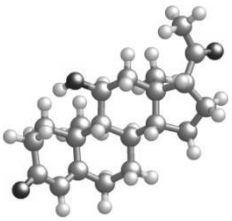

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Name: …… **( )**

Class: ……

Date: …… **/** …… **/** ……

Rate of Reaction – Assignment One

Question 1.

a) Write a balanced chemical equation, including state symbols, for the reaction between zinc and dilute sulfuric acid.

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b) Give **three** ways by which the speed of the reaction between zinc and hydrochloric acid can be measured.

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c) Give **three** ways in which the speed of the reaction between zinc and dilute sulphuric acid can be increased.

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Question 2.

Equal lengths of magnesium ribbon were added to 3 mol / dm^3 hydrochloric acid and to 3 mol / dm^3 sulfuric acid. When the reactions had stopped, some metal remained.

a) Write the equations for the reactions.

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b) With which acid would the reaction be faster at the start? Briefly explain your answer.

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c) How would the speed of the reaction change if the concentration of the acids were changed to 6 mol / dm^3?

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d) What would be the effect on the speed of reaction if the magnesium ribbon were replaced by powdered magnesium? Briefly explain your answer.

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Question 3.

Sulfur is formed when colourless solutions of hydrochloric acid and sodium thiosulfate are mixed.

$$2HCl(aq) + Na_2S_2O_3(aq) \rightarrow 2NaCl(aq) + SO_2(g) + H_2O(l) + S(s)$$

a) What would you see during the reaction?

……

b) State two ways to make the reaction go faster.

i) ……

ii) ……

c) In this experiment, 50 cm^3 of 1.0 mol / dm^3 hydrochloric acid is added to 50 cm^3 of 1 mol / dm^3 sodium thiosulfate. What causes the reaction to stop?

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d) Why is sulfur dioxide gas not obtained during this reaction? Suggest how gaseous sulfur dioxide can be obtained from the final reaction mixture.

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Question 4.

Manganese(IV) oxide acts as a catalyst for the decomposition of hydrogen peroxide into water and oxygen.

a) Write the balanced chemical equation for the decomposition of hydrogen peroxide.

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b) State briefly the general properties associated with catalysts.

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c) Describe the experiment(s) you would carry out to confirm that manganese(IV) oxide is acting as a catalyst in this decomposition.

……..

d) **i)** Write the balanced chemical equation for the industrial manufacture of ammonia by the Haber process.

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ii) Name the catalyst that is used for the industrial manufacture of ammonia.

……....

e) Name the catalyst used by green plants for photosynthesis.

……..

Question 5.

When liquid hydrogen peroxide (H_2O_2) is mixed with liquid hydrazine (N_2H_4) a very fast exothermic reaction takes place which can propel a rocket into space. The reaction products are nitrogen and steam.

a) Draw a dot-and-cross diagram to clearly show the arrangement of the electrons, and hence the bonding, in hydrogen peroxide.

b) What is meant by "*an exothermic reaction*"?

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……..

c) Suggest a reason why this reaction needs to be very fast.

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……

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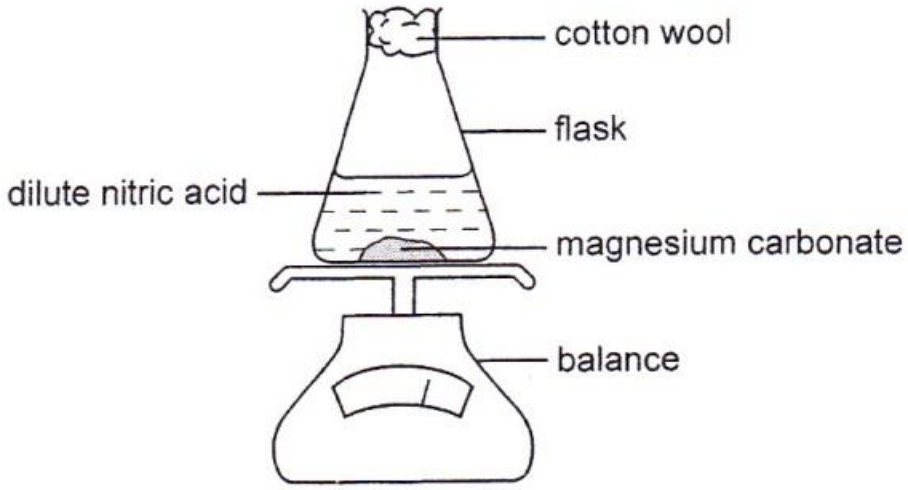
d) Write the balanced chemical equation, including state symbols, for the reaction between hydrogen peroxide and hydrazine.

