LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

VHEMBE WEST

HLANGANANI CENTRAL CIRCUIT

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

PHYSICAL SCIENCES

TERM 2 PRE – TEST

25 JUNE 2021

MARKS: 100

TIME: 1,5 hours

This question paper consists of 7 pages and 3 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your NAME and school name on your answer paper.

2. This question paper consists of five (5) questions. Answer ALL the questions in the ANSWER PAPER.

3. Start EACH question on a NEW page in the ANSWER PAPER.

4. Number the answers correctly according to the numbering system used in this question paper.

5. Leave ONE line between two subquestions, 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 SHEETS.

9. Show ALL formulae and substitutions in ALL calculations.

10. Round off your FINAL numerical answers to 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. Each question has only ONE correct answer. Choose the answer and write only the letter (A-D) next to the question number (1.1 – 1.3) in the ANSWER PAPER, for example **1.4 E**

1.1 The electrostatic force between two charged spheres, a distance *r* apart, is ***F***. When the charge on each sphere is doubled and the distance between the spheres is also doubled, the force between the spheres will now be …

A ½ ***F***

B ***F***

C ***2F***

D ***4F*** (2)

1.2 The boiling point of CH_4 is much lower than that of HF. Which ONE of the following best explains this difference in boiling points?

A HF molecules are more polar than CH_4 molecules.

B CH_4 molecules are more polar than HF molecules.

C There are dipole-dipole forces between CH_4 molecules.

D There are hydrogen bonds between HF molecules. (2)

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

A 44,8 dm^3

B 22,4 dm^3

C 11,2 dm^3

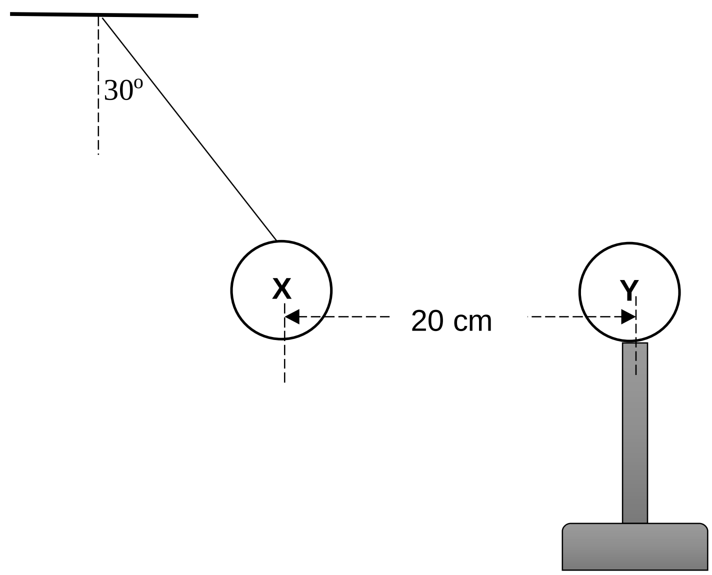
D 2,0 dm^3 (2)

[6]

QUESTION 2

The charged sphere **X** with a charge + 5 x 10^{-6} C is suspended from a light, inextensible string. Another sphere **Y**, with a charge of – 9 x 10^{-6} C, on an insulated stand, is brought closer to sphere **X**.

As a result, sphere **X** moves to a position where it is 20 cm from sphere **Y** as shown below. The system is in equilibrium and angle between the string and the vertical is 30°.



2.1 Draw a labelled free – body diagram for sphere **X**. (3)

2.2 Calculate the magnitude of the electrostatic force that sphere **Y** exerts on sphere **X**. (4)

2.3 Hence, calculate the magnitude of the tension in the string. (3)

The two spheres are allowed to touch and as a results they repel each other.

2.4 Are the electrons removed from or added to sphere **X**? Write only REMOVED FROM or ADDED TO sphere **X**. (1)

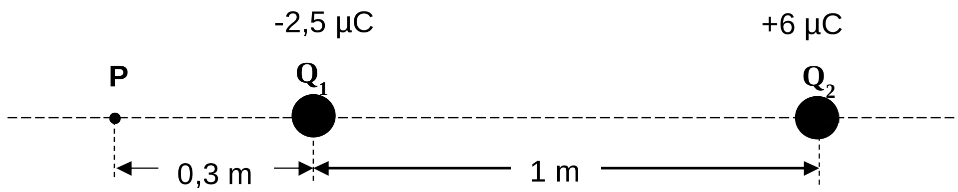
2.5 Hence, or otherwise calculate the number of electrons transferred between the spheres. (5)

[16]

QUESTION 3

A sphere $\mathbf{Q_1}$, with a charge of – 2,5 µC, is placed 1 m away from a second sphere $\mathbf{Q_2}$, with a charge +6 µC. The spheres lie along a straight line, as shown in the diagram below. Point **P** is located at a distance of 0,3 m to the left of sphere $\mathbf{Q_1}$.

