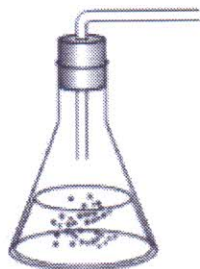


Q.1 A student added 100cm³ of 0.10 mol/dm³ hydrochloric acid to 0.5 g of calcium carbonate contained in a conical flask. The reaction produced carbon dioxide. The equation for the reaction is shown.



(a) Name the piece of apparatus which should be attached to the flask, for collecting and measuring the volume of carbon dioxide produced.

..... [1]

(b) Give a test to confirm the presence of carbon dioxide test and observation

..... [1]

(c) (i) Calculate the number of moles of calcium carbonate in 0.5 g.

[A_r: Ca, 40; C, 12; O, 16]

.....moles [1]

(ii) Calculate the number of moles of hydrochloric acid in 100 cm³ of 0.10 mol/dm³.

.....moles [1]

(iii) Was one of the reagents in excess? Explain your answer.

[3]

(d) Using your answers in (c) calculate the volume of carbon dioxide produced when the reaction reached completion. (One mole of a gas occupies 24dm^3 at room temperature and pressure).

..... dm^3 [1]

(e) The experiment was repeated using 0.5 g of magnesium carbonate instead of 0.5 g of calcium carbonate. Calculate the volume of carbon dioxide produced.

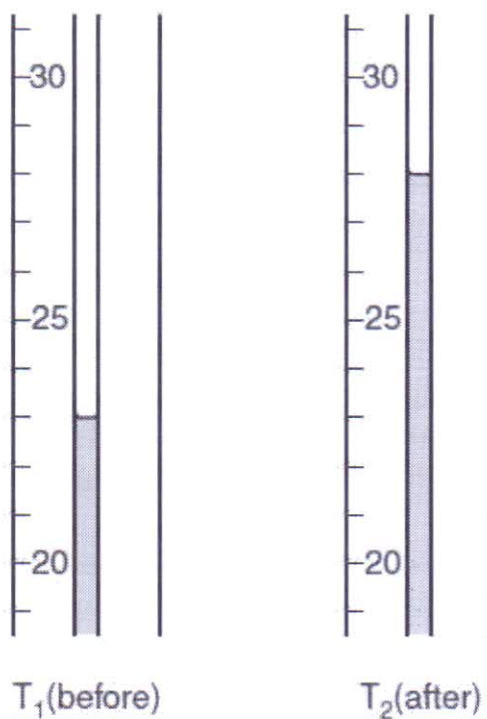
[A_r : Mg, 24; C, 12; O, 16]

..... dm^3 [1]

[Total: 09]

Q.2) Approximately 4 g of sodium hydroxide is added to 100 cm^3 of water. A thermometer is used to measure the temperature of the liquid both before and after the addition of sodium hydroxide.

The diagrams below show parts of the thermometer stem giving the two temperatures.



(a) Complete the table and calculate the change in temperature.

temperature T2 after sodium hydroxide is added / °C	
temperature T1 before sodium hydroxide is added / °C	
change in temperature / °C	

[2]

(b) (i) What type of process does this temperature change suggest has taken place?

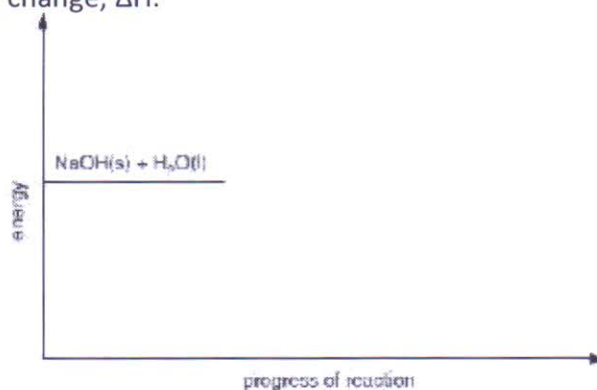
.....

[1]

(ii) Complete the energy profile diagram for sodium hydroxide dissolving in water.

On your diagram label

- the products,
- the enthalpy change, ΔH .

