Applecross Senior High School
AECHE 2017

Reaction Rates Investigation

Validation Test

Time: 55 minutes

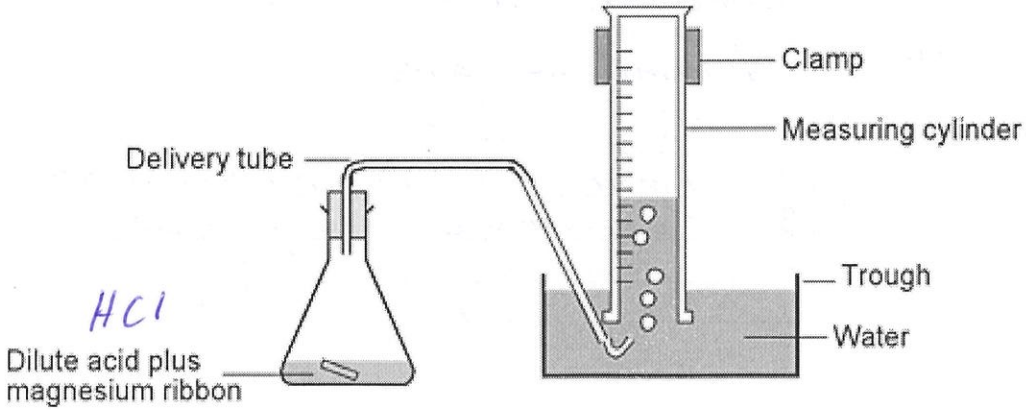
Name: Answer Key

Section	Possible Marks	Marks Scored
One	32	
Two	12	
Total	44	/44 = %

Section One [32 marks]

Read the following experimental procedure.

The equipment for the experiment was set up similarly to the diagram below.



1. A series of dilutions was performed in order to obtain the different concentrations.

HCl

Concentration of Acid ($MolL^{-1}$)	Volume of Acid (mL)	Volume of Water (mL)	Total Volume of Acid (mL)
2.0	8	0	8
1.5	6	2	8
1.0	4	4	8
0.5	2	6	8
0.0	0	8	8

2. One piece of 3cm long magnesium ribbon was used and then the volume of gas is collected was collected over a time period of 60 seconds.
3. Step two was repeated for each different acid concentrations stated in the table above.
4. The experiment was repeated three times.

Question 1:

Write a net ionic equation for the reaction in this experiment. (1 mark)

$2H^+_{(aq)} + Mg_{(s)} \rightarrow Mg^{2+}_{(aq)} + H_{2(g)}$

Question 2:

Write a hypothesis for this experiment. (1 mark)

As the concentration of the hydrochloric acid increases, the volume of gas produced will also increase

Question 3: (4 marks)

Complete the following table of variables for this investigation.

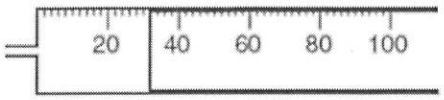
Independent Variable	Concentration of Acid (HCl)	(1)
Dependent Variable	Volume of gas	(1)
Controlled Variables (List 4)	1. Volume of Acid 2. Amount of Mg ribbon (mass) 3. Temperature (starting temp) 4. Surface Area of Mg	($\frac{1}{2}$) each

Reaction Time
Type of Acid
Type of Metal

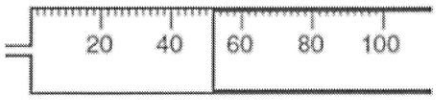
Question 4:

The diagrams below show the volumes of hydrogen gas that has been collected in a gas syringe. Use the diagrams to complete the table below for the first trial of the experiment.

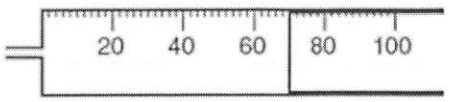
(a)



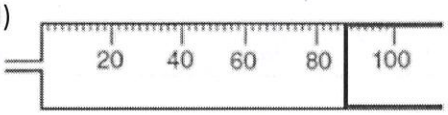
(b)



(c)



(d)

