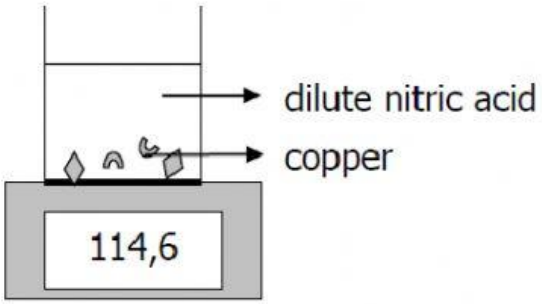
Question 6

Sarah wants to investigate the rate at which a reaction proceeds and places a beaker containing dilute nitric acid on a sensitive balance in a fume cupboard. She drops a few pieces of copper metal into the beaker. Mass readings of the beaker and contents are recorded every 15s, from the moment the copper metal is dropped into the acid until there is no more copper metal present.



The following results are obtained:

time (s)	mass of beaker and contents (g)	decrease in mass (g)
0	114,6	0,0
15	114,0	0,6
30	112,4	2,2
45	110,4	4,2
60	109,4	5,2
75	108,7	5,9
90	108,4	6,2
105	108,3	6,3
120	108,3	6,3
135	108,3	6,3
150	108,3	6,3

The reaction that occurs is represented by the following equation:

$$Cu(s) + 4HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2NO(g) + 2H_2O(l) \quad \Delta H > 0$$

6.1 Why does the mass of the beaker and contents DECREASE?
(Choose ALL reasons that are true for this reaction.) (2)

The copper is used up during the course of the reaction.

It is not a closed system.

The mass of the products is less than the mass of the reactants.

The gas produced is lost to the atmosphere.

6.2 Use the values in the table and calculate the average rate in $g.s^{-1}$ for the whole 150 s of the reaction.

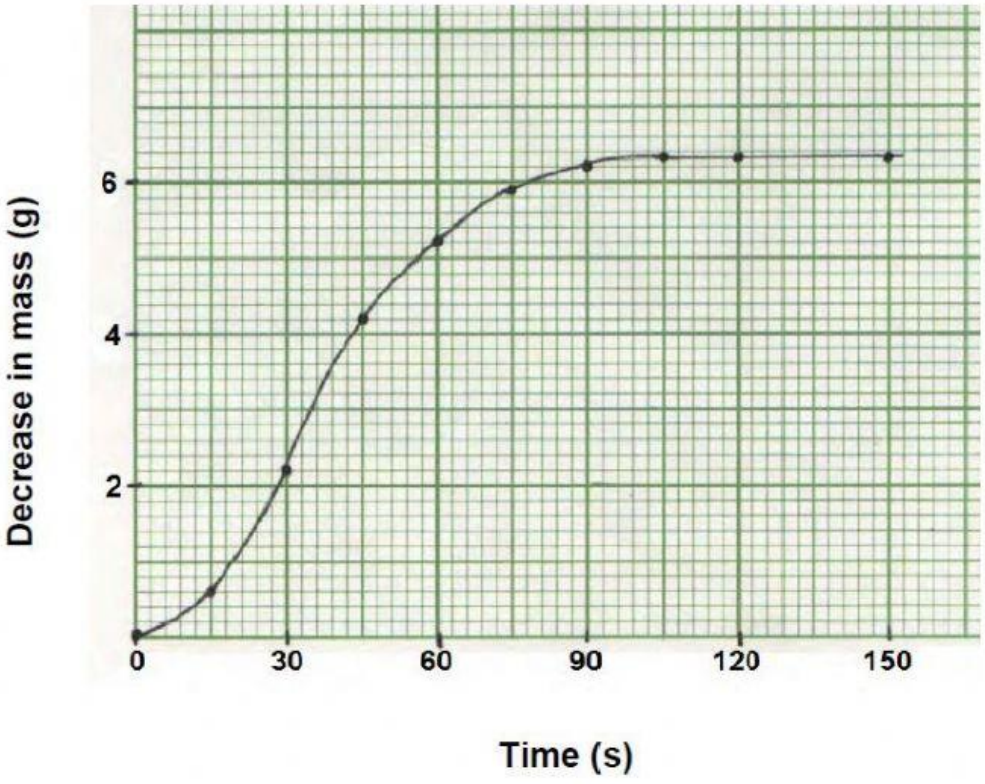
Average rate = $\frac{\Delta \_\_\_\_\_}{\Delta}$ (write the formula in words)

