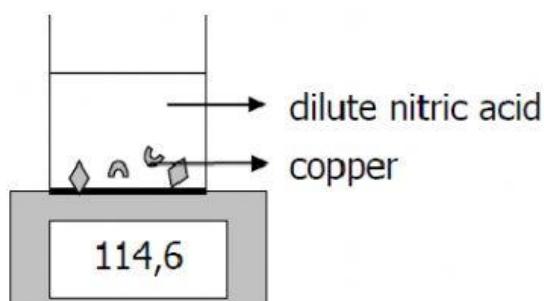


Question 6

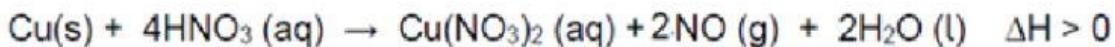
Sarah wants to investigate the rate at which a reaction proceeds and places a beaker containing dilute nitric acid on a sensitive balance in a fume cupboard. She drops a few pieces of copper metal into the beaker. Mass readings of the beaker and contents are recorded every 15s, from the moment the copper 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:



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.

$$\text{Average rate} = \frac{\Delta \text{mass}}{\Delta \text{time}} \quad (\text{write the formula in words})$$

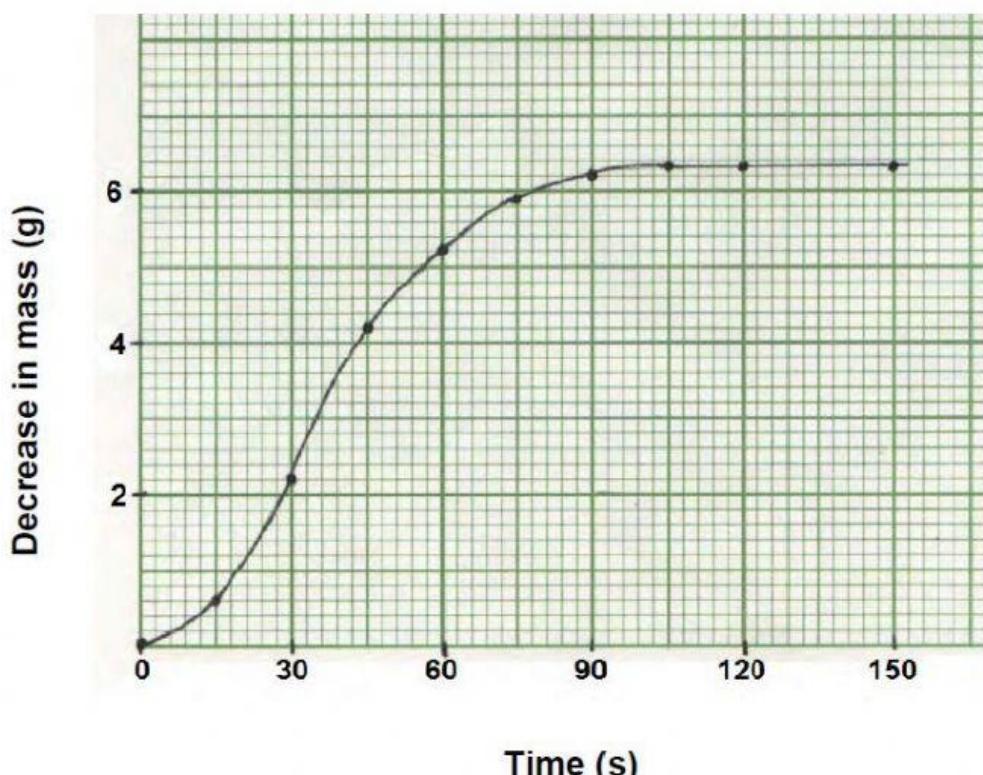
(show your workings below and leave no spaces between numbers and signs)

$$= \text{_____}$$

$$= \text{_____} \text{ g.s}^{-1}$$

(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 cm³ of 0,3 mol.dm⁻³ hydrochloric acid.
In **Experiment 2**, 5 g zinc powder is added to 50 cm³ of 0,3 mol.dm⁻³ hydrochloric acid.



