

What volume of gas has been collected?	
(1)	
(1)	



(e) State two variables, other than temperature, that must be kept constant to make the investigation a fair test.Variable 1 .....

- Variable 2 .....
  - (2)

Leave blank

(f) The table shows the teacher's results.

Concentration of sulphuric acid	Volume of gas (cm <sup>3</sup> ) collected in 20 seconds				
(%)	Run 1	Run 2	Run 3		
10	46	48	47		
15	62	63	62		
20	75	74	71		
30	65	63	67		
40	50	33	46		
50	33	34	35		
60	27	23	22		

(i) For which concentration of acid are the results most reliable?

.....

(1)

(ii) One of the results is anomalous.

Circle this result and explain what may have happened to cause this anomaly.

.....

(2)

(iii) Calculate the mean volume of gas collected in 20 seconds when the acid had a concentration of 60%.

(1)



(g) The rate of the reaction can be calculated using the equation:

rate =  $\frac{\text{total volume of gas collected}}{\text{total time taken to collect gas}}$ 

The rate of reaction at each concentration is:

Concentration (%)	Rate
0	0.00
10	2.35
15	3.12
20	3.67
30	3.25
40	2.40
50	1.70
60	1.20

(i) Place a cross  $(\boxtimes)$  in one box to show the correct units for the rate in this experiment.



(1)

5

Leave blank



		17
7.		
·		
END		
(Total 23 n TOTAL FOR PAPER: 50 M	narks) ARKS	
······································	(2)	Q3
(iii) What further practical work would you do to check the accuracy o calculated volume in (h)(ii)?	of your	
	(1)	
	••••••	
<ul><li>(ii) Use your answers to (h)(i) to calculate the volume of gas that would be co in 20 seconds at this concentration.</li></ul>	llected	
Concentration	(2)	
Highest rate		
<ul><li>(h) (i) Use your graph to determine the highest rate, and the concentration of ac will give this rate.</li></ul>	id that	blank
		Leave

Leave blank Malachite chips, containing copper(II) carbonate, react with hydrochloric acid.  $CuCO_3(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l) + CO_2(g)$ Some students investigate the effect of changing the concentration of acid on the rate of the reaction. They use this method. cotton wool small beaker of Pour some hydrochloric acid into a flask malachite chips and place it on a balance. Place a beaker of malachite chips (an excess) on the balance. hydrochloric acid Set the balance to zero. g cotton wool Add the malachite chips to the flask and replace the cotton wool. At the same time start a stopwatch. g

The balance shows the loss in mass as carbon dioxide gas is given off.

After 1 minute the reading on the balance is recorded.

Some students repeat the experiment at the same temperature using acid with the same volume but a different concentration.

(a) Suggest **two** features of the malachite chips that need to be the same to ensure that the experiment is a fair test.



(b)	The teacher They did son these results	gave four students some dilute hydrochloric acid that was labelled 100%. me experiments using different dilutions of this acid. They wrote down	Leave blank
	Student 1	When the concentration of acid was 100% the reading on the balance was –1.12 grams after 1 minute	
	Student 2	The flask lost 0.87g in one minute when I used 75% hydrochloric acid	
	Student 3	The mass of gas given off was 0.62g when there were no more bubbles coming from the malachite chips and the acid was 50%	
	Student 4	0.24 grams of carbon dioxide were given off in 60 seconds when the acid concentration was 25%	
	(i) Which s Explain	student wrote down results that cannot be compared with the other three? your choice.	
	Student		
	Explana	tion	
		(2)	
	(ii) Draw a units. E	suitable table using column headings that show what was recorded, with Enter the three results that can be used.	

(4)



(c) Another group of students repeated the experiment, but using a mixture of sulphuric acid and water instead of hydrochloric acid.The table shows the results obtained by the students.

Mass of carbon dioxide given off (g)	0.20	0.27	0.44	0.54	0.60	0.67
Volume of sulphuric acid (cm <sup>3</sup> )	30	40	50	80	90	100
Volume of water (cm <sup>3</sup> )	70	60	50	20	10	0
Concentration of acid (%)	30	40	50	80	90	100

(i) Choose a suitable scale for the mass of carbon dioxide given off. Plot these results on the grid below and draw the line of best fit.



Leave blank

	11	9
	(Total 21 marks)	
	(2)	Q
(11)	Give an explanation for this relationship.	
('')	(2)	
(d) (i)	Describe the relationship between the mass of carbon dioxide given off in one minute and the concentration of the acid.	
	acid concentration is 70%. Show on your graph how you have obtained your answer.	