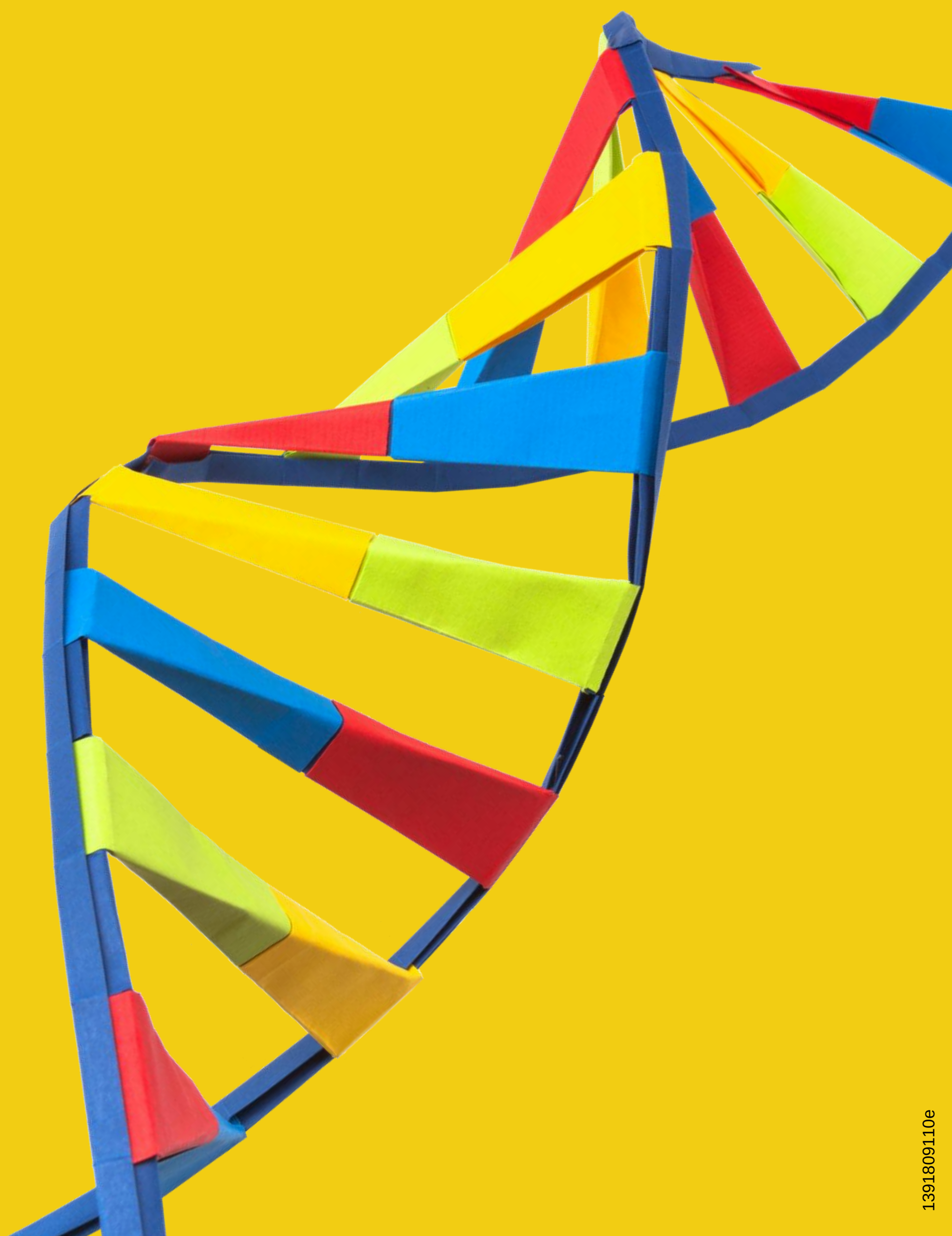
Pearson
Edexcel

GCSE Science

Practical Booklet: Terminology



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Introduction

This booklet has been crafted to support students in mastering the essential terms and concepts they will encounter throughout their GCSE science studies. Understanding and correctly using scientific terminology is crucial for both grasping core concepts and excelling in exams. The primary goal of this glossary is to offer a student-friendly guide to the terminology that frequently appears in GCSE science lessons and exams. Drawing from practical guides and curriculum specifications, this glossary includes a carefully curated list of terms relevant to practical science activities. Each term has been selected to ensure it aligns with the needs and expectations of GCSE science courses, providing students with a robust understanding of the language of science.

What You'll Find in This Booklet

Comprehensive Definitions: Each term is defined in straightforward, accessible language to ensure that students can easily grasp its meaning.

Visual Representations: Wherever possible, visual aids accompany definitions to help clarify concepts and provide a visual context, making complex ideas easier to understand.

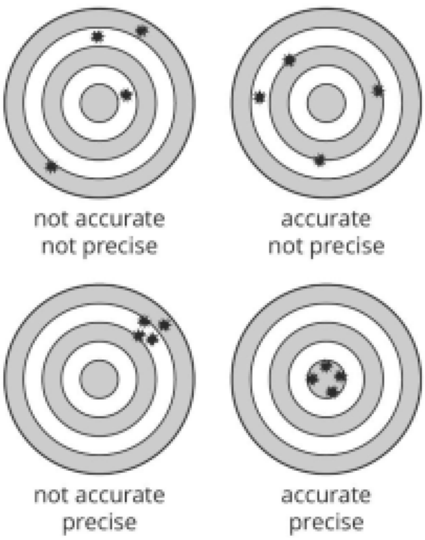
Exam Questions and Analysis: To illustrate how these terms are applied in a testing environment, we have included sample exam questions. These are accompanied by detailed analyses, including candidate answers, mark schemes, and awarding of marks, helping students to see how their knowledge is assessed.

Practice Questions: At the end of each section, you'll find additional questions designed to reinforce your understanding and provide practice opportunities similar to those found in exams.

Accuracy and Precision within Practical Science

Accuracy	This is how close a measurement is to its true value.
Precision	Is how closely repeated the measurements are, for results to be precise there will be a small range between your measurements.

