

Scientific Investigation Practice

Directions: Questions 6 through 9 are based on the information below.

Impact craters are formed when meteorites strike the surface of a planet. A researcher investigated some factors that might influence the formation of impact craters by either dropping marbles into a tray of sand or launching them from a slingshot into the sand. The results are shown in the table below.

Test Number	Mass of Marble (g)	Method of Crater Formation	Marble Speed (cm/s)	Crater Diameter (cm)
1	3	Drop from 2 m	626	5.0
2	6	Drop from 2 m	626	7.0
3	6	Drop from 10 cm	140	1.8
4	6	Drop from 2 m	626	6.5
5	6	Launch from 36 cm	3,000	11.0

- 6** Tests 1 and 2 were designed to test the effects of which of the following factors?

- A The mass of the marble
- B The speed of the marble
- C The crater diameter
- D The method of crater formation

- 8** The observed difference in the crater diameters in tests 3 and 4 is most likely due to which of the following factors?

- A The mass of the marbles
- B The researcher's measuring technique
- C Whether the marble was dropped or launched
- D The height from which the marbles were dropped

- 7** Which of the following statements best explains why the speed of the marble in test 5 is so much greater than the speed of the marbles in tests 3 and 4?

- A It was dropped from the greatest height.
- B It was launched rather than dropped.
- C It produced the largest crater.
- D It was made of a different material.

Mod 5 – Question 9

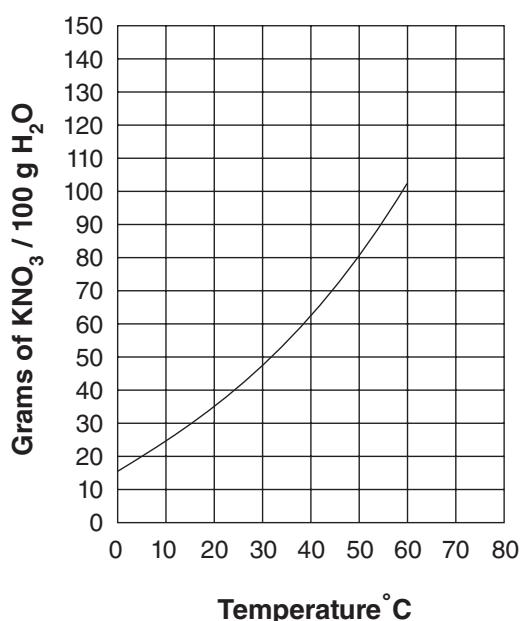
A student wanted to investigate the water content of a variety of foods. The student weighed out exactly 5 g of a variety of food samples including apple, raw beef, celery and tomato. The foods were then placed in an incubating oven for 4 days, removed and then reweighed.

What would be the dependent variable in this investigation?

- A. The types of food samples used
- B. The temperature of the incubating oven
- C. The amount of mass lost after 4 days in the incubating oven
- D. The amount of mass of each sample prior to being placed in the incubating oven

Directions: The graph below shows the number of grams (g) of potassium nitrate (KNO_3) dissolved in 100 grams of water (H_2O) at different Celsius temperatures ($^{\circ}\text{C}$). Use this information to answer questions 10 through 13.

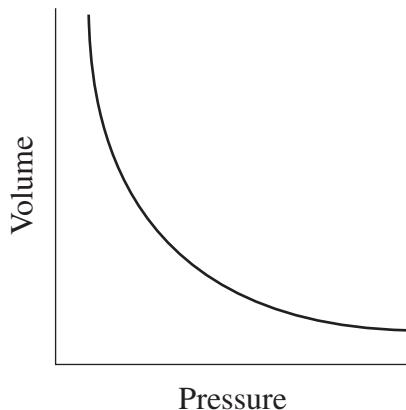
Solubility of Potassium Nitrate (KNO_3)



- 12 Which of the following is the best prediction of the mass of KNO_3 that could be dissolved in 100 grams of H_2O at 70°C ?
- A 105 g
 - B 115 g
 - C 135 g
 - D 155 g