The diagram is not drawn to scale.



3.1 Define the term *electric field at a point* in words. (2)

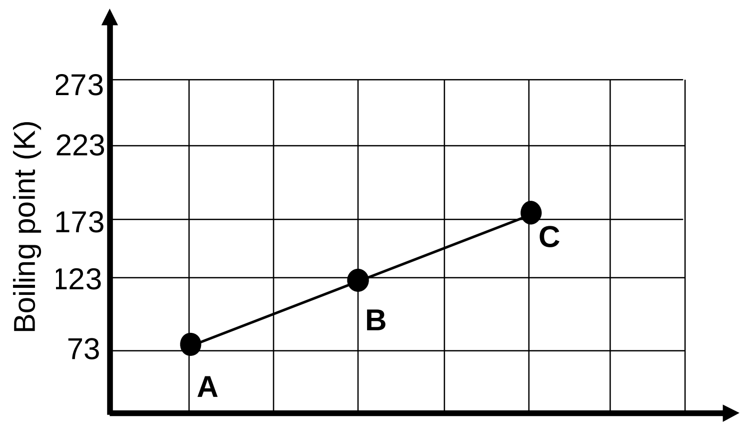
3.2 Draw the resultant electric field patterns for the two spheres. (3)

3.3 Calculate the net electric field at point **P**, due to the two charged spheres $\mathbf{Q_1}$ and $\mathbf{Q_2}$. (5)

[10]

QUESTION 4

4.1 The graph of molecular size versus the boiling point is given below. The letters **A**, **B** and **C** represent the compounds CH_4 , C_4H_6 and C_3H_8 respectively.



4.1.1 Define the term *boiling point*. (2)

4.1.2 Describe the trend in the boiling points of the compounds as shown by the graph. (2)

4.1.3 Explain the answer to QUESTION 4.1.2 by referring to MOLECULAR SIZE, TYPE and STRENGTH of INTERMOLECULAR FORCES. (3)

4.1.4 Which ONE of the compounds (**A, B** or **C**) has the HIGHEST vapour pressure? Explain the answer by referring to the data on the graph. (2)

4.2 Consider the two molecules in the table below.

NAME OFSUBSTANCE	**FORMULA**	**MOLACULAR MASS (g)**	**BOILING POINT (ºC)**
Ammonia	NH_3	17	- 33
Phosphine	PH_3	x	– 87,4

4.2.1 Determine the molecular mass (x) of phosphine (1)

4.2.2 Explain the difference in the boiling points by referring to the TYPE and STRENGTH of INTERMOLECULAR FORCES. (3)

[14]

QUESTION 5

5.1 In order to determine the empirical and molecular formula of a compound, C_xH_y, a certain mass of the compound is burnt completely in excess oxygen to produce 47,1 g CO_2 and 19,35 g H_2O as the only products.

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

5.1.2 Use relevant calculations to determine the empirical formula of the compound. (7)

5.1.3 The molar mass of the compound is 28 g·mol^{-1}. Determine by using calculations the values of **x** and **y**. (2)

5.2 The following balanced equation represents a redox reaction in which 8 grams of iron (III) oxide (Fe_2O_3) reacts with 3,8 grams of aluminium (Aℓ).

$$Fe_2O_3 + 2A\ell \rightarrow A\ell_2O_3 + 2Fe$$

The reaction runs to completion.

5.2.1 Define the term *limiting reagent*. (2)

5.2.2 Which ONE is the limiting reagent (**Iron (III) oxide** or **Aluminium**)? Justify the answer by suitable calculations. (4)

5.2.3 Hence or otherwise calculate the percentage yield if 4,76 g of Fe was formed. (4)

5.3 A solution of potassium hydroxide (KOH) is prepared by dissolving 3,36 g crystals of KOH in 250 cm^3 of water.

Calculate the concentration of the potassium hydroxide solution. (3)

5.4 25 cm^3 of a potassium hydroxide solution of concentration 0,25 mol.dm-3 completely neutralises a dilute solution of sulphuric acid (H_2SO_4) in a flask.