As you can see below this dartboard analogy helps clarify the difference between accuracy and precision: accuracy is about hitting the target, while precision is about hitting the same spot consistently.



In practical science, we commonly use the terms "accurate" and "precise" to evaluate the effectiveness of methods and the reliability of apparatus. Here's how these concepts apply in a practical context:

Accuracy in Practical Work

When we talk about accuracy in practical experiments, we are referring to how close the results obtained are to the true or accepted value.

Method: An accurate method is one that consistently produces results close to the true value. Often, we need to amend and improve a method to obtain accurate and precise results. This could be simply stirring a liquid to ensure the temperature is uniform throughout the liquid or adding a marker to a spring to make it easier to read the results.

Apparatus: An accurate piece of apparatus gives measurements that are close to the true value. For instance, rather than using universal indicator to measure the pH of a solution, if you use a pH meter that is correctly calibrated, it should give you a pH reading that is close to the actual pH of the solution you're testing.

Precision in Practical Work

Precision, on the other hand, relates to the consistency of your results when using the same method or apparatus repeatedly.

For Example: If you use a pipette that consistently dispenses 50.0 mL of liquid each time, it is precise. However, if the true volume should be 52.0 mL, the pipette is not accurate, but it is still precise.

Application in Practical Work

In practical experiments, both accuracy and precision are important for obtaining reliable results:

Evaluating Methods: When designing or assessing a practical method, you should consider whether it produces results close to the true value (accuracy) and whether it produces consistent results (precision).

Assessing Apparatus: When choosing or evaluating equipment, check if it consistently gives the same readings (precision) and if those readings are close to the true value (accuracy).