- 10 Approximately how many grams of KNO_3 can be dissolved in 100 grams of H_2O at 35°C ?
- A 65
 - B 60
 - C 55
 - D 50
- 11 Which of the following is the lowest temperature at which 70 grams of KNO_3 can be dissolved in 100 grams of H_2O ?
- A 55°C
 - B 45°C
 - C 35°C
 - D 25°C
- 13 Approximately 80 grams of KNO_3 is dissolved in 100 grams of H_2O at 50°C . If this solution is cooled to 10°C , approximately how much KNO_3 will come out of the solution?
- A 25 g
 - B 35 g
 - C 45 g
 - D 55 g

Mod 5 – Question 2 - The graph shows the relationship between volume and pressure.



How are the variables related?

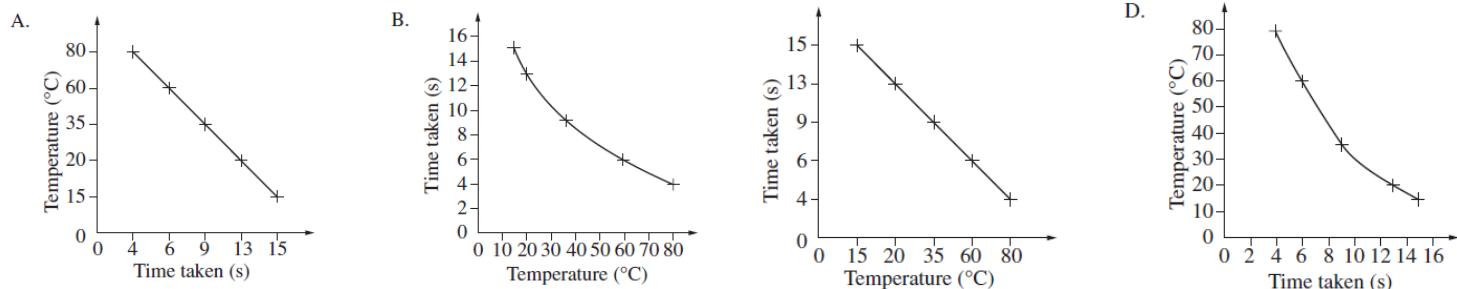
- A. As pressure is increased, volume decreases at a decreasing rate.
- B. As pressure is increased, volume decreases at an increasing rate.
- C. As volume is decreased, pressure increases at a decreasing rate.
- D. As volume is decreased, pressure increases at a constant rate.

Mod 5 – Question 3

An experiment was performed to investigate the effect of temperature on the time it takes for a tablet to dissolve. Five glasses of water of varying temperature were prepared. An effervescent tablet was then dropped into each of the glasses. The table below shows the temperature of each glass of water and the time taken for each of the tablets to dissolve.

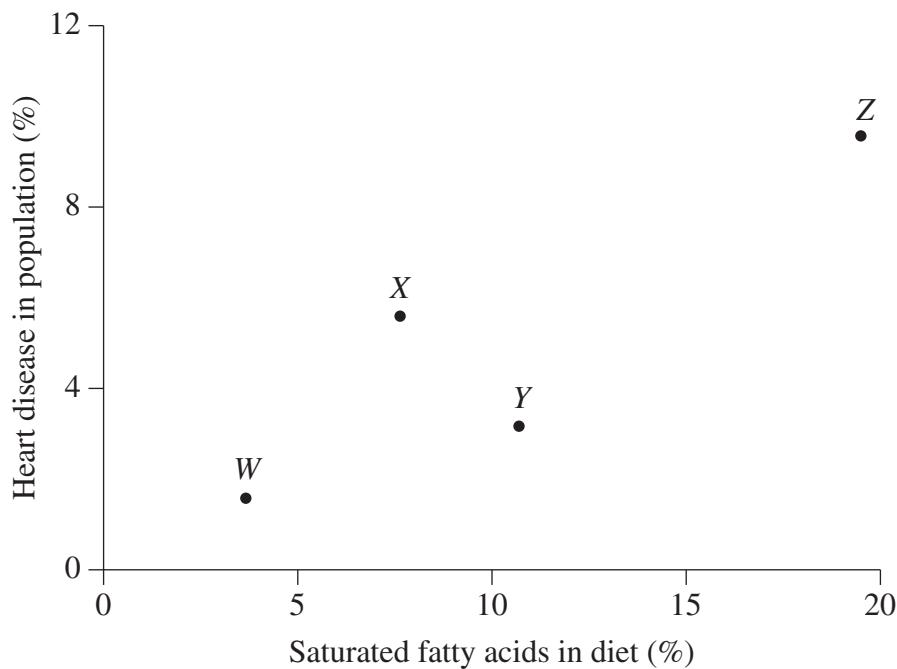
Temperature of water (°C)	Time taken to dissolve (seconds)
15	15
20	13
35	9
60	6
80	4