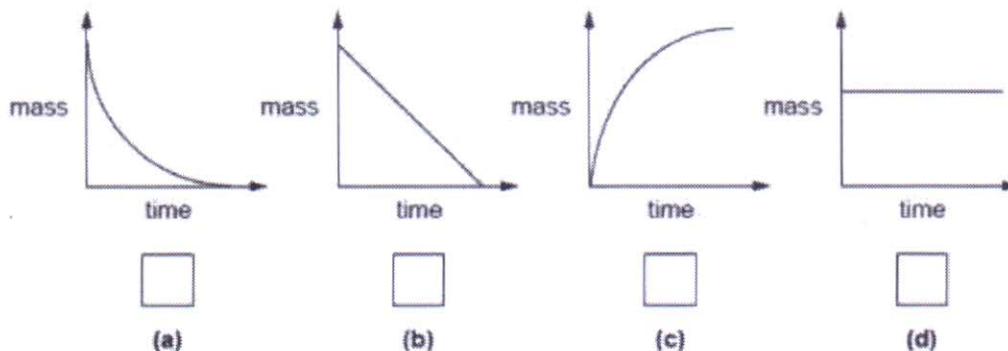


[2]

[Total: 05]

Q.3) A student made oxygen by adding hydrogen peroxide to a weighed sample of powdered manganese (IV) oxide, which acts as a catalyst.

Which of the following graphs represents how the mass of manganese (IV) oxide varied as the experiment proceeded?



[Total: 01]

Q.4) Calcium carbonate reacts with hydrochloric acid as shown below.



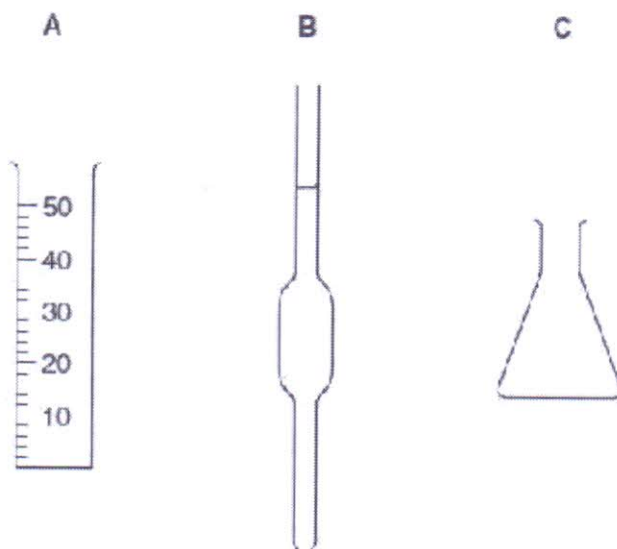
What volume of 1.0 mol/dm^3 hydrochloric acid is needed to completely react with 2.0 g of calcium carbonate?

[M_r : CaCO_3 , 100]

- (a) 20 cm^3
- (b) 40 cm^3
- (c) 200 cm^3
- (d) 400 cm^3

[Total: 01]

Q.5)



(a) Which of the above apparatus A, B or C, is used for measuring out a fixed volume of liquid for a titration experiment?

..... [1]

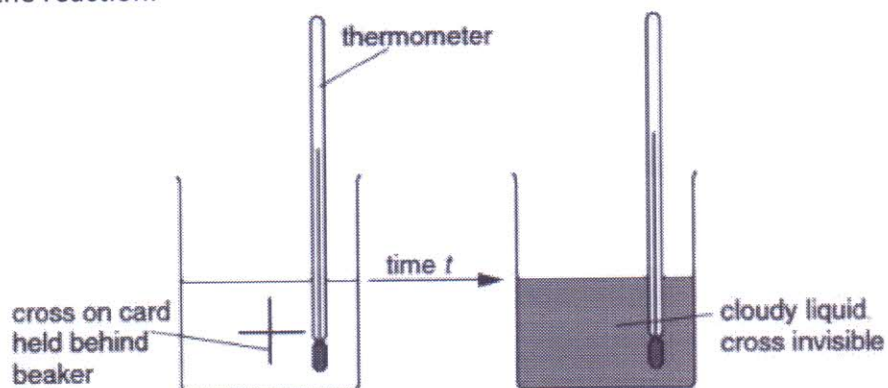
(b) Name this apparatus.

..... [1]

[Total: 02]

Q.6) The reaction between sodium thiosulphate and hydrochloric acid produces sulphur which makes the solution cloudy. The rate of this reaction determines the time it takes for the solution to go cloudy.

A student did two experiments to investigate the effects of temperature and concentration on the rate of the reaction.