Useful tips

When conducting GCSE science practical’s, it is crucial to follow precise techniques to ensure accurate results. Always calibrate equipment, such as balances, by ensuring they read zero before measurement. For chemistry experiments, use a pipette and minimize parallax errors by reading measurements at eye level. Use digital apparatus like multi-meters or pH meters over analogue versions for better accuracy and ease of use. When working with electrodes, rinse them with alcohol since it evaporates quickly and won’t affect the mass. Additionally, when using a runway in experiments, raise it slightly to compensate for friction and ensure accurate results.

Sample exam question

Q5aii, 1SC0/1BH, June 2023

1 A student investigated the movement of water in potatoes.

The student used three identical cubes of potato. […]

One cube was placed in water and each of the other two cubes were placed in solutions with different concentrations of salt. The cubes were left for 20 minutes.

Figure 7 shows the student's results.

	starting mass in grams	**final mass in grams**
water	0.95	1.08
dilute salt solution	0.95	0.98
concentrated salt solution	0.94	0.88

(ii) Give one way the student could ensure the measurement of the mass of the cubes is **accurate**. **(1)**

Examiners' report

This was a practical skills question which asked how the accuracy of a measurement could be improved. **Accuracy** is about how close the measured value is to the true value. The mark was awarded for drying the cube before its mass was measured or measuring using a balance that measured to a 1000th gram. Some candidates gave the idea of using a balance or repeating the measurement which does not address accuracy.

Mark scheme

Question number	Answer	Additional guidance	Mark
1(a)(ii)	dry the cube / check the balance is on zero	accept use a balance accurate to 1000th gram ignore repeat the investigation	**(1)**

Exam Style Questions

Q1 A student measures the density of glass.

The student has

− a bag of marbles, all made from the same type of glass

− a weighing balance

− a plastic measuring cylinder containing water

Describe how the student could find, as accurately as possible, the density of the glass used for the marbles. **(4)**

....

....

....

....

....

Q2 In this investigation, the resistance can be measured in two ways.

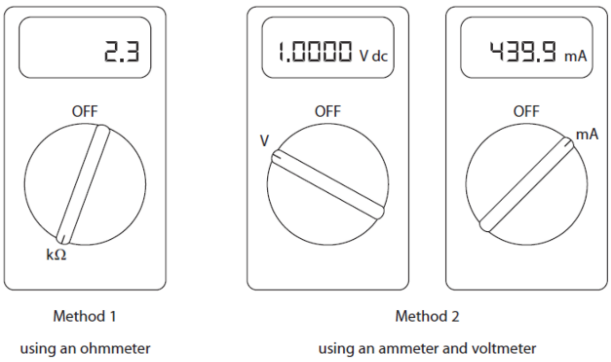


Figure 18

Method 1 − use an ohmmeter.

Method 2 − use an ammeter and a voltmeter.

(ii) Explain why method 2 gives more precise results than method 1.

(1)

....

Q3 The student finds it difficult to make an accurate measurement of the change in length of the spring using the equipment as shown.

Describe **one** way that the student could improve the procedure.

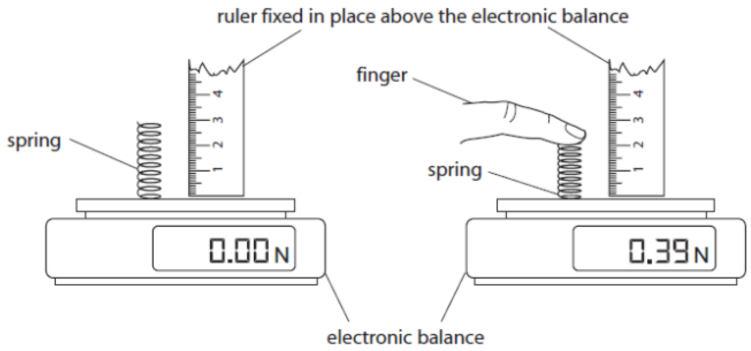


Figure 17

(2)

....

