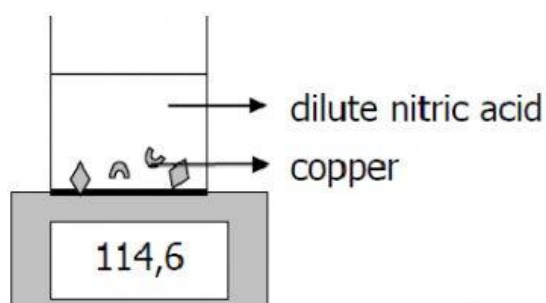


### Question 6

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.

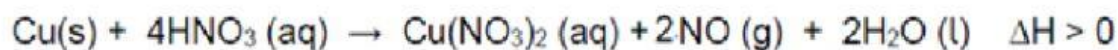
She drops a few pieces of copper metal into the beaker. Mass readings of the beaker and contents are recorded every 15s, from the moment the copper metal is dropped into the acid until there is no more copper metal present.



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  $\text{g}\cdot\text{s}^{-1}$  for the whole 150 s of the reaction.

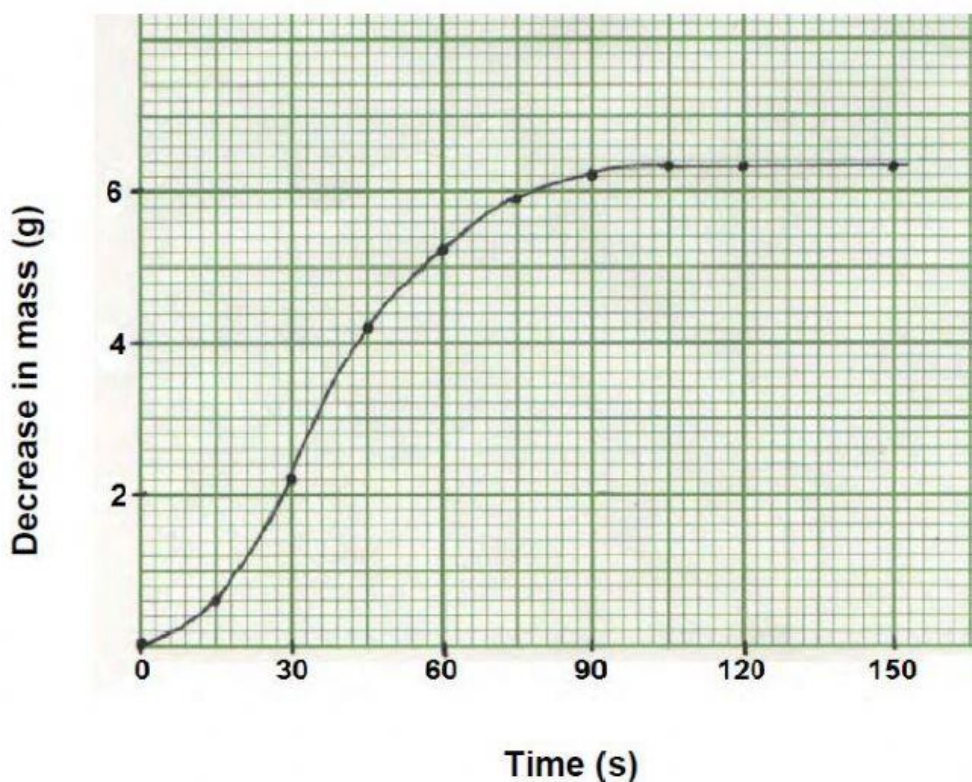
Average rate =  $\frac{\Delta}{\Delta}$  (write the formula in words)

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

=

=  $\text{g}\cdot\text{s}^{-1}$  (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<sup>3</sup> of 0,3 mol.dm<sup>-3</sup> hydrochloric acid.  
In **Experiment 2**, 5 g zinc powder is added to 50 cm<sup>3</sup> of 0,3 mol.dm<sup>-3</sup> 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)