Which graph correctly represents the data from the experiment?



Mod 5 – Question 4

The scatter plot shows the relationship between heart disease and the percentage of saturated fatty acids in the diets of the populations of some different countries.



What hypothesis would a comparison of the data from ONLY country X and country Y support?

- A. That heart disease is more common in country Y than in country X
- B. That people in country X have a high intake of saturated fatty acids
- C. That having more saturated fatty acids in the diet increases the risk of heart disease
- D. That having more saturated fatty acids in the diet decreases the risk of heart disease

Mod 5 – Question 13

An experiment was conducted to compare the effectiveness of two water treatments for purifying pond water. Three samples of pond water, A, B and C, were collected. Each sample was used to inoculate an agar plate. The plates were incubated at 25°C. The number of visible bacterial colonies on each plate was counted three days later.

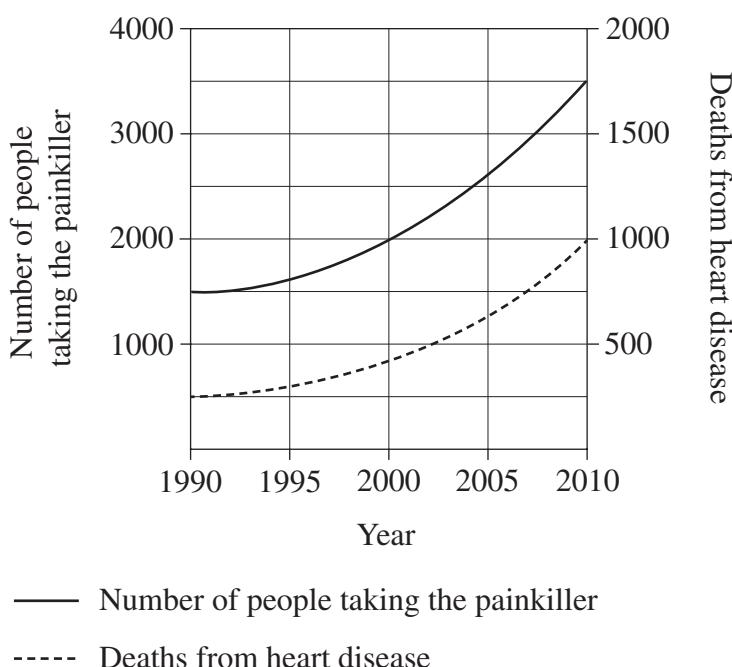
Sample	A	B	C
Treatment	5 grams of pool chlorine per litre of water	Boiling for one minute	No treatment
Number of visible bacterial colonies	0	6	22

Which row of the table correctly identifies an independent variable, a dependent variable, a controlled variable and the purpose of Sample C in this experiment?

	Independent variable	Dependent variable	Controlled variable	Purpose of Sample C
A.	Quality of pond water	Temperature	Number of bacterial colonies	To control the independent and dependent variables
B.	Quality of pond water	Number of bacterial colonies	Treatment	To ensure that the results reflect the effects of the water treatments
C.	Treatment	Pond water	Temperature	To control the independent and dependent variables
D.	Treatment	Number of bacterial colonies	Temperature	To ensure that the results reflect the effects of the water treatments

Mod 7 – Question 5

The graph shows information related to the consumption of a particular painkiller and death from heart disease in a city.