……

e) If the rocket is loaded with 680 kg of hydrogen peroxide, calculate the mass of hydrazine that will be needed to react with it.

Question 6.

Small lumps of magnesium carbonate were added to dilute nitric acid (solution **A**) in the apparatus shown in the diagram.



The balance reading was noted as soon as the lumps were added, and again after two minutes. The experiment was repeated by changing only the concentration of the nitric acid (solution **B**).

The results obtained were:

Acid Solution	Balance Reading	
	Initial	After 2 Minutes
A	120.7	116.2
B	104.9	98.8

a) Why do the balance readings decrease over the two minutes?

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b) What is the purpose of the cotton wool plug?

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c) Giving reasons for your answers, explain which solution, **A** or **B**,

i) Gives the faster speed of reaction.

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ii) Has the highest concentration.

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d) Using ideas of collisions between particles, explain why powdered magnesium carbonate would react faster than lumps of magnesium carbonate in this experiment.

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e) Write the balanced chemical equation for another reaction for which the rate could be followed using this apparatus.

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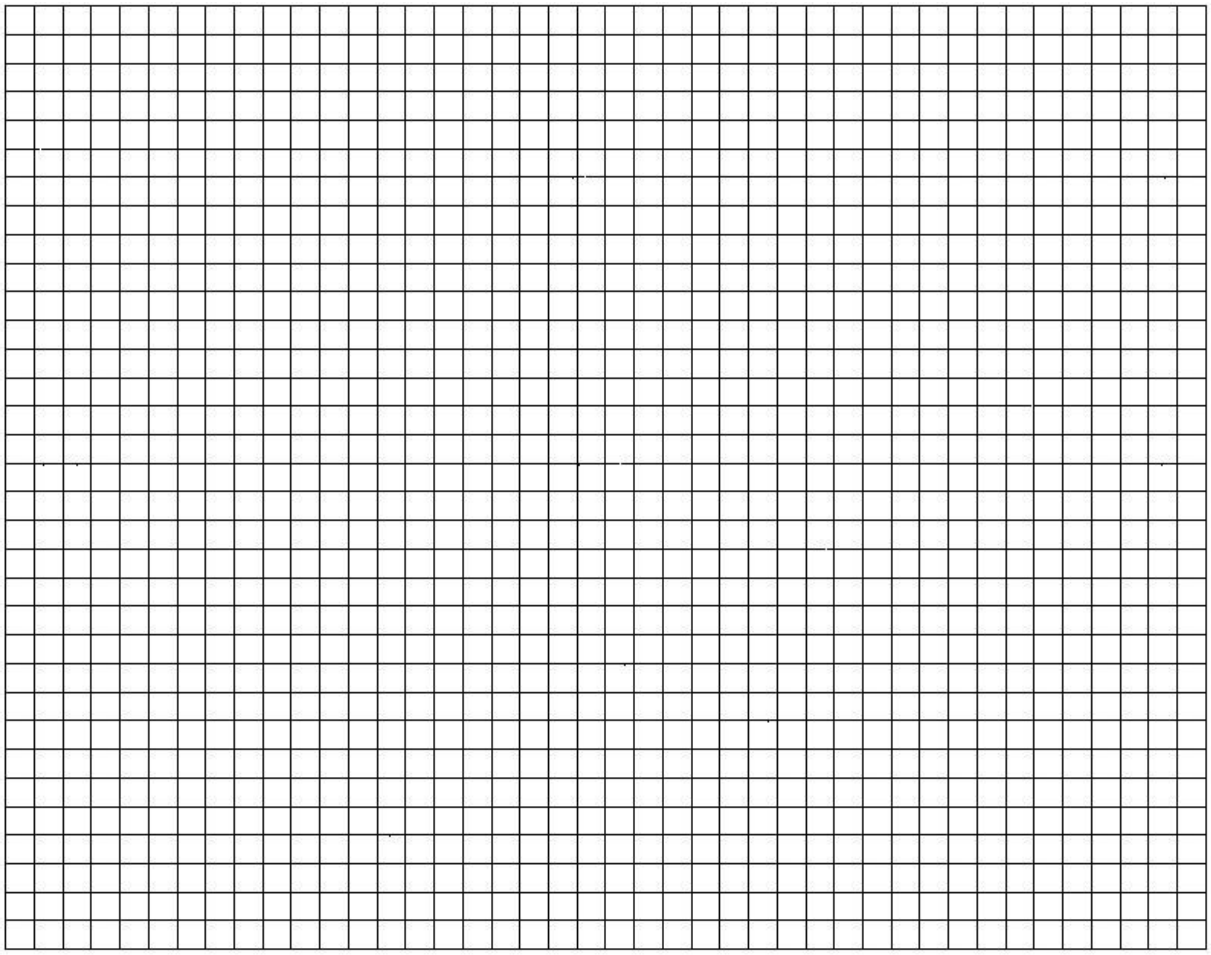
Question 7.