....

....

Mark Schemes

Q1

Question Number	Answer	Additional guidance	Mark
	A description including: find mass of marble(s) (1) put marble(s) into water (in cylinder) and measure **change** in water level (1) divide mass by volume (1) suitable idea to improve accuracy such as use several marbles (1)	weigh marble(s) accept volume for water level note level before and after marble(s) added find **volume** of water displaced density = mass/volume in words or symbols subtract mass of bag from total mass of marbles and bag ensure water measured at eye level use appropriately sized measuring cylinder ignore reference to repeating and taking average	**(4)**

Q2

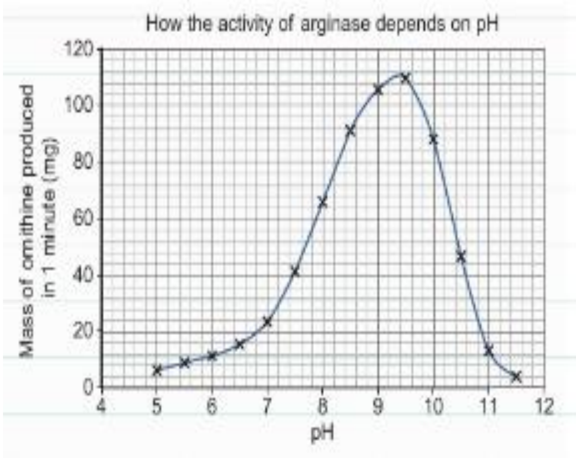
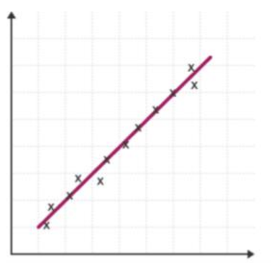
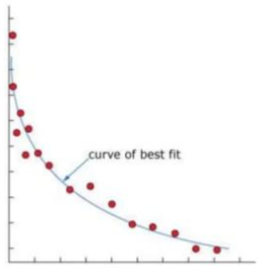
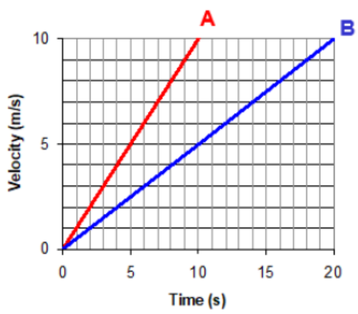
Question number	Answer	Additional guidance	Mark
(ii)	an explanation including: method 2 has measurements to more significant figures / more decimal places (than method 1) (1) so the calculated answer can have more s.f.'s / d.p.'s (1)	may be shown via a calculation accept an alternative argument in terms of consistency in final calculated answer ignore restating stem of question – e.g. so more precise ignore more accurate	**(2)** **AO3.2**

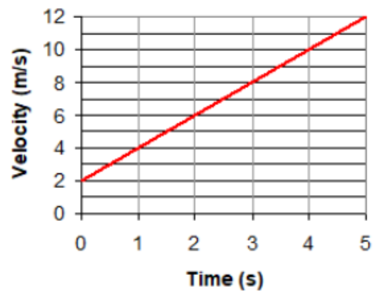
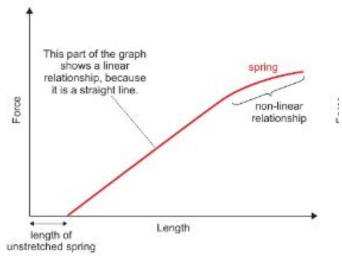
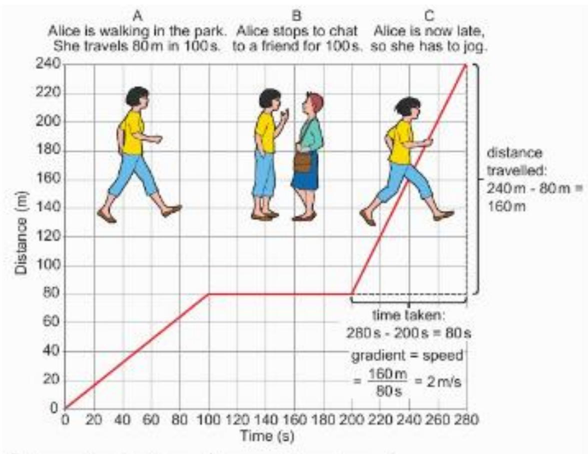
Q3