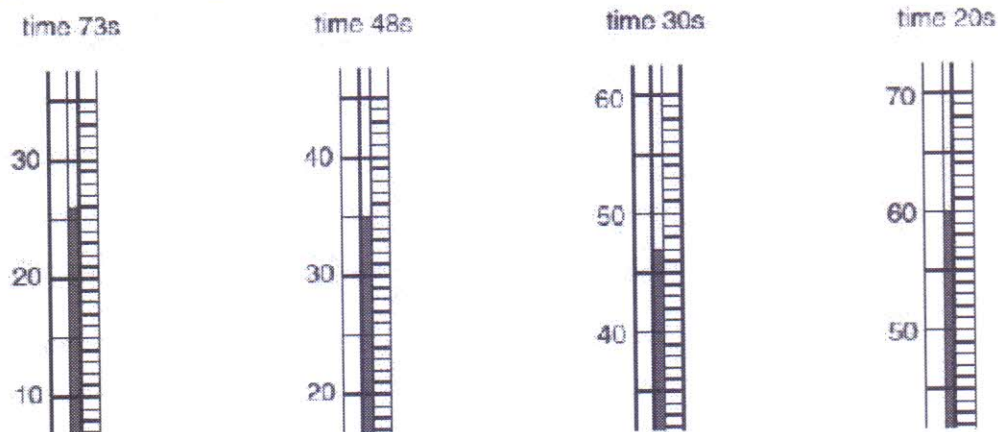


Experiment 1

50 cm³ of aqueous sodium thiosulphate was put into a beaker and 5.0 cm³ of 2.0 mol/dm³ hydrochloric acid was added.

A stop watch was started and the temperature of the solution was noted. At the moment the cross became invisible, the watch was stopped and the time taken was recorded. The experiment was repeated at different temperatures.

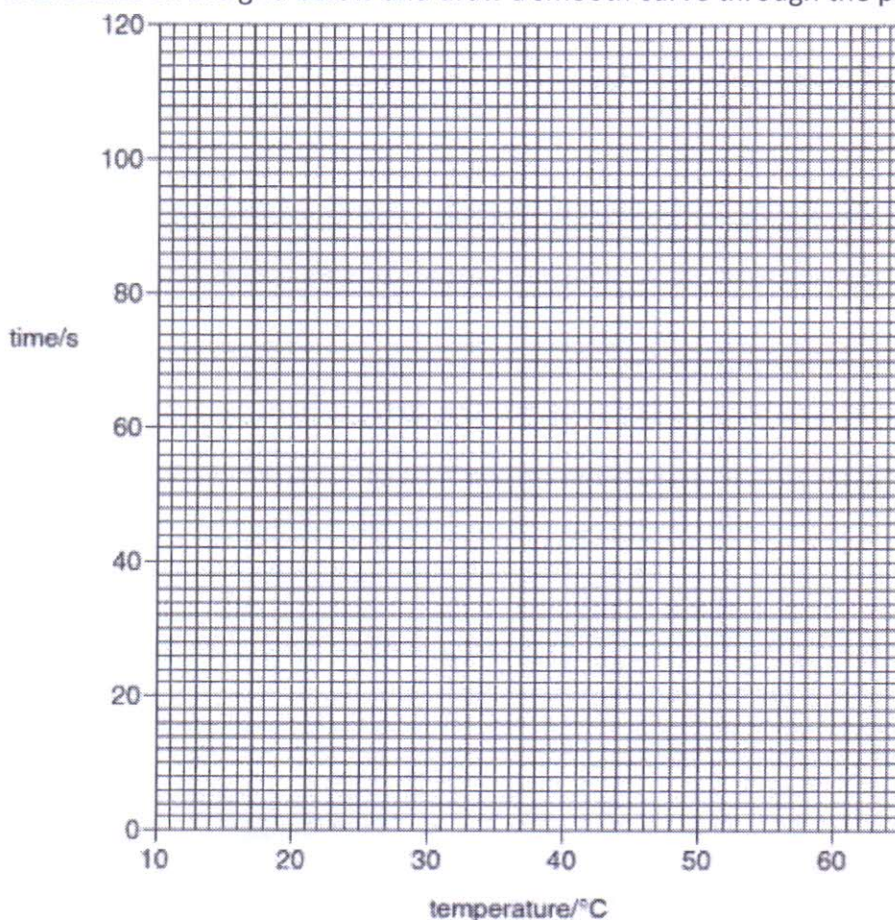
(a) The diagrams below show parts of the thermometer stem for each of the temperature readings. Use these diagrams to complete the table below.



temperature / °C	time / s
20	110
	73
	48
	30
	20

[2]

(b) Plot the results on the grid below and draw a smooth curve through the points.



[1]

(c) How long would it take for the cross to become invisible at 40 °C?

.....s

[1]

(d) At what temperature would the reaction be twice as fast as at 20 °C?