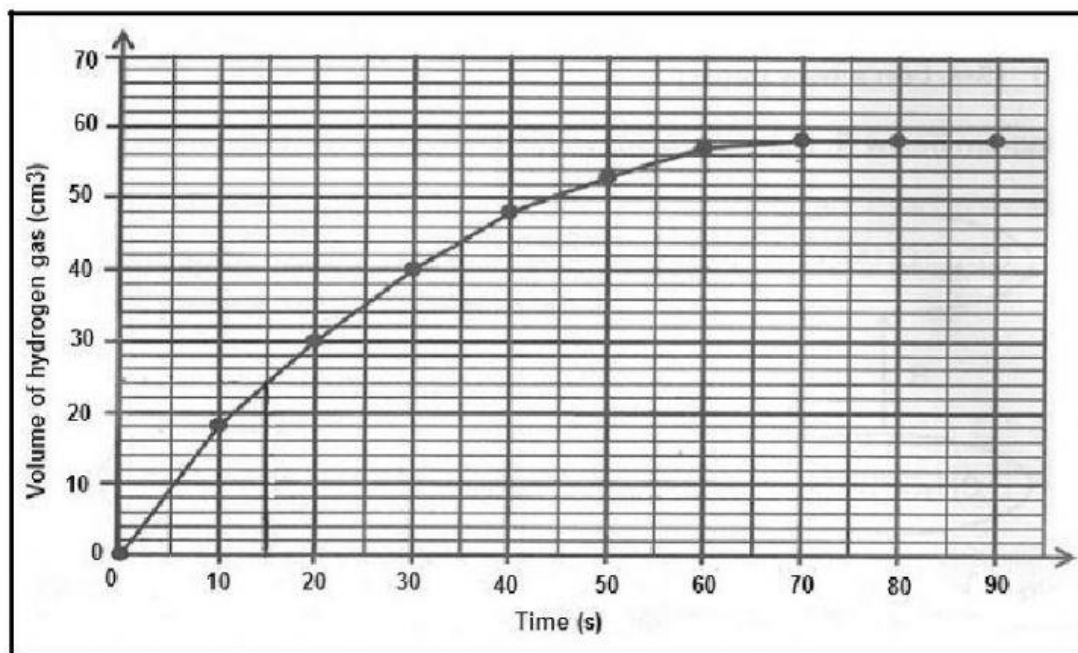
\_\_\_\_\_ of zinc (1 word)

\_\_\_\_\_ 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 FISIIESE WETENSKAPPE GRAAD 12  
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIIESE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Standard pressure <i>Standaarddruk</i>	$p^{\theta}$	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	$V_m$	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	$T^{\theta}$	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 $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$
$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14} \text{ at/by } 298 \text{ K}$	
$E_{\text{cell}}^{\theta} = E_{\text{cathode}}^{\theta} - E_{\text{anode}}^{\theta} / E_{\text{sel}}^{\theta} = E_{\text{katode}}^{\theta} - E_{\text{anode}}^{\theta}$  or/of $E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta} / E_{\text{sel}}^{\theta} = E_{\text{reduksie}}^{\theta} - E_{\text{oksidasie}}^{\theta}$  or/of $E_{\text{cell}}^{\theta} = E_{\text{oxidising agent}}^{\theta} - E_{\text{reducing agent}}^{\theta} / E_{\text{sel}}^{\theta} = E_{\text{oksideermiddel}}^{\theta} - E_{\text{reduseermiddel}}^{\theta}$	

**TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE**

		KEY/SLEUTEL																							
		Atomic number Atoomgetal																							
		Symbol Simbool																							
		Electronegativity Elektronegativiteit																							
		Approximate relative atomic mass Benaderde relatieve atoommassa																							
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	He	3	Li	4	Be	5	B	6	C	7	N	8	O	9	F	10	Ne	11	Na	12	Mg	13	Al
14	Si	15	P	16	S	17	Cl	18	Ar	19	K	20	Ca	21	Sc	22	Ti	23	V	24	Cr	25	Mn	26	Fe
27	Co	28	Ni	29	Cu	30	Zn	31	Ga	32	Ge	33	As	34	Se	35	Br	36	Kr	37	Rb	38	Sr	39	Y
41	Nb	42	Mo	43	Tc	44	Ru	45	Rh	46	Pd	47	Ag	48	Cd	49	In	50	Sn	51	Sb	52	Te	53	I
55	Cs	56	Ba	57	La	58	Ce	59	Pr	60	Nd	61	Pm	62	Sm	63	Eu	64	Gd	65	Tb	66	Dy	67	Ho
69	Er	70	Yb	71	Lu	72	Hf	73	Ta	74	W	75	Re	76	Os	77	Ir	78	Pt	79	Au	80	Hg	81	Tl
83	Bi	84	Po	85	At	86	Rn	87	Fr	88	Ra	89	Ac	90	Th	91	Pa	92	U	93	Np	94	Pu	95	Am
97	Bk	98	Cf	99	Es	100	Fm	101	Md	102	No	103	Lr	104	La	105	Ce	106	Pr	107	Nd	108	Pm	109	Sm
110	Eu	111	Gd	112	Tb	113	Dy	114	Ho	115	Er	116	Yb	117	Lu	118	Hf	119	Ta	120	W	121	Re	122	Os
123	Ir	124	Pt	125	Au	126	Hg	127	Tl	128	Pb	129	Bi	130	Po	131	At	132	Rn	133	Fr	134	Ra	135	Ac
136	Th	137	Pa	138	U	139	Np	140	Pu	141	Am	142	Cm	143	Bk	144	Cf	145	Es	146	Fm	147	Md	148	No
149	Lr	150	La	151	Ce	152	Pr	153	Nd	154	Pm	155	Sm	156	Eu	157	Gd	158	Tb	159	Dy	160	Ho	161	Er
162	Yb	163	Lu	164	Hf	165	Ta	166	W	167	Re	168	Os	169	Ir	170	Pt	171	Au	172	Hg	173	Tl	174	Pb
175	Bi	176	Po	177	At	178	Rn	179	Fr	180	Ra	181	Ac	182	Th	183	Pa	184	U	185	Np	186	Pu	187	Am
188	Cm	189	Bk	190	Cf	191	Es	192	Fm	193	Md	194	No	195	Lr	196	La	197	Ce	198	Pr	199	Nd	200	Pm
201	Sm	202	Eu	203	Gd	204	Tb	205	Dy	206	Ho	207	Er	208	Yb	209	Lu	210	Hf	211	Ta	212	W	213	Re
214	Os	215	Ir	216	Pt	217	Au	218	Hg	219	Tl	220	Pb	221	Bi	222	Po	223	At	224	Rn	225	Fr	226	Ra
227	Ac	228	Th	229	Pa	230	U	231	Np	232	Pu	233	Am	234	Cm	235	Bk	236	Cf	237	Es	238	Fm	239	Md
240	No	241	Lr	242	La	243	Ce	244	Pr	245	Nd	246	Pm	247	Sm	248	Eu	249	Gd	250	Tb	251	Dy	252	Ho
255	Er	256	Yb	257	Lu	258	Hf	259	Ta	260	W	261	Re	262	Os	263	Ir	264	Pt	265	Au	266	Hg	267	Tl
