2.3 $\%purity = \frac{mass\ of\ pure\ substance}{mass\ of\ sample} \times 100✓$

$\%purity = \frac{3}{7} \times 100✓$

$\%purity = 42.85\%✓$ (3)

[17]

QUESTION 4

4.1 $\overbrace{2Ag_2O_{(s)} + C_{(s)}}$ ✓ → $\overbrace{4Ag_{(s)} + CO_{2(g)}}$ ✓ (2)

4.2.1 $n_{Ag2O} = \frac{m.✓}{M}$ $n_C = \frac{m}{M}$

$$n_{Ag2O} = \frac{151.91✓}{232}$$

$$n_{Ag2O} = 0.65\ mol$$

2 mol of Ag_2O reacts with 1 mol of C.

$\therefore Required\ n_c = 0.325$mol 0.325>0.25 C is the limiting reagent ✓ (4)

$$n_C = \frac{3✓}{12}$$

$$n_C = 0.25mol$$

4.2.2 $$\frac{n_C}{n_{Ag}} = \frac{1}{4}$$

$$\frac{0.25}{n_{Ag}} = \frac{1}{4}$$

$$n_{Ag} = 1mol\ ✓$$

$$n_{Ag} = \frac{m✓}{M}$$

$$1 = \frac{m✓}{108}$$

m = 108g✓ (4)

4.2.3 $$\%yeild = \frac{actual\ yeild}{theoretical\ yeild} \times 100✓$$

$$\%purity = \frac{92}{108} \times 100✓$$

$$\%purity = 85.18\%✓$$ (3)

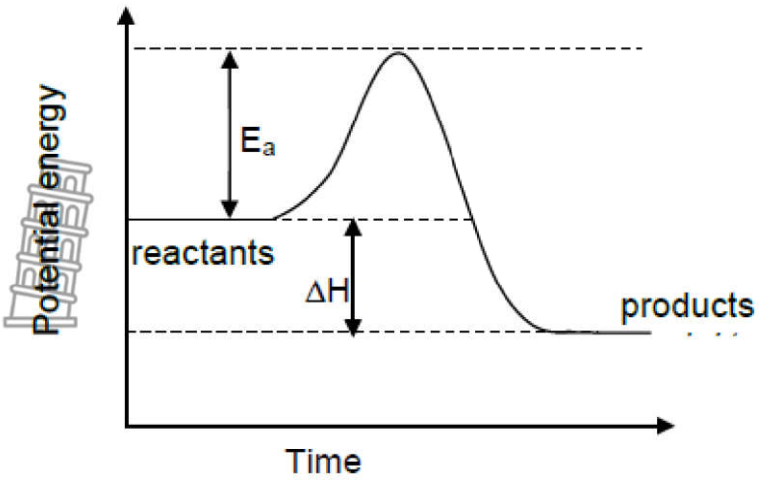
[13]

QUESTION 5

5.1 Activation energy is the minimum energy required for a reaction to take place.✓✓ (2)

5.2 Exothermic✓ ΔH< 0✓ (2)

5.3



Reactants and products in the correct place ✓ (3)
Heat of reaction correct ✓
Activation energy correct ✓

[7]

QUESTION 6

6.1 An ampholyte is a substance that can act as either an acid or a base. ✓✓ (2)

6.2.1 SO_4^{2-}✓ (1)

6.2.2 H_2SO_4 ✓ (1)

6.2.3 HSO_4^- ✓ (1)

6.3.1 A substance that ionizes in water to form hydrogen ions (H^+) ✓✓ (2)

6.3.2 $HCl(aq) + H_2O(l)$ ✓ → $H_3O^+_{(aq)} + Cl^-$ ✓ balanced ✓ (3)

6.3.3 $V_1c_1 = V_2c_2$ ✓ (3)
$0.02(0.5) = V_1 0.015$ ✓
$V_2 = 0.67\text{dm}^3$ ✓

6.4.1
$$c_{KOH} = \frac{m✓}{MV}$$

$$c = \frac{6✓}{56(0.2)}$$

c= 0.54 mol.dm^{-3}

$$\frac{n_a}{n_b} = \frac{c_a V_a}{c_b V_b} \checkmark$$ (6)

$$\frac{1}{1} \checkmark = \frac{(0.54)(20)}{c_b 25} \checkmark$$

$$c_b = 0.43 \text{ mol.dm}^{-3} \checkmark$$

[19]

QUESTION 7

7.1 Boyles Law states that the pressure of an enclosed gas is inversely proportional to the volume it occupies at constant temperature. ✓✓ (2)

7.2 $p \propto \frac{1}{V}$ ✓ (1)

7.3 Temperature✓ and Number of molecules (moles) of the gas. ✓ (2)

7.4 The pressure of a gas is the collision of the molecules with the walls of the container. ✓✓ (2)

7.5 $p_1V_1 = p_2V_2$✓
$90(3)$✓ $= p_2 5$✓
$p_2 = 54kPa$✓ (4)

7.6 Low pressure ✓ and High Temperature✓ (2)

7.7

Real Gas	**Ideal gas**
Particles have a definite volume and a mass. ✓	Particles do not have a definite volume and mass. ✓
Collisions between real gas molecules are inelastic. ✓	Collisions between molecules are elastic. ✓
Kinetic energy of real gas molecules changes with collision. ✓	Kinetic energy of ideal gas partcles is constant. ✓
There are intermolecular forces between the particles of a real gas.	There are no intermolecular forces between the particles of ideal gas.

(any 3x2=6)

7.8 At low temperatures the kinetic energy of the particles is low, this allows intermolecular forces to exist. ✓ (1)

[20]