50 cm^3 of dilute hydrochloric acid was added to an excess of calcium carbonate contained in a flask connected to a gas syringe. The gas evolved was collected in the syringe at room temperature and pressure, and the total volume recorded at 10 second intervals. When no more gas was evolved some calcium carbonate remained unreacted in the flask. The results are shown in the table.

Time / s	10	20	30	40	50	60	70	80	90	100	110	120
Total Volume of gas / cm^3	130	225	330	380	410		480	490	500	500	500	500

a) Plot the results on the graph paper provided below.



b) At what time does the reaction stop?

…….

c) What causes the reaction to slow down and eventually stop?

…….

…….

…….

d) Estimate, from the graph, the total volume of gas collected at 60 seconds.

……

e) Write an equation for the reaction.

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f) Calculate the concentration, in mol / dm^3, of the hydrochloric acid.

g) On the graph paper, sketch a second curve, labelled "*Experiment 2*" to show the results you would expect to obtain if the experiment were repeated with the same quantities of materials, but with the hydrochloric acid at a higher temperature (the gas still being collected at room temperature).

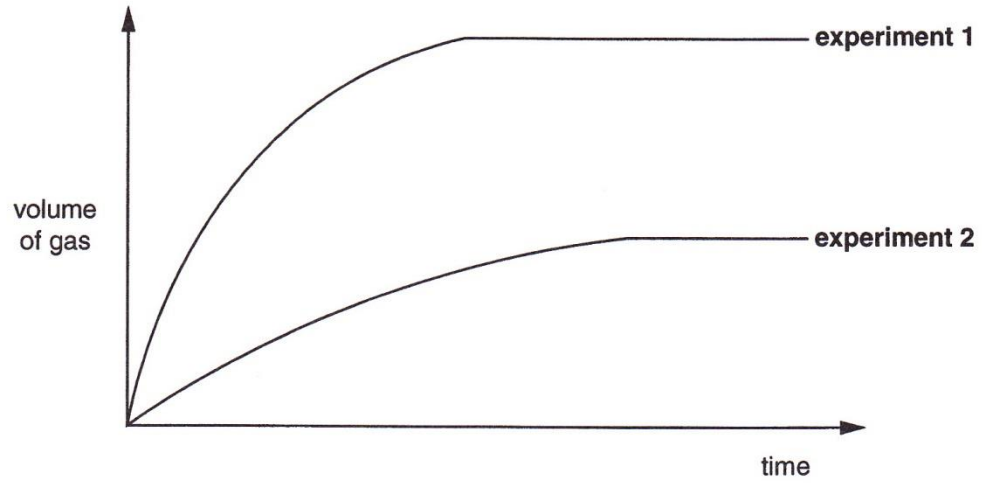
Question 8.

An experiment was carried out to measure the rate of reaction between excess powdered calcium carbonate and dilute acids.

In **Experiment 1**, 25 cm^3 of 1.5 mol / dm^3 hydrochloric acid were used.

A further experiment using hydrochloric acid, **Experiment 2**, was carried out.

The results of **Experiments 1** and **2** are shown on the graph below.



a) Suggest the concentration and volume of acid used for **Experiment 2**.

Concentration …… mol / dm^3

Volume …… cm^3

b) **Experiment 3** was carried out using 25 cm^3 of 1.5 mol / dm^3 sulfuric acid.
The initial rate of reaction for **Experiment 3** was faster than that for the other experiments, but the reaction stopped suddenly after only a small amount of gas had been produced.

i) Name the salt formed in **Experiment 3**.

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ii) Explain why the reaction stops suddenly.

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iii) Explain why the initial rate of reaction for Experiment 3 was faster that the initial rate of reaction for Experiments 1 and 2.