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)

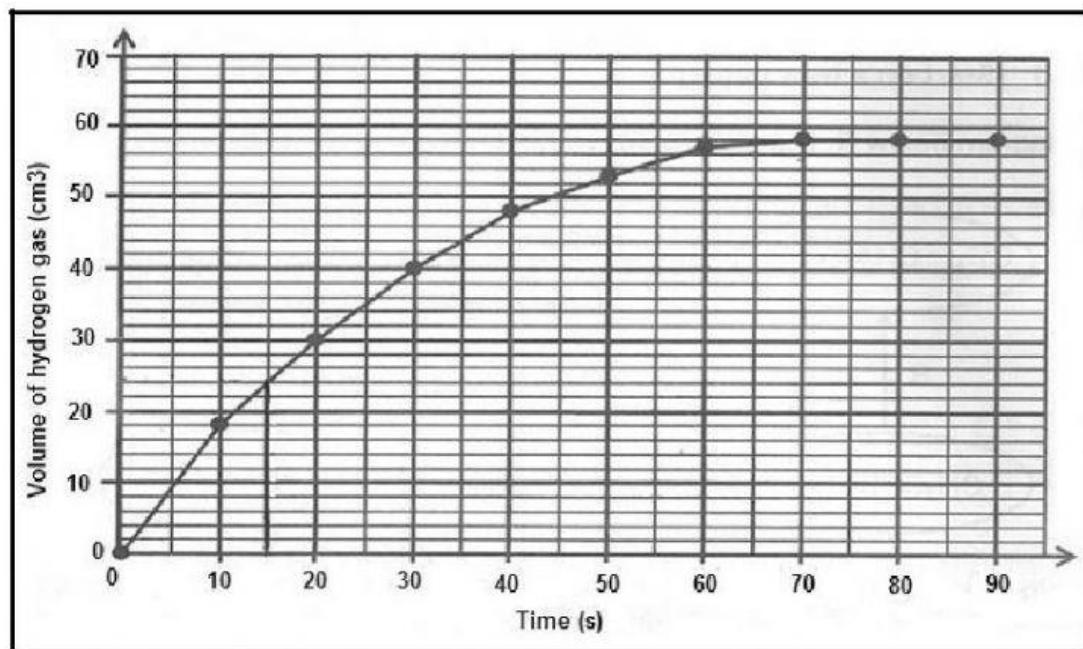
_____ of zinc (1 word)

_____ 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 <i>Standaarddruk</i>	p^\ominus	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molære gasvolume by STD</i>	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T^\ominus	273 K
Charge on electron <i>Lading op elektron</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Avogadro's constant <i>Avogadro-konstante</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$
$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14} \text{ at/by 298 K}$	
$E_{\text{cell}}^\ominus = E_{\text{cathode}}^\ominus - E_{\text{anode}}^\ominus / E_{\text{sel}}^\ominus = E_{\text{katode}}^\ominus - E_{\text{anode}}^\ominus$	
or/of	
$E_{\text{cell}}^\ominus = E_{\text{reduction}}^\ominus - E_{\text{oxidation}}^\ominus / E_{\text{sel}}^\ominus = E_{\text{reduksie}}^\ominus - E_{\text{oksidasie}}^\ominus$	
or/of	
$E_{\text{cell}}^\ominus = E_{\text{oxidising agent}}^\ominus - E_{\text{reducing agent}}^\ominus / E_{\text{sel}}^\ominus = E_{\text{oksideermiddel}}^\ominus - E_{\text{reduseermiddel}}^\ominus$	