Which deduction **CANNOT** be made from this graph?

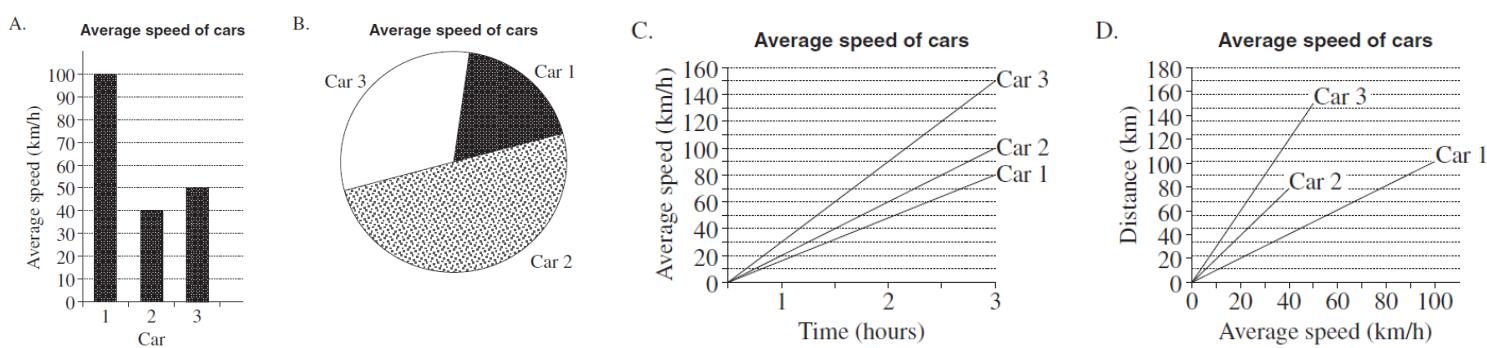
- A. There is a correlation between taking the painkiller and deaths from heart disease.
- B. The number of deaths from heart disease in the city quadrupled from 1990 to 2010.
- C. The number of people in the city taking the painkiller more than doubled in the 20 years.
- D. The increase in deaths from heart disease was caused by the consumption of the painkiller.

Mod 5 – Question 15

A student measured the time taken for three cars to travel particular distances. The student then calculated the average speed of each car, and put the information in the table below.

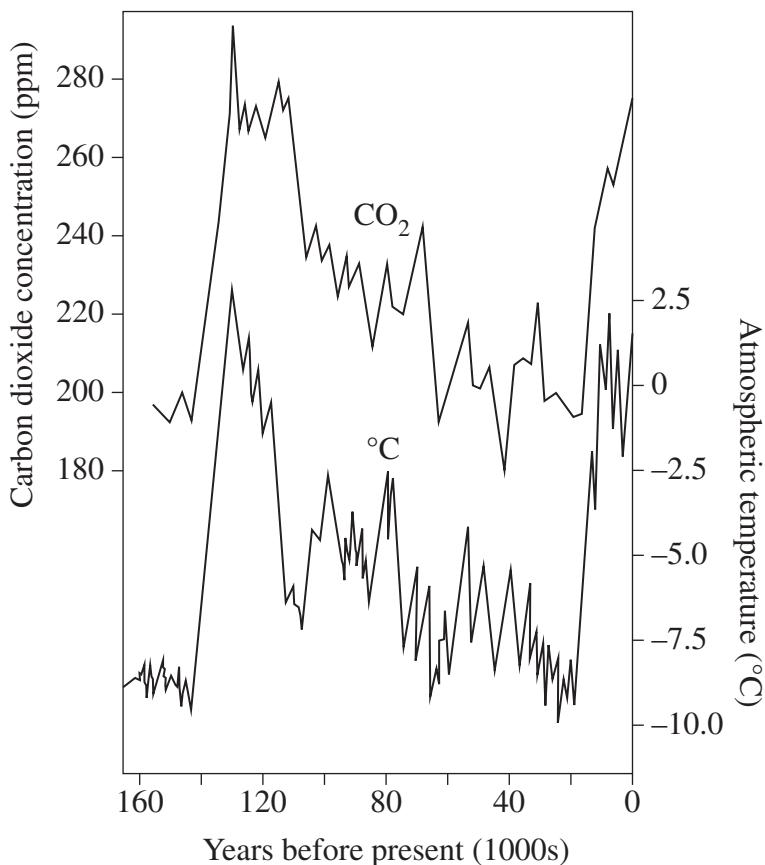
<i>Car</i>	<i>Distance (km)</i>	<i>Time (hours)</i>	<i>Average speed (km/h)</i>
Car 1	100	1	100
Car 2	80	2	40
Car 3	150	3	50