The unbalanced equation below represents the reaction that takes place:

$$H_2SO_4\,(aq) + KOH\,(aq) \longrightarrow K_2SO_4\,(aq) + H_2O\,(\ell)$$

5.4.1 Balance the above equation. (2)

5.4.2 Calculate the mass of sulphuric acid in the flask. (5)

[29]

TOTAL: 75

DATA FOR PHYSICAL SCIENCES GRADE 11

PAPER 1 (PHYSICS)

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	$9,8\ m\cdot s^{-2}$
Universal gravitational constant	G	$6,67 \times 10^{-11}\ N\cdot m^2\cdot kg^{-2}$
Mass of the Earth	M_E	$5,98 \times 10^{24}\ kg$
Radius of the Earth	R	$6,38 \times 10^6\ m$
Speed of light in a vacuum	c	$3,0 \times 10^8\ m\cdot s^{-1}$
Coulomb's constant	k	$9,0 \times 10^9\ N\cdot m^2\cdot C^{-2}$
Charge on electron	e	$-1,6 \times 10^{-19}\ C$
Electron mass	m_e	$9,11 \times 10^{-31}\ kg$

PAPER 2 (CHEMISTRY)

TABLE 2: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Avogadro's constant	N_A	$6,02 \times 10^{23}\ mol^{-1}$
Molar gas constant	R	$8,31\ J\cdot K^{-1}\cdot mol^{-1}$
Standard pressure	p^θ	$1,013 \times 10^5\ Pa$
Molar gas volume at STP	V_m	$22,4\ dm^3\cdot mol^{-1}$
Standard temperature	T^θ	273 K

TABLE 3: FORMULAE (PHYSICS)

MOTION

$v_f = v_f + \Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$	$\Delta x = \left(\frac{v_f + v_f}{2}\right)\Delta t$

FORCE

$F_{net} = ma$	$w = mg$
$F = \frac{Gm_1m_2}{r^2}$	$f_{s(max)} = \mu_sN$
$f_k = \mu_{sk}N$	

ELECTROSTATICS

$F = \frac{kQ_1Q_2}{r^2}$ (k = 9,0 x 10^9 N·m^2·C^{-2})	$E = \frac{E}{q}$
$E = \frac{kQ}{r^2}$ (k = 9,0 x 10^9 N·m^2·C^{-2})	$n = \frac{Q}{e}$

TABLE 4: FORMULAE (CHEMISTRY)

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

TABLE 5: THE PERIODIC TABLE OF ELEMENTS

KEY/*SLEUTEL*

Atomic number / ***Atoomgetal***: 29
Electronegativity / ***Elektronegatiwiteit***: 1,9
Symbol / ***Simbool***: Cu
Approximate relative atomic mass: 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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MARKING GUIDELINES

MARKS: 75

This marking guideline consists of 7 pages.

QUESTION 1

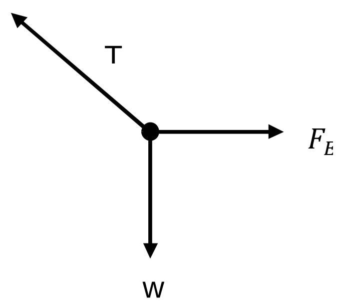
1.1 B ✓✓ (2)

1.2 D ✓✓ (2)

1.3 A ✓✓ (2)

QUESTION 2

2.1



Accepted labels		Marks
W	F_g / F_w / weight / mg / gravitational force	✓
T	Tension/F_T	✓
F_E	Electrostatic force / $F_{Y on X}$	✓

(3)

Notes

- Mark awarded for label and arrow.
- Do not penalise for length of arrows since drawing is not to scale.
- Any other additional vector(s). $^2/_3$
- If force(s) do not make contact with body. $^2/_3$

2.2

$F = \frac{KQ_1Q_2}{r^2}$ ✓

$= 9 x 10^9 \frac{(5 x 10^{-6})(9 x 10^{-6})✓}{(0,2)^2 ✓}$

= 10,125 N ✓ (4)