269	Pb	270	Bi	271	Po	272	At	273	Rn	274	Fr	275	Ra	276	Ac	277	Th	278	Pa	279	U	280	Np	281	Pu
282	Am	283	Cm	284	Bk	285	Cf	286	Es	287	Fm	288	Md	289	No	290	Lr	291	La	292	Ce	293	Pr	294	Nd
295	Pm	296	Sm	297	Eu	298	Gd	299	Tb	300	Dy	301	Ho	302	Er	303	Yb	304	Lu	305	Hf	306	Ta	307	W
309	Re	310	Os	311	Ir	312	Pt	313	Au	314	Hg	315	Tl	316	Pb	317	Bi	318	Po	319	At	320	Rn	321	Fr
322	Ra	323	Ac	324	Th	325	Pa	326	U	327	Np	328	Pu	329	Am	330	Cm	331	Bk	332	Cf	333	Es	334	Fm
335	Md	336	No	337	Lr	338	La	339	Ce	340	Pr	341	Nd	342	Pm	343	Sm	344	Eu	345	Gd	346	Tb	347	Dy
349	Ho	350	Er	351	Yb	352	Lu	353	Hf	354	Ta	355	W	356	Re	357	Os	358	Ir	359	Pt	360	Au	361	Hg
363	Tl	364	Pb	365	Bi	366	Po	367	At	368	Rn	369	Fr	370	Ra	371	Ac	372	Th	373	Pa	374	U	375	Np
376	Pu	377	Am	378	Cm	379	Bk	380	Cf	381	Es	382	Fm	383	Md	384	No	385	Lr	386	La	387	Ce	388	Pr
389	Nd	390	Pm	391	Sm	392	Eu	393	Gd	394	Tb	395	Dy	396	Ho	397	Er	398	Yb	399	Lu	400	Hf	401	Ta
403	W	404	Re	405	Os	406	Ir	407	Pt	408	Au	409	Hg	410	Tl	411	Pb	412	Bi	413	Po	414	At	415	Rn
416	Fr	417	Ra	418	Ac	419	Th	420	Pa	421	U	422	Np	423	Pu	424	Am	425	Cm	426	Bk	427	Cf	428	Es
429	Fm	430	Md	431	No	432	Lr	433	La	434	Ce	435	Pr	436	Nd	437	Pm	438	Sm	439	Eu	440	Gd	441	Tb
443	Dy	444	Ho	445	Er	446	Yb	447	Lu	448	Hf	449	Ta	450	W	451	Re	452	Os	453	Ir	454	Pt	455	Au
457	Hg	458	Tl	459	Pb	460	Bi	461	Po	462	At	463	Rn	464	Fr	465	Ra	466	Ac	467	Th	468	Pa	469	U
470	Np	471	Pu	472	Am	473	Cm	474	Bk	475	Cf	476	Es	477	Fm	478	Md	479	No	480	Lr	481	La	482	Ce
483	Pr	484	Nd	485	Pm	486	Sm	487	Eu	488	Gd	489	Tb	490	Dy	491	Ho	492	Er	493	Yb	494	Lu	495	Hf
497	Ta	498	W	499	Re	500	Os	501	Ir	502	Pt	503	Au	504	Hg	505	Tl	506	Pb	507	Bi	508	Po	509	At
510	Rn	511	Fr	512	Ra	513	Ac	514	Th	515	Pa	516	U	517	Np	518	Pu	519	Am	520	Cm	521	Bk	522	Cf
523	Es	524	Fm	525	Md	526	No	527	Lr	528	La	529	Ce	530	Pr	531	Nd	532	Pm	533	Sm	534	Eu	535	Gd
537	Tb	538	Dy	539	Ho	540	Er	541	Yb	542	Lu	543	Hf	544	Ta	545	W	546	Re	547	Os	548	Ir	549	Pt
551	Au	552	Hg	553	Tl	554	Pb	555	Bi	556	Po	557	At	558	Rn	559	Fr	560	Ra	561	Ac	562	Th	563	Pa
565	U	566	Np	567	Pu	568	Am	569	Cm	570	Bk	571	Cf	572	Es	573	Fm	574	Md	575	No	576	Lr	577	La