Which of the following graphs best shows the average speed of each car?



Mod 7 – Question 6

The diagram shows some changes in Earth's atmosphere.



Which of the following is supported by the information in the graph?

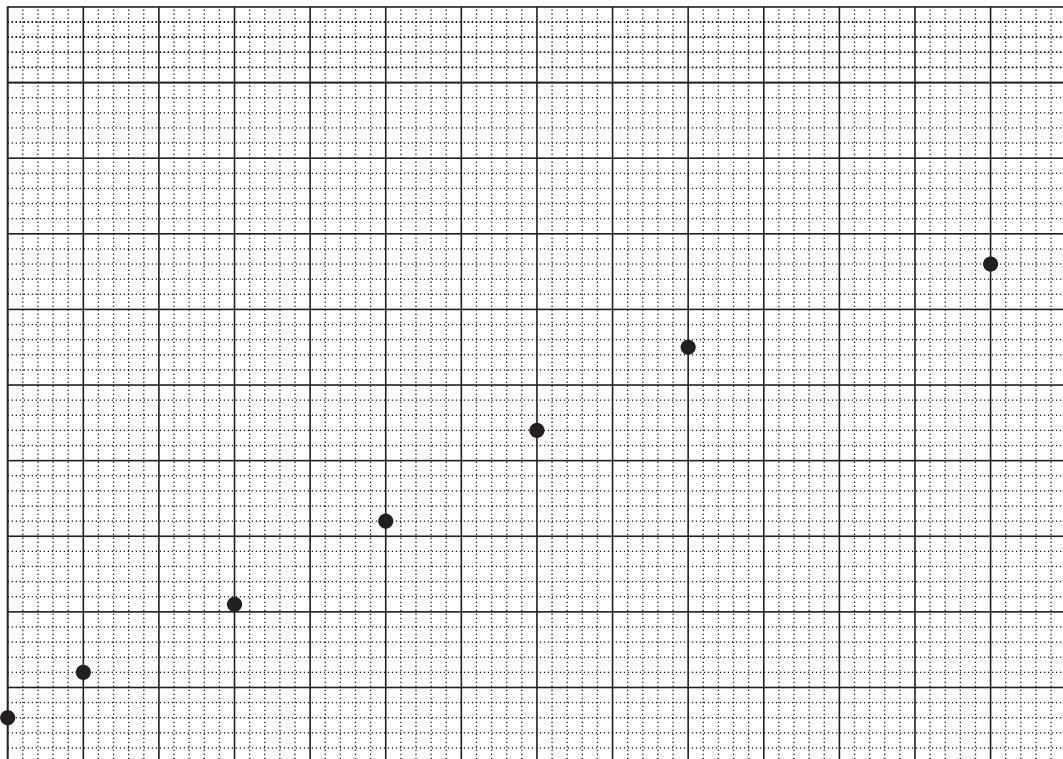
- A. The temperature on Earth, 160 thousand years ago, ranged from 8°C to 10°C.
- B. The amount of carbon dioxide in Earth's atmosphere decreased between 80 and 40 years ago.
- C. For most of the last 160 thousand years the amount of carbon dioxide in the atmosphere has been decreasing.
- D. There is no relationship between the amount of carbon dioxide in the atmosphere and the temperature of the atmosphere.