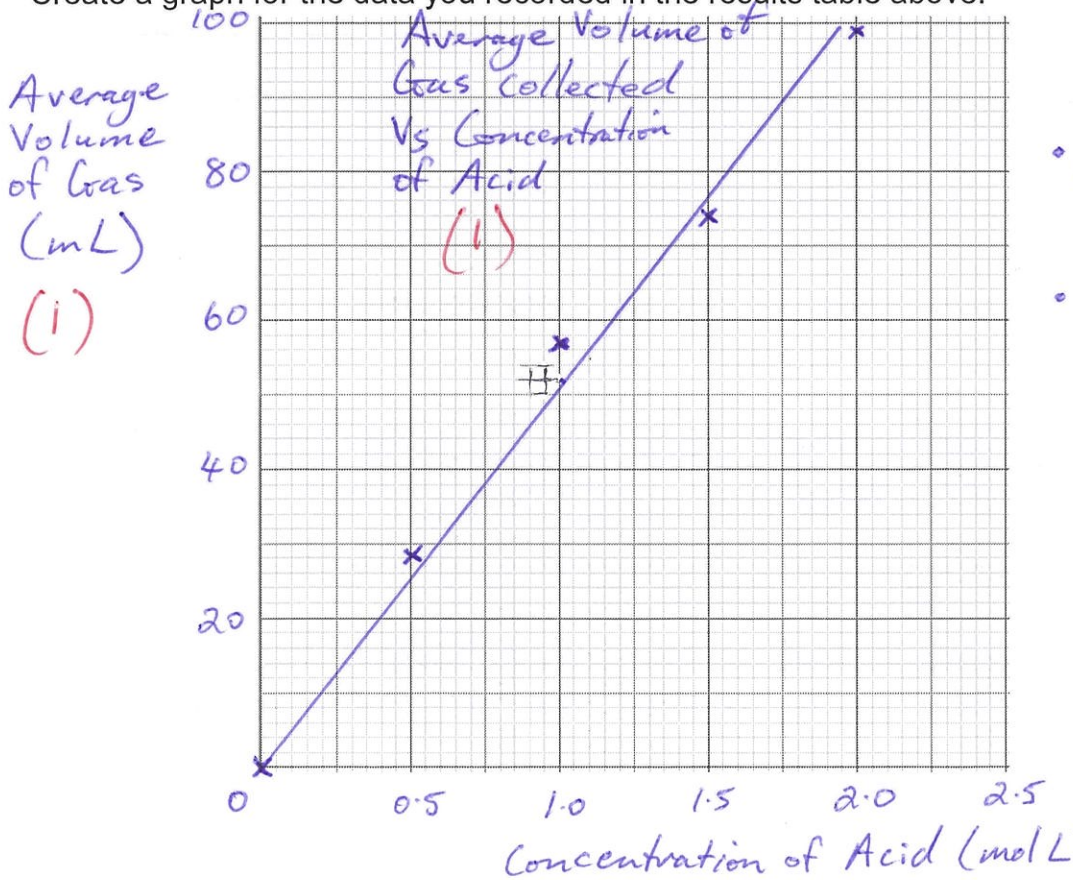


(1 mark)

Concentration of Acid ($molL^{-1}$)	Volume of Gas Trial 1 (mL)	Volume of Gas Trial 2 (mL)	Volume of Gas Trial 3 (mL)	Average Volume of Gas (mL)
2.0	(d) 88	98	110	98.7
1.5	(c) 70	79	73	74.0
1.0	(b) 52	54	64	56.7
0.5	(a) 32	28	24	28.0
0.0	0	0	0	0

i. Calculate the average volumes in the table above. (1 mark)

ii. Create a graph for the data you recorded in the results table above. (6 marks)



- points plotted accurately (2)
- line of best fit (1)

Question 5:

In question 3 there was a different method for collecting the gas. Could this create a systematic or random error? Would you expect this to change this to change the result you obtained and why?

(3 marks)

Systematic Error (1)

Yes, it could change the result. (1)

This could change the accuracy of the results in the 3rd trial in comparison to the 1st two trials. OR All measurements using the different method could be out by approx. the same. (1)

Question 6:

Use the graph to describe a trend for this experiment. (1 mark)

As the concentration of acid increased, the volume increased proportionately. (Straight line - linear relationship).

Question 7

Suggest one way you could increase the reliability of these results. (1 mark)

More trials

Question 8

Suggest two ways you could increase the accuracy of measurements in this experiment.

(2 marks)

- Measure concentration more accurately (careful doing dilutions using the most accurate equipment - volumetric flasks or appropiate measuring cylinders)
- Measure volume of gas more accurately
  - appropriate sized measuring cylinders to collect gas
  - consistancy of method for all trials to collect gas
  - make sure all air is removed from system before collecting gas

Question 9

Explain how you could improve the validity of these results. (1 mark)

Improve method - clean Mg ribbon well, make sure of accurate acid concentration before dilution, good procedure in collecting gas, etc

Question 10

Write a conclusion for this experiment. State whether your hypothesis was supported or not. (3 marks)

As the concentration increases the volume of gas increases.
Yes, this supports the hypothesis.

Question 11

Use your knowledge of the Collision Theory and Reaction Rates to explain your conclusion. (3 marks)

An increased concentration of acid increases the number of H^+ ions in the solution (1) More H^+ ions means more collisions with the Mg (1) More collisions means more gas produced (1)

Question 12

Suggest two additional ways you could increase the Reaction Rate of this experiment. Explain your ideas using your knowledge of Collision Theory and Reaction Rate. (4 marks)

Increase Temperature - particles of H^+ ions move faster so collisions occur more often to speed up the reaction. (OR more H^+ ions have energy above activation energy)
Increase Surface Area of Solid (Mg)
- cut up Mg to small pieces increases the surface area for collisions with H^+ ions → more collisions → faster reaction

SECTION TWO [12 marks]

Question 13

Compare and contrast the three experiments in the table below: (6 marks)

	Phenolphthalein Jelly Experiment	**Iodine Clock Experiment**
Factor affecting Reaction Rate (Independent Variable)	Phenolphthalein Jelly changing surface area.	"Iodine Clock" reaction changing temperature
How reliable is the data? Explain	One (1) trial was conducted. Answer: Not reliable One trial means we were unable to see if the same or similar results would happen every time.	Three (3) trials were conducted. Answer: More Reliable Were able to see if similar results occurred each time.
How accurate is the data?	List three (3) areas of inaccuracy. • measurements of length, width, height of blocks of jelly. • time measurements • concentration of acid measurements • block fully submerged in acid • temp changes	List three (3) areas of inaccuracy. • Temp measurements • Time measurements • Concentration measurements • Mixing/swirling as iodine is added to starch. • human error - judgement of when reaction is complete
Comment on the validity of the results?	Experiment was valid - smaller blocks expose more surface area. Accept not valid if a good arguement to say that smaller cube experiment did not have full volume	Experiment was valid. Good method with appropriate measurements taken

Question 14

Use a Maxwell Boltzmann Energy Distribution graph to show the changes that occurred in iodine clock reaction experiment (Hint: the independent variable had four values).

(6 marks)