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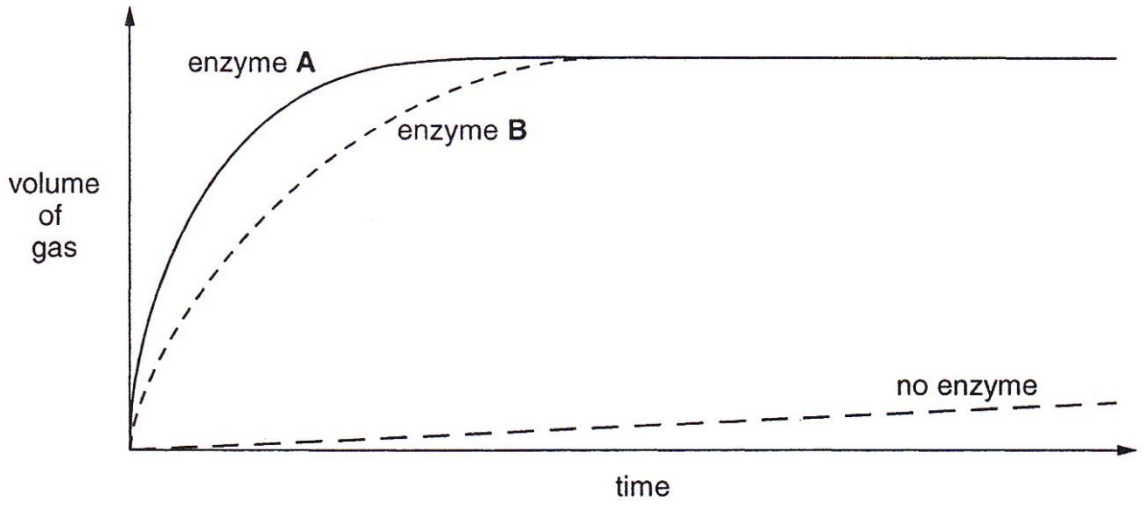
Question 9.

Hydrogen peroxide decomposes to give water and oxygen.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

A student carried out three experiments to investigate the rate of reaction. She used the same volume and concentration of hydrogen peroxide each time. Her first experiment used only hydrogen peroxide. Her second and third experiments investigated the effects of adding enzyme **A** and enzyme **B** to the reaction mixture. The graph shows her results.



a) Suggest a method the student could use to follow the rate of the reaction.

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b) **i)** Describe the effect of each enzyme on the rate of the reaction.

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ii) Use ideas about activation energy to explain why the shape of the graph is so different when no enzyme is used.

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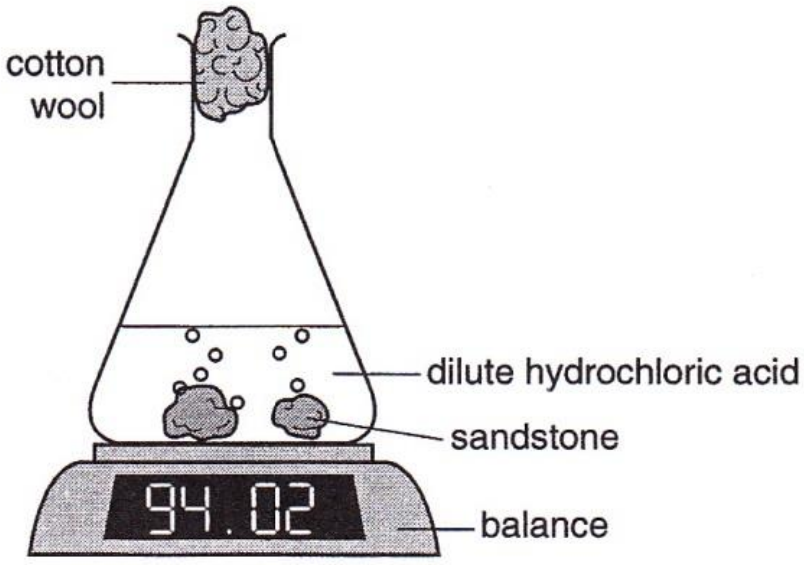
c) The student repeated the experiment for enzyme **B**. This time she used the same volume of hydrogen peroxide, but half the original concentration. She continued to measure the volume of gas until the reaction was complete. Sketch a curve on the graph to show the pattern of results for this experiment.

Question 10.

Sandstone contains sand (mainly silicon dioxide) and calcium carbonate. In an experiment, excess sandstone was reacted with dilute hydrochloric acid.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

The rate of reaction was followed by measuring the mass lost during the reaction.



This is a table of the results.

Time / minutes	Total mass lost / g
0	0.00
4	0.18
8	0.30
12	0.38
16	0.44
20	0.48
24	0.51

a) Use the information from the table to show that the rate of reaction decreased.

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b) Explain, using ideas about particles colliding, why the rate of reaction decreased.

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c) Draw a labelled diagram to show a **different** method of following the rate of reaction between sandstone and hydrochloric acid.

d) In a second experiment, 10 g of sandstone was added to excess hydrochloric acid. The total mass lost was 0.88 g. Calculate the percentage by mass of calcium carbonate in the sandstone.

- Scan the QR code below for the answers to this assignment.

http://www.chemist.sg/rate_of_reaction/rate_one_ans.pdf