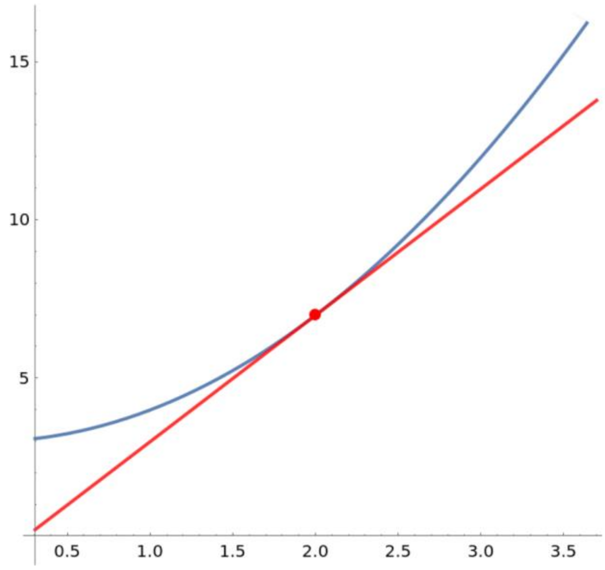
Question number	Answer	Additional guidance	Mark
(iii)	change to enable accurate location of top of spring (1) for example: pointer, set square, thin sheet / another ruler (under finger) description of how the change is used (1)	in Figure 17 move ruler closer to spring compress spring with weight rather than finger ignore photographs make measurements from where pointer / set square / thin sheet / other ruler touches the ruler reduce parallax error prevents fluctuations while measuring ignore repeats ignore unqualified references to accuracy or precision	**(2)** **AO3**

Graphs within Practical Work

In science practicals, graphs are essential tools for visualising data and identifying relationships between variables. Understanding key terms related to graphs can help you accurately interpret and present your experimental results.

Scale	The scale of a graph refers to the number values assigned to each division on the axes. Choosing an appropriate scale is crucial for accurately representing data, normally 1,2,5,10 and not 3,4,6,7,8,9. The scale should be consistent and large enough to clearly show trends without distorting the information.	
Line of best fit	A line of best fit is a straight or curved line drawn on a graph that best represents the data points, make sure there is an even number of points either side of the line. It may pass through some or none of the points	 
Directly proportional	When two variables are directly proportional, it means that as one variable increases, the other increases at a constant rate. This relationship is represented on a graph by a straight line that passes through the origin (0,0).	

Linear relationship	A linear relationship between two variables is shown on a graph as a straight line. This line does not necessarily have to pass through the origin.	
Non-Linear relationship	A non-linear relationship is one in which the rate of change between two variables is not constant, resulting in a curved line on the graph.	
Gradient	The gradient of a line on a graph shows how steep the line is. It tells us how much the value on the y-axis changes for every change in the x-axis. If the gradient is high, the line is steep; if the gradient is low, the line is less steep. In simple terms, it tells us how quickly something is increasing or decreasing. Gradient = Change in y value/ Change in x value	

Tangent	A tangent is a straight line that touches a curve at just one point. The tangent line should have the same slope (steepness) as the curve at that point, if you're drawing a tangent to a curve, the tangent at any point will be perpendicular to the radius at that point.	