(show your workings below and leave no spaces between numbers and signs)

= _____

= $g \cdot s^{-1}$ (5)

Consider the graph below of *Decrease in mass* versus *Time*:



6.3 Explain using collision theory key words why the rate of reaction DECREASES between 45 s and 105 s. **(The mark allocation should guide you in terms of how many options to choose)**

(4)

Temperature has decreased.

Concentration of reactant has decreased.

Due to this change, the number of particles per unit volume decreased.

Due to this change, the kinetic energy of the particles decreased.

Due to this change, the activation energy of the reaction is lowered.

This causes particles to move less.

This causes fewer collisions to occur.

This results in less particles having sufficient energy to react.

Thus fewer effective collisions occur per unit time, resulting in a decrease in
reaction rate.

[11]

Question 7

The grade 12 teacher investigates one of the factors that affect the rate of reaction.

In **Experiment 1**, 5 g zinc granules are added to 50 cm^3 of 0,3 $mol.dm^{-3}$ hydrochloric acid.
In **Experiment 2**, 5 g zinc powder is added to 50 cm^3 of 0,3 $mol.dm^{-3}$ hydrochloric acid.

$HCl + Zn \rightarrow ZnCl_2 + H_2$

For both experiments the volume of hydrogen gas produced is measured every 10 seconds.

7.1 Name the factor affecting the rate of reaction that is being investigated here. (1)

(2 words)

7.2 List FOUR controlled variables in this reaction. (4)

(fill in the missing words)

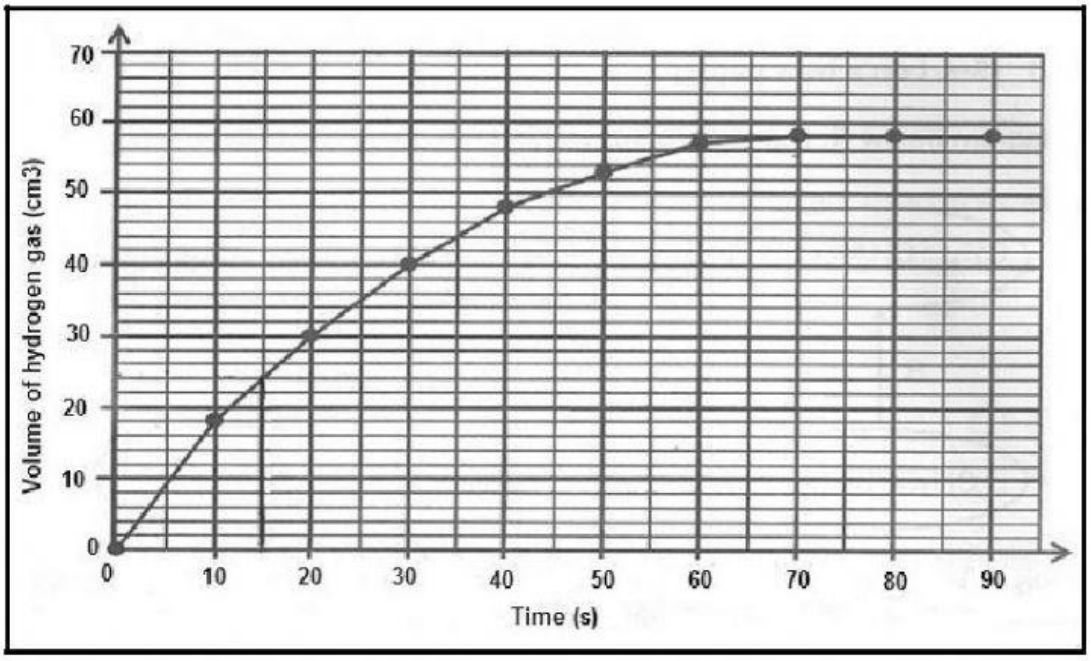
_____of zinc (1 word)