2.3 **POSITIVE MARKING FROM 2.2**

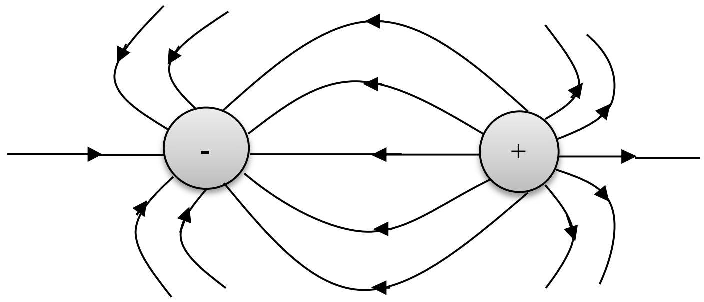
OPTION 1	OPTION 2
$\sin 30° = \frac{F_E}{T}$	$\cos 60° = \frac{F_E}{T}$
$\sin 30° = \frac{10,125}{T}$ ✓	$\cos 60° = \frac{10,125}{T}$ ✓
$T = \frac{10,125}{0,5}$	$T = \frac{10,125}{0,5}$
T = 20,25 N ✓	T = 20,25 N ✓

	OPTION 3	**OPTION 3**	
	$F_{net,x} = 0$ $T_x + (-F_E) = 0$ $T\sin 30° = F_E$ $T\sin 30° = 10{,}125$ ✓ $T = \frac{10{,}125}{0{,}5}$ T = 20,25 N ✓	$F_{net,x} = 0$ $T_x + (-F_E) = 0$ $T\cos 60° = F_E$ $T\cos 60° = 10{,}125$ ✓ $T = \frac{10{,}125}{0{,}5}$ T = 20,25 N ✓	(3)
2.4	Added to (sphere **X**) ✓		(1)
2.5	**OPTION 1**		
	$Q_{each} = \frac{Q_1 + Q_2}{2}$ $= \frac{5 \times 10^{-6} - 9 \times 10^{-6}}{2}$ ✓ $= -2 \times 10^{-6}$ C		
	$\Delta Q_X = Q_{fX} - Q_{iX}$ $= -2 \times 10^{-6} - 5 \times 10^{-6}$ ✓ $= -7 \times 10^{-6}$ C $n_{transferred} = \frac{Q}{e}$ ✓ $= \frac{-7 \times 10^{-6}}{-1{,}6 \times 10^{-19}}$ ✓ $= 4{,}375 \times 10^{13}$ electrons ✓	$\Delta Q_Y = Q_{fY} - Q_{iY}$ $= -2 \times 10^{-6} - (-9 \times 10^{-6})$ ✓ $= +7 \times 10^{-6}$ C $n_{transferred} = \frac{Q}{e}$ ✓ $= \frac{7 \times 10^{-6}}{1{,}6 \times 10^{-19}}$ ✓ $= 4{,}375 \times 10^{13}$ electrons ✓	
	OPTION 3	**OPTION 3**	
	$n_{iX} = \frac{Q_{iX}}{e}$ ✓ $= \frac{5 \times 10^{-6}}{1{,}6 \times 10^{-19}}$ ✓ $= 3{,}125 \times 10^{13}$ electrons $n_{fX} = \frac{Q_{fX}}{e}$ $= \frac{-2 \times 10^{-6}}{-1{,}6 \times 10^{-19}}$ ✓ $= 1{,}25 \times 10^{13}$ electrons $n_{transfer} = \underline{3{,}125 \times 10^{13} + 1{,}25 \times 10^{13}}$ ✓ $= 4{,}375 \times 10^{13}$ electrons ✓	$n_{iY} = \frac{Q_{iY}}{e}$ ✓ $= \frac{-9 \times 10^{-6}}{-1{,}6 \times 10^{-19}}$ ✓ $= 5{,}625 \times 10^{13}$ electrons $n_{fY} = \frac{Q_{fY}}{e}$ $= \frac{-2 \times 10^{-6}}{-1{,}6 \times 10^{-19}}$ ✓ $= 1{,}25 \times 10^{13}$ electrons $n_{trans} = \underline{5{,}625 \times 10^{13} - 1{,}25 \times 10^{13}}$ ✓ $= 4{,}375 \times 10^{13}$ electrons ✓	(5) **[16]**

QUESTION 3

3.1 The (electrostatic) force experienced per unit positive charge ✓placed at that point✓. **(2)**

3.2



Criteria for sketch	**Marks**
Correct shape as shown.	✓
Direction away from positive	✓
Field lines start on spheres and do not cross for correct diagram.	✓

(3)

3.3

$E_1 = \frac{kQ_1}{r^2}$ ✓

$= \frac{(9x10^9)(2{,}5\ x\ 10^{-6})}{(0{,}3)^2}$ ✓

= 250 000 N·C^{-1} to the right

$E_2 = \frac{kQ_2}{r^2}$

$= \frac{(9x10^9)(6\ x\ 10^{-6})}{(1{,}3)^2}$ ✓

= 31 952,66272 N·C^{-1} to the left

$E_{net,P} = E_1 - E_2$

= <u>250 000 – 31 952,66272</u> ✓

= 218 047,3373 (218 047,34) N·C^{-1} ✓ to the <u>right / eastwards</u> ✓

(5)