Mod 5 – Question 18 (6 marks)

Some rats were being fed to determine the rate at which they put on ‘weight’. The table shows the average masses of male and female rats from birth to 26 months of age when they are fully grown.

Age (months)	Average mass of female rats (grams)	Average mass of male rats (grams)
birth	65	54
2	123	100
6	211	164
10	320	400
14	440	485
18	550	630
26	665	865

The change in the mass of female rats with age was graphed as shown.



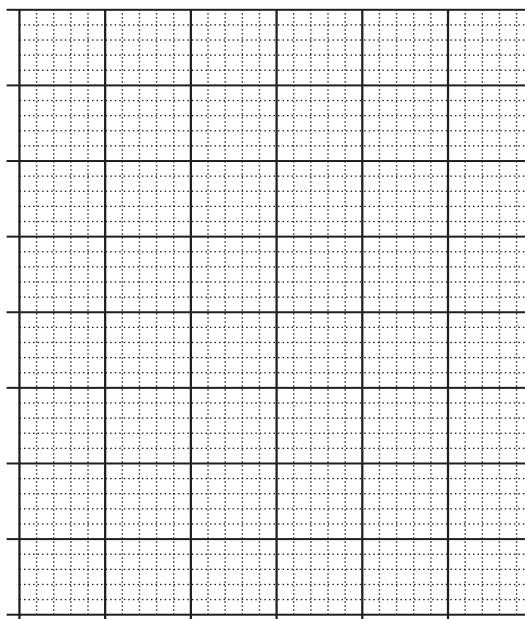
- (a) Label the axes and indicate the scales. 2
- (b) On the same grid, construct a graph to show the change in the mass of male rats with age. 2
- (c) Outline how to predict the average mass of male rats at 28 months. Include the predicted value in your answer. 2

Mod 6 – Question 7 (7 marks)

A student investigated the average rate of a chemical reaction over a period of time. She measured the amount of solid product produced over a 4-minute period, and tabulated her data as shown.

Time (s)	Mass of product produced (g)
0	0
30	1.4
60	2.1
90	2.8
120	3.1
150	3.5
180	3.6
210	3.6
240	3.6

- (a) Graph the results of the student's investigation on the grid provided.



3

Question 7 (continued)

- (b) Use the graph and the formula given to find the average reaction rate between 40 and 100 seconds. Note that for this investigation, reaction rate is measured in (g s^{-1}) .

2

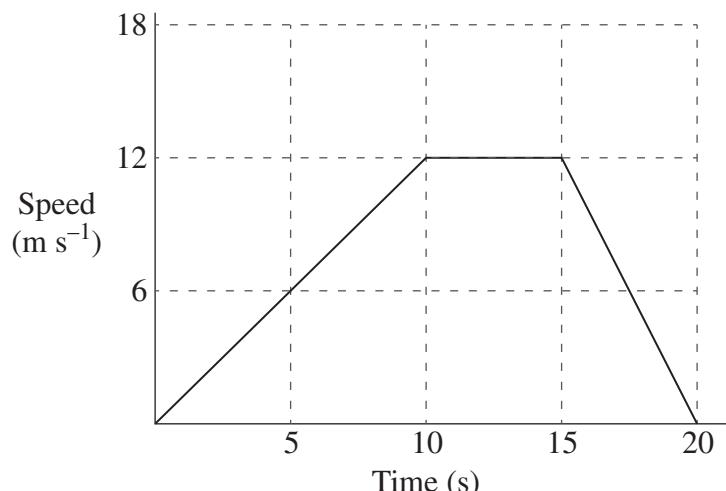
$$\text{average reaction rate} = \frac{\text{change in mass}}{\text{change in time}}$$

- (c) At what point is the reaction complete? Justify your answer.

2

Mod 6 – Question 9 (5 marks)

A student conducted an experiment to investigate the change in the speed of a car over time. The speed of the car at various times was measured and graphed.