.....°C

[1]

Experiment 2

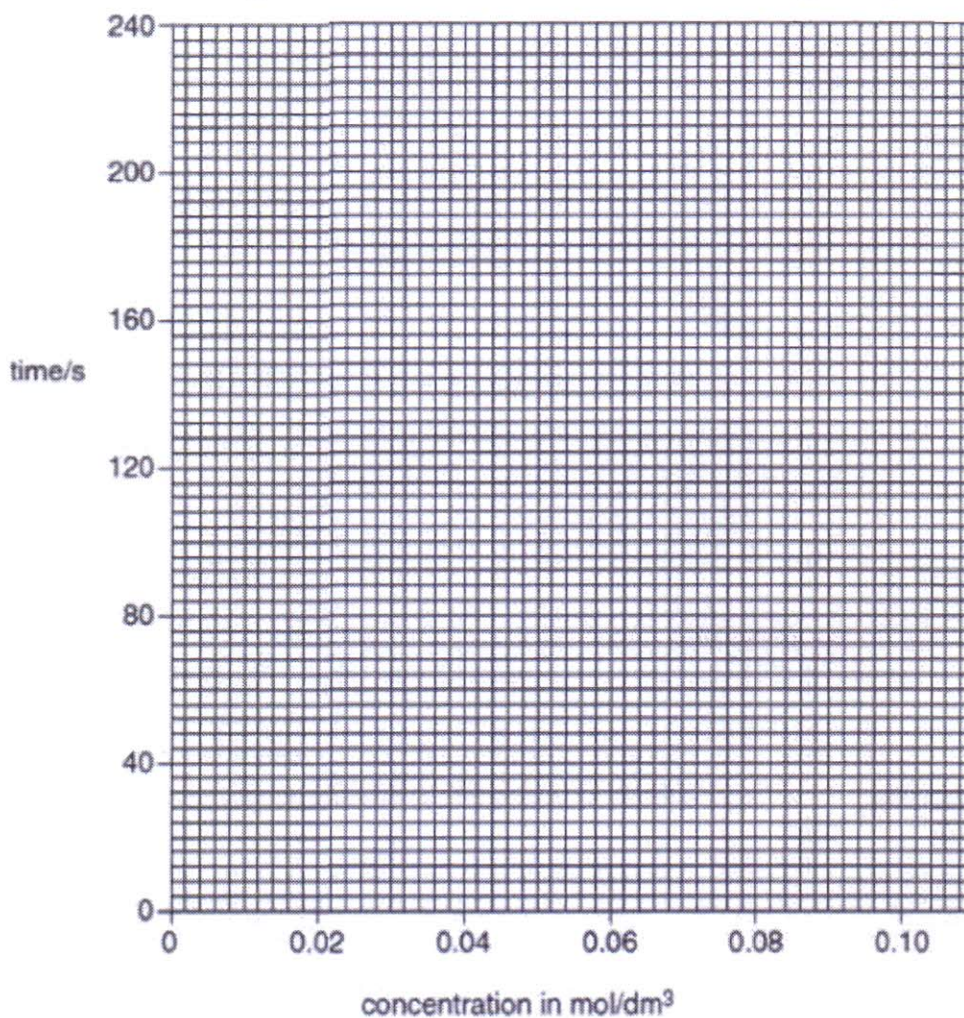
50 cm³ of 0.02 mol /dm³ sodium thiosulphate was added to 5.0 cm³ of 2.0 mol /dm³ hydrochloric acid. The temperature was kept at 30 °C.

The time taken for the cross to become invisible was recorded.

The experiment was repeated for solutions of sodium thiosulphate of different concentrations, each at a temperature of 30 °C.

concentration, mol /dm ³	time, t/s	temperature /°C
0.02	210	30
0.04	86	30
0.06	43	30
0.08	28	30
0.10	20	30

(e) Plot the results on the grid below and draw a smooth curve through the points



[2]

(f) How long would it take for the cross to become invisible for a sodium thiosulphate concentration of 0.07 mol /dm^3 ?

.....s

[1]

(g) Using both graphs, suggest what the concentration of sodium thiosulphate was in the first experiment.

..... mol/dm^3

[1]

[Total: 09]

Q.7) A student was given a sample of marble, which is impure calcium carbonate. The student was asked to determine the percentage of calcium carbonate in the sample. The sample of marble was added to a previously weighed container, which was then reweighed.

Mass of container + marble = 9.40 g

Mass of container = 7.85 g

(a) Calculate the mass of marble used in the experiment.

.....g [1]

The sample was placed in a volumetric flask and 50.0 cm³ of 1.00 mol/dm³ hydrochloric acid (an excess) was added. The stopper was placed in the top of the flask and the mixture was allowed to react. The stopper had to be frequently loosened.

(b) Why was the stopper frequently loosened?