579	Ce	580	Pr	581	Nd	582	Pm	583	Sm	584	Eu	585	Gd	586	Tb	587	Dy	588	Ho	589	Er	590	Yb	591	Lu
593	Hf	594	Ta	595	W	596	Re	597	Os	598	Ir	599	Pt	600	Au	601	Hg	602	Tl	603	Pb	604	Bi	605	Po
607	At	608	Rn	609	Fr	610	Ra	611	Ac	612	Th	613	Pa	614	U	615	Np	616	Pu	617	Am	618	Cm	619	Bk
620	Cf	621	Es	622	Fm	623	Md	624	No	625	Lr	626	La	627	Ce	628	Pr	629	Nd	630	Pm	631	Sm	632	Eu
634	Gd	635	Tb	636	Dy	637	Ho	638	Er	639	Yb	640	Lu	641	Hf	642	Ta	643	W	644	Re	645	Os	646	Ir
648	Pt	649	Au	650	Hg	651	Tl	652	Pb	653	Bi	654	Po	655	At	656	Rn	657	Fr	658	Ra	659	Ac	660	Th
662	Pa	663	U	664	Np	665	Pu	666	Am	667	Cm	668	Bk	669	Cf	670	Es	671	Fm	672	Md	673	No	674	Lr
676	La	677	Ce	678	Pr	679	Nd	680	Pm	681	Sm	682	Eu	683	Gd	684	Tb	685	Dy	686	Ho	687	Er	688	Yb
689	Lu	690	Hf	691	Ta	692	W	693	Re	694	Os	695	Ir	696	Pt	697	Au	698	Hg	699	Tl	700	Pb	701	Bi
702	Po	703	At	704	Rn	705	Fr	706	Ra	707	Ac	708	Th	709	Pa	710	U	711	Np	712	Pu	713	Am	714	Cm
716	Bk	717	Cf	718	Es	719	Fm	720	Md	721	No	722	Lr	723	La	724	Ce	725	Pr	726	Nd	727	Pm	728	Sm
729	Eu	730	Gd	731	Tb	732	Dy	733	Ho	734	Er	735	Yb	736	Lu	737	Hf	738	Ta	739	W	740	Re	741	Os
743	Ir	744	Pt	745	Au	746	Hg	747	Tl	748	Pb	749	Bi	750	Po	751	At	752	Rn	753	Fr	754	Ra	755	Ac
757	Th	758	Pa	759	U	760	Np	761	Pu	762	Am	763	Cm	764	Bk	765	Cf	766	Es	767	Fm	768	Md	769	No
770	Lr	771	La	772	Ce	773	Pr	774	Nd	775	Pm	776	Sm	777	Eu	778	Gd	779	Tb	780	Dy	781	Ho	782	Er
783	Yb	784	Lu	785	Hf	786	Ta	787	W	788	Re	789	Os	790	Ir	791	Pt	792	Au	793	Hg	794	Tl	795	Pb
796	Bi	797	Po	798	At	799	Rn	800	Fr	801	Ra	802	Ac	803	Th	804	Pa	805	U	806	Np	807	Pu	808	Am
809	Cm	810	Bk	811	Cf	812	Es	813	Fm	814	Md	815	No	816	Lr	817	La	818	Ce	819	Pr	820	Nd	821	Pm
822	Sm	823	Eu	824	Gd	825	Tb	826	Dy	827	Ho	828	Er	829	Yb	830	Lu	831	Hf	832	Ta	833	W	834	Re
836	Os	837	Ir	838	Pt	839	Au	840	Hg	841	Tl	842	Pb	843	Bi	844	Po	845	At	846	Rn	847	Fr	848	Ra
849	Ac	850	Th	851	Pa	852	U	853	Np	854	Pu	855	Am	856	Cm	857	Bk	858	Cf	859	Es	860	Fm	861	Md
862	No	863	Lr	864	La	865	Ce	866	Pr	867	Nd	868	Pm	869	Sm	870	Eu	871	Gd	872	Tb	873	Dy	874	Ho
875	Er	876	Yb	877	Lu	878	Hf	879	Ta	880	W														