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)	
1 H	2,1 Li	3 Be	4 B	5 C	6 N	7 O	8 F	9 Ne	10 Ar	11 Kr	12 Xe	13 Rn	14 He	15 Ne	16 Ar	17 Kr	18 Xe	
11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Br	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	
23 Na	24 Mg	25 Al	26 Si	27 P	28 S	29 Cl	30 Br	31 K	32 Ca	33 Sc	34 Ti	35 V	36 Cr	37 Mn	38 Fe	39 Co	40 Ni	
39 K	40 Ca	41 Sc	42 Ti	43 V	44 Cr	45 Mn	46 Fe	47 Co	48 Ni	49 Cu	50 Zn	51 Ga	52 Ge	53 As	54 Se	55 Br	56 Kr	
49 Cu	50 Zn	51 Ga	52 Ge	53 As	54 Se	55 Br	56 Kr	57 Rb	58 Sr	59 Y	60 Zr	61 Nb	62 Mo	63 Tc	64 Ru	65 Rh	66 Pd	
57 Rb	58 Sr	59 Y	60 Zr	61 Nb	62 Mo	63 Tc	64 Ru	65 Rh	66 Pd	67 Ag	68 Cd	69 In	70 Sn	71 Sb	72 Te	73 I	74 Xe	
65 Ag	66 Cd	67 In	68 Sn	69 Sb	70 Te	71 I	72 Xe	73 Fr	74 Ra	75 Ac	76 Rf	77 Pa	78 Np	79 Pu	80 Am	81 Cm	82 Bk	
74 Fr	75 Ra	76 Ac	77 Rf	78 Pa	79 Np	80 Pu	81 Am	82 Cm	83 Bk	84 Cf	85 Es	86 Fm	87 Md	88 No	89 Lr	90 Th	91 Pa	
86 Fm	87 Md	88 No	89 Lr	90 Th	91 Pa	92 Np	93 Pu	94 Am	95 Cm	96 Bk	97 Cf	98 Es	99 Fm	100 Md	101 No	102 Lr	103 Th	104 Pa
98 Es	99 Fm	100 Md	101 No	102 Lr	103 Th	104 Pa	105 Np	106 Pu	107 Am	108 Cm	109 Bk	110 Cf	111 Es	112 Fm	113 Md	114 No	115 Lr	116 Th
105 Es	106 Fm	107 Md	108 No	109 Lr	110 Th	111 Pa	112 Np	113 Pu	114 Am	115 Cm	116 Bk	117 Cf	118 Es	119 Fm	120 Md	121 No	122 Lr	123 Th
115 Es	116 Fm	117 Md	118 No	119 Lr	120 Th	121 Pa	122 Np	123 Pu	124 Am	125 Cm	126 Bk	127 Cf	128 Es	129 Fm	130 Md	131 No	132 Lr	133 Th
125 Es	126 Fm	127 Md	128 No	129 Lr	130 Th	131 Pa	132 Np	133 Pu	134 Am	135 Cm	136 Bk	137 Cf	138 Es	139 Fm	140 Md	141 No	142 Lr	143 Th
134 Es	135 Fm	136 Md	137 No	138 Lr	139 Th	140 Pa	141 Np	142 Pu	143 Am	144 Cm	145 Bk	146 Cf	147 Es	148 Fm	149 Md	150 No	151 Lr	152 Th
144 Es	145 Fm	146 Md	147 No	148 Lr	149 Th	150 Pa	151 Np	152 Pu	153 Am	154 Cm	155 Bk	156 Cf	157 Es	158 Fm	159 Md	160 No	161 Lr	162 Th
154 Es	155 Fm	156 Md	157 No	158 Lr	159 Th	160 Pa	161 Np	162 Pu	163 Am	164 Cm	165 Bk	166 Cf	167 Es	168 Fm	169 Md	170 No	171 Lr	172 Th
164 Es	165 Fm	166 Md	167 No	168 Lr	169 Th	170 Pa	171 Np	172 Pu	173 Am	174 Cm	175 Bk	176 Cf	177 Es	178 Fm	179 Md	180 No	181 Lr	182 Th
174 Es	175 Fm	176 Md	177 No	178 Lr	179 Th	180 Pa	181 Np	182 Pu	183 Am	184 Cm	185 Bk	186 Cf	187 Es	188 Fm	189 Md	190 No	191 Lr	192 Th
184 Es	185 Fm	186 Md	187 No	188 Lr	189 Th	190 Pa	191 Np	192 Pu	193 Am	194 Cm	195 Bk	196 Cf	197 Es	198 Fm	199 Md	200 No	201 Lr	202 Th
194 Es	195 Fm	196 Md	197 No	198 Lr	199 Th	200 Pa	201 Np	202 Pu	203 Am	204 Cm	205 Bk	206 Cf	207 Es	208 Fm	209 Md	210 No	211 Lr	212 Th
204 Es	205 Fm	206 Md	207 No	208 Lr	209 Th	210 Pa	211 Np	212 Pu	213 Am	214 Cm	215 Bk	216 Cf	217 Es	218 Fm	219 Md	220 No	221 Lr	222 Th
214 Es	215 Fm	216 Md	217 No	218 Lr	219 Th	220 Pa	221 Np	222 Pu	223 Am	224 Cm	225 Bk	226 Cf	227 Es	228 Fm	229 Md	230 No	231 Lr	232 Th