[10]

QUESTION 4

4.1.1	The temperature ✓at which the vapour pressure of a substance equals atmospheric pressure✓.	(2)
4.1.2	The boiling point increases from **A** to **C**.	(2)
4.1.3	• Molecular mass increases from **A to C**.✓ • Strength of the London forces /Dispersion forces/Induced dipole forces✓ increases. ✓	(3)
4.1.4	**A** (CH_4) ✓ Methane (CH_4/A) has lowest boiling point. ✓	(2)
4.2.1	34 $g{\cdot}mol^{-1}$	(1)
4.2.2	• Between molecules of phospine (PH_3) are London forces. ✓ • Between molecules of ammonia (NH_3) are hydrogen bonds (in addition to London forces) ✓ • The intermolecular forces (hydrogen bond) in $NH_3$are stronger than (London forces) in PH_3 . ✓ OR • More energy is needed to overcome the intermolecular forces in NH_3 than in PH_3. ✓	(3) **[14]**

QUESTION 5

5.1.1	Smallest whole number ratio of elements that make up the substance. ✓✓		(2)
5.1.2	**OPTION 1** $n(CO_2) = \frac{m}{M}$ ✓ $= \frac{47,1}{44}$ ✓ $= 1,07\ mol$ $n(C) = n(CO_2)$✓ $= 1,07$ mol $n(H_2O) = \frac{m}{M}$ $= \frac{19,35}{18}$ ✓ $= 1,075\ mol$ $n(H) = 2n(H_2O)$ $= (2)(1,075)$ ✓ $= 2,15$ mol Molar ratio = C : H	**OPTION 2** %H in H_2O $= \frac{2}{18} x\ 100$ ✓ $= 11,11\%$ m(H) in H_2O $= \frac{11,11}{100} x\ 19,35$ ✓ $= 2,15$ g %C in CO_2 $= \frac{12}{44} x\ 100$ ✓ $= 27,27\%$ m(C) in CO_2 $= \frac{27,27}{100} x\ 47,1$ ✓ $= 12,84$ g mol C: mol H	

	1,07 : 2,15 1 : 2✓ Empirical formula: CH_2✓	$\frac{12,84}{12}$: $\frac{2,15}{1}$ ✓ 1,07 : 2,15 1:2✓ Empirical formula: CH_2✓	(7)
5.1.3	M(CH2) = 1(12) + 2(1) = 14 g·mol^{-1} M(true formula)/M(emperical formula) 28/14 = 2✓ C_2H_4 x = 2 and y = 4✓		(2)
5.2.1	Substance that is used up completely during a reaction. ✓✓		(2)
5.2.2	$n(Fe_2O_3) = \frac{m}{M}$ ✓ $= \frac{8}{160}$✓ = 0,05 mol $n(Al) = \frac{m}{M}$ $= \frac{3,8}{27}$ ✓ = 0,14 mol Iron (III) oxide[(Fe_2O_3)] is the limiting reagent ✓		(4)
5.2.3	n(Fe) = 2n(Fe_2O_3) = 2 (0,05) ✓ = 0,1 mol m = nM = (0,1)(56) ✓ = 5,6 g $Percentage yield = \frac{4,76}{5,6} x\ 100$✓ = 85 % ✓  		(4)

5.3	OPTION 1	OPTION 2	(1)
	$c = \frac{m}{MV}$ ✓ $= \frac{3,36}{(56)(0,25)}$ ✓ = 0,24 mol·dm^{-3}✓	$n = \frac{m}{M}$ $= \frac{3,36}{56}$ ✓ = 0,06 mol $c = \frac{n}{V}$ $= \frac{0,06}{0,25}$ ✓ = = 0,24 mol·dm^{-3}✓	(3)
5.4.1	H_2SO_4 (aq) + 2KOH (aq) ⟶ K_2SO_4 (aq) + $2H_2O$ (ℓ) ✓✓		(2)
5.4.2	n(KOH) = cV = (0,25)(0,025) ✓ = 0,00625 mol n(H_2SO_4) = $\frac{1}{2}$n(KOH) = $\frac{1}{2}$(0,00625) ✓ = 0,003125 mol n(H_2SO_4) = nM✓ = (0,003125)(98) ✓ = 0,31 g ✓		(5) **[29]**
		TOTAL:	**75**