_____of acid (1 word)

_____ of acid (1 word)

_____ (1 word)

The teacher asks learners to draw the graph using the results obtained in **Experiment 1**. The learners use the results in **Experiment 1** to draw the graph below:



7.3 How will the average rate of the reaction in **Experiment 2** compare with that in **Experiment 1**?

GREATER THAN, LESS THAN or EQUAL TO. (1)

7.4 Choose the appropriate key words from the collision theory to explain your answer in QUESTION 7.4. (4)

Concentration of a reactant has decreased.

Concentration of a reactant has increased.

Particle size has decreased.

Particle size has increased.

Due to this change, the surface area of the reactant has increased.

Due to this change, the surface area of the reactant has decreased.

Thus, the number of particles per unit volume decreased.

Thus, the number of particles per unit volume increased.

This caused fewer collisions to occur.

This caused more collisions to occur.

Thus fewer effective collisions occurred per unit time, resulting in a decrease in reaction rate.

Thus more effective collisions occurred per unit time, resulting in an increase in reaction rate.

[15]

Question 8

TOTAL = 64

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)

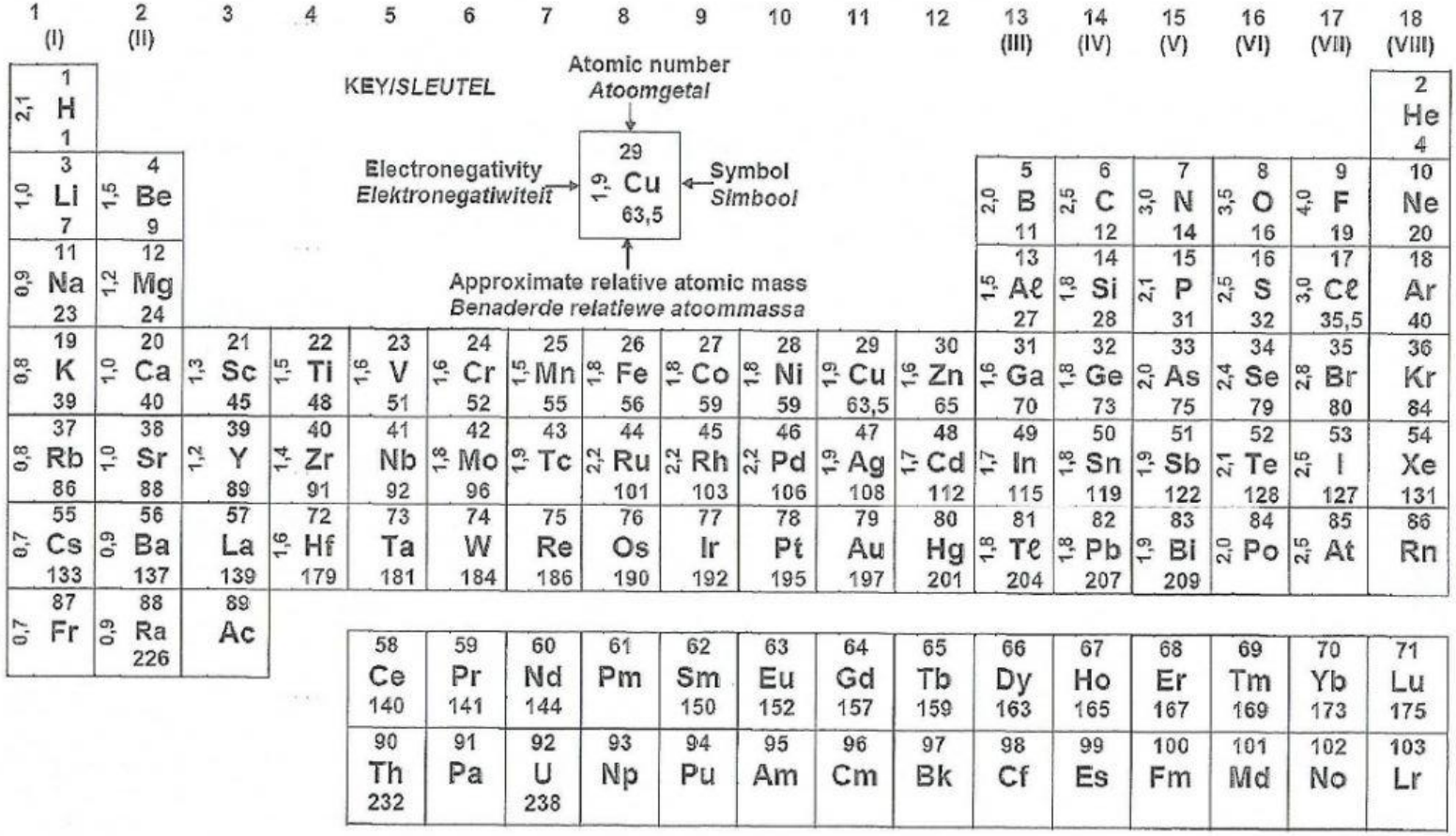
TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
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
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}$ C
Avogadro's constant *Avogadro-konstante*	N_A	$6{,}02 \times 10^{23}$ mol^{-1}