..... [1]

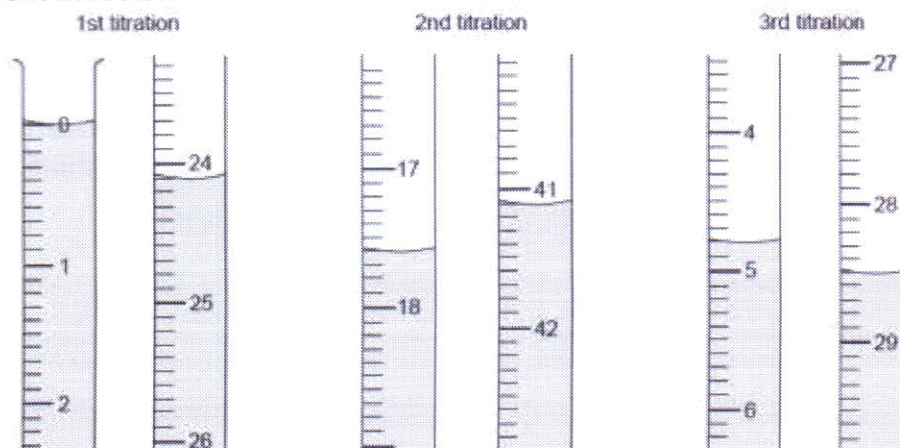
When the reaction had finished the solution was made up to 250 cm³ with distilled water. This was solution G. 25.0 cm³ of solution G was transferred to a titration flask and a few drops of methyl orange indicator was added.

0.100 mol/dm³ sodium hydroxide was added to the solution from a burette until an endpoint was reached.

(c) What was the colour change of the methyl orange?

The colour changed from to [1]

Three titrations were done. Parts of the burette with liquid levels before and after each titration are shown below.



(d) Use the diagrams to complete the following results table.

titration number	1	2	3
final burette reading / cm ³			
initial burette reading / cm ³			
volume of 0.100 mol/dm ³ sodium hydroxide / cm ³			
best titration results (✓)			

Summary

Tick the best titration results. Using these results, the average volume of 0.100 mol/dm³ sodium hydroxide was cm³. [4]

(e) Calculate how many moles of sodium hydroxide are in the average volume of 0.100 mol/dm³ sodium hydroxide in (d).

..... moles [1]

(f) Using the equation, calculate how many moles of hydrochloric acid are in 25.0 cm³ of solution G.



.....moles [1]

(g) Calculate how many moles of hydrochloric acid are in 250 cm³ of solution G.

.....moles [1]

(h) How many moles of hydrochloric acid were contained in the original 50.0 cm³ of 1.00 mol/dm³ hydrochloric acid?

.....moles [1]

(i) By subtracting your answer in (g) from your answer in (h), calculate how many moles of hydrochloric acid reacted with the calcium carbonate in the sample of marble.

.....moles [1]

(j) Using the equation, calculate how many moles of calcium carbonate react with the number of moles of hydrochloric acid in your answer (i).



.....moles [1]

(k) (i) Calculate the mass of one mole of CaCO₃.
Ar: Ca, 40; C, 12; O, 16.

.....g [1]

(ii) Using your answers to parts (j) and (k) (i) calculate the mass of calcium carbonate in the sample of marble.

.....g [1]

(iii) Using your answers to parts (a) and (k)(ii) calculate the percentage of calcium carbonate in the sample of marble.

.....% [3]

[Total: 18]

Q.8) When iron is heated with steam in a sealed container, an equilibrium mixture is obtained.



(a) The forward reaction is endothermic. What is the meaning of term “endothermic”?

.....

.....

[1]

(b) Describe and explain what happens to the rate of the forward reaction when the temperature is increased. The pressure remains constant.

.....

.....

.....

[2]

(c) Describe and explain what happens, if anything, to the position of equilibrium when the pressure is increased. The temperature remains constant.

.....

.....

.....

[2]

[Total: 05]

Q.9) The following table shows the tests a student did on substance **T** and the conclusions made from the observations. Complete the table by describing these observations and suggest the test and observations which lead to the conclusion from test **4**.

Test	observation	conclusion
1 T was dissolved in water and the solution divided into three parts for tests 2, 3 and 4		T contains a transition metal
2 (a) To the first part, aqueous sodium hydroxide was added until a change was seen (b) An excess of aqueous sodium hydroxide was added to the mixture from (a)		T may contain Cu^{2+} ions.
3 (a) To the second part, aqueous ammonia was added until a change was seen. (b) An excess of aqueous ammonia was added to the mixture from (a)		The presence of Cu^{2+} ions is confirmed.
		T contains Cl^- ions.

Conclusion: the formula for substance **T** is

[Total: 10]