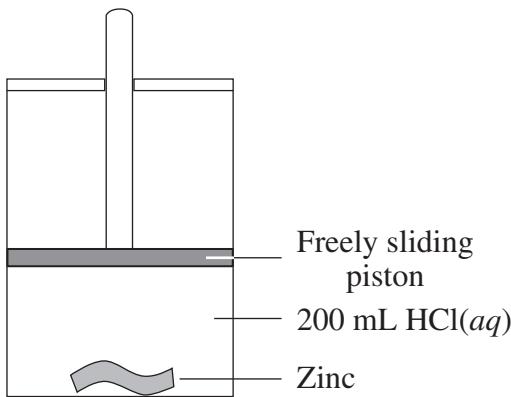


- (a) Describe, in words, the change in the speed of the car for t
- (i) the first 10 secs
 - (ii) from 10 secs to 15 secs
 - (iii) the final 5 secs

3

Mod 6 – Question 10 (5 marks)

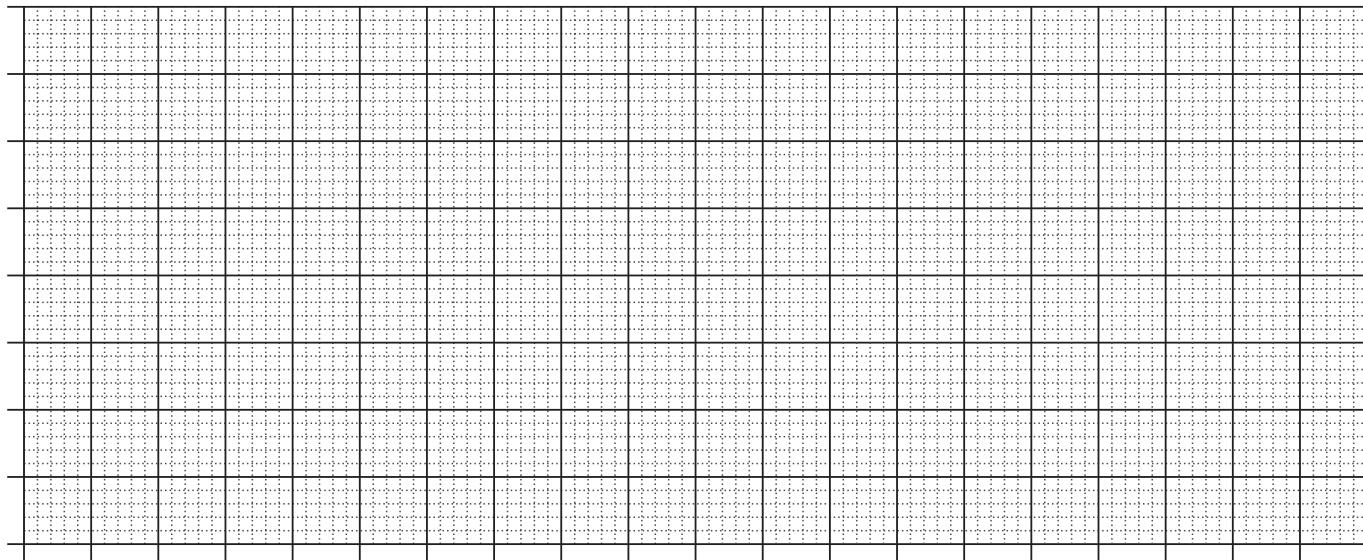
A student carried out a first-hand investigation to identify the relationship between the mass of a metal used in a reaction and the volume of gas produced. The first-hand investigation was carried out at 25°C and 100 kPa. In each trial, 200 mL of hydrochloric acid was added to some zinc, and the volume of gas produced was recorded. The diagram shows the equipment used, and the table contains the student's results.



<i>Mass of zinc (g)</i>	<i>Volume of gas collected (mL)</i>
0.12	45
0.33	125
0.56	115
0.83	315
0.96	365
1.22	380
1.64	380
1.93	380

- (a) Draw an appropriate graph to represent these results.

3



- (b) Predict the volume of gas that would be produced in this experiment if 3.00 g of zinc is used. Justify your answer.

2