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at/*by* 298 K	
$E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ / $E^\theta_{sel} = E^\theta_{katode} - E^\theta_{anode}$ or/*of* $E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ / $E^\theta_{sel} = E^\theta_{reduksie} - E^\theta_{oksidasie}$ or/*of* $E^\theta_{cell} = E^\theta_{oxidising\ agent} - E^\theta_{reducing\ agent}$ / $E^\theta_{sel} = E^\theta_{oksideermiddel} - E^\theta_{reduseermiddel}$	

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)
2,1 H 1																	2 He 4
1,0 Li 7	1,5 Be 9											2,0 B 11	2,5 C 12	3,0 N 14	3,5 O 16	4,0 F 19	10 Ne 20
0,9 Na 23	1,2 Mg 24											1,5 Aℓ 27	1,8 Si 28	2,1 P 31	2,5 S 32	3,0 Cℓ 35,5	18 Ar 40
0,8 K 39	1,0 Ca 40	1,3 Sc 45	1,5 Ti 48	1,6 V 51	1,6 Cr 52	1,5 Mn 55	1,8 Fe 56	1,8 Co 59	1,8 Ni 59	1,9 Cu 63,5	1,6 Zn 65	1,6 Ga 70	1,8 Ge 73	2,0 As 75	2,4 Se 79	2,8 Br 80	36 Kr 84
0,8 Rb 86	1,0 Sr 88	1,2 Y 89	1,4 Zr 91	41 Nb 92	1,8 Mo 96	1,9 Tc	2,2 Ru 101	2,2 Rh 103	2,2 Pd 106	1,9 Ag 108	1,7 Cd 112	1,7 In 115	1,8 Sn 119	1,9 Sb 122	2,1 Te 128	2,5 I 127	54 Xe 131
0,7 Cs 133	0,9 Ba 137	57 La 139	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	1,8 Tℓ 204	1,8 Pb 207	1,9 Bi 209	2,0 Po	2,5 At	86 Rn
0,7 Fr	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