Sample Questions

Q1

(ii) Figure 4 shows a graph of the results.

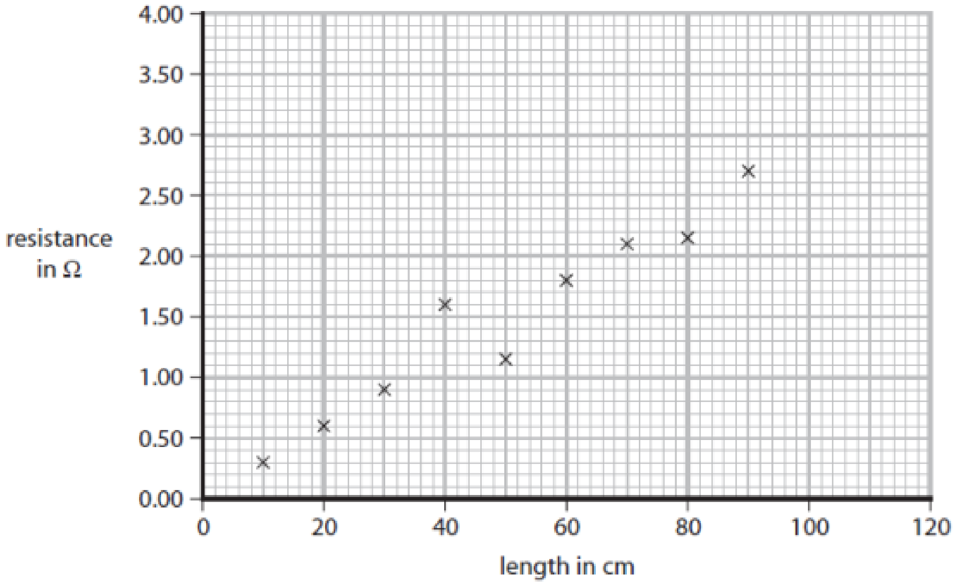


Figure 4

Draw a straight line of best fit on Figure 4.

(1)

Q2

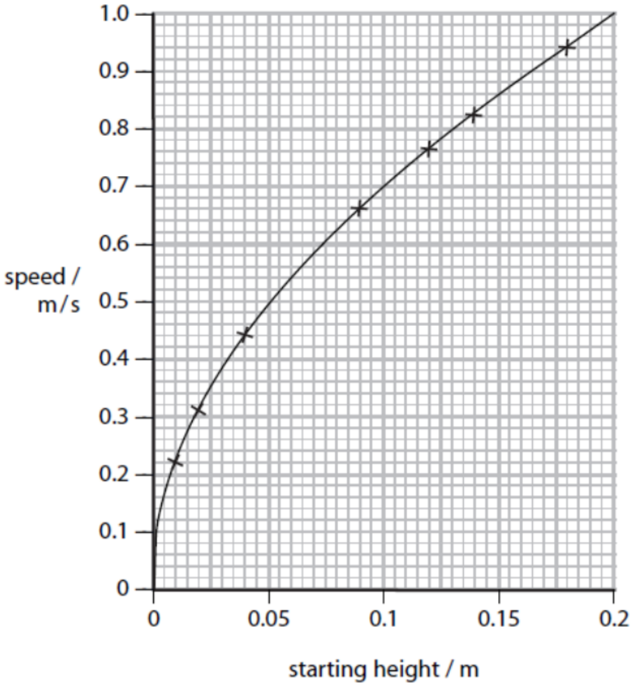


Figure 11

(ii) Determine the gradient of the graph when the height is 0.1 m.

(2)

gradient = ...

Q3

The graph in Figure 12 shows the results of this experiment.

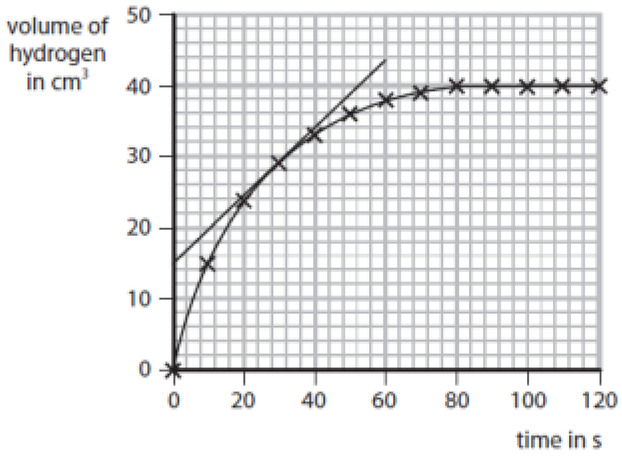


Figure 12

(ii) A tangent has been drawn to the line on the graph in Figure 12. Calculate the rate of reaction at this point.

(2)

....
....
....
....

rate of reaction = ... $cm^3\ s^{-1}$

Examiners’ Reports for Sample Questions

Q1. (ii-iii) There was a range of possible lines of best fit and examiners would accept any straight line that, if extended, gave a resistance between 2.8 ohms and 3.2 ohms at 100cm and crossed the horizontal axis between 0 and 6cm. A neat line of best fit was drawn by most candidates and the resistance of 100 cm of wire correctly found from the graph. Partial credit was also given for correctly reading the value at 100cm from a line that was not in the acceptable range.

Results Plus: Examiner Comments

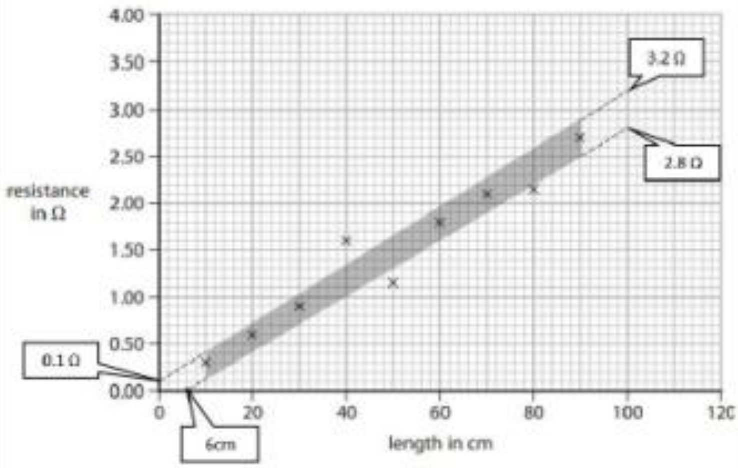
A nice straight line that goes through or close to as many points as possible and a correct reading of the graph to predict the resistance of 100cm of wire.

Q2 Remember to draw the line on the graph and show the triangle. The line should be a tangent to the curve.

Q3 (ii) Just over a third of the students could make an attempt at calculating the gradient at the point shown by using the tangent line. Some made errors in reading the graph to calculate the gradient. The most obvious error seen was where students calculated the average gradient by dividing the volume at that point (29 cm3) by the time (30 s). Many others used numbers that were difficult to identify how they were obtained. It seemed that few students knew how to calculate the gradient of the line shown.

Mark schemes

Q1

Question number	Answer	Additional guidance	Mark
(ii)	(ii) Figure 4 shows a graph of the results.  	accept any straight line within the shaded range judge by eye. ignore extrapol-ation for this marking point	(1) AO2

Q2

Question number	Answer	Additional guidance	Mark
(b)(ii)	• Tangent to the graph at h = 0.1 (1) • Answer in the region 3.5 to 3.6	either seen on graph or suitable pairs of values of Δv and Δh	(2)

Q3

Question Number	Answer	Additional guidance	Mark
(ii)	final answer in range 0.44 – 0.52 inclusive with or without working (2) If answer not in range: $\frac{\text{difference in volume}}{\text{difference in time}} = \frac{(43 - 15)}{(60 - 0)}$ (1) = 0.47 / 0.467 (1)	allow ecf throughout where values are less than 1 (1 max) use of inverted gradient expression giving 2.27 – 1.92 scores 1 mark (evidence of working required)	**(2)** AO 2 1

Exam Style questions

Q1

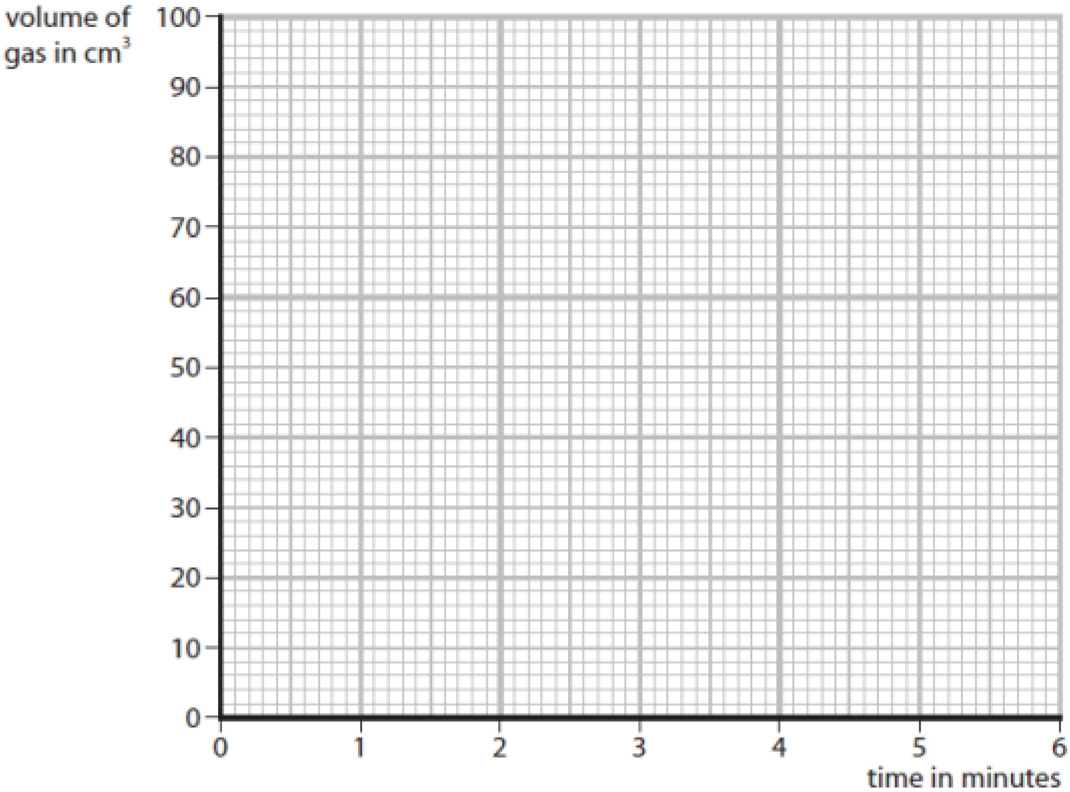
time in minutes	0	1	2	3	4	5	6
volume of gas in cm^3	0	52	78	91	97	100	100

Figure 11

On the grid, plot the results shown in Figure 11.

Draw a curve of best fit.

(3)



(Total for question = 3 marks)

Q2.

A student investigated the rate of reaction between dilute hydrochloric acid and marble chips (calcium carbonate).

Calcium chloride, carbon dioxide and water are formed.

The student investigated the rate by using different sizes of marble chips. In their investigation, the same mass of marble chips was used in each experiment.

The volume of gas given off was measured.

The graph in Figure 8 shows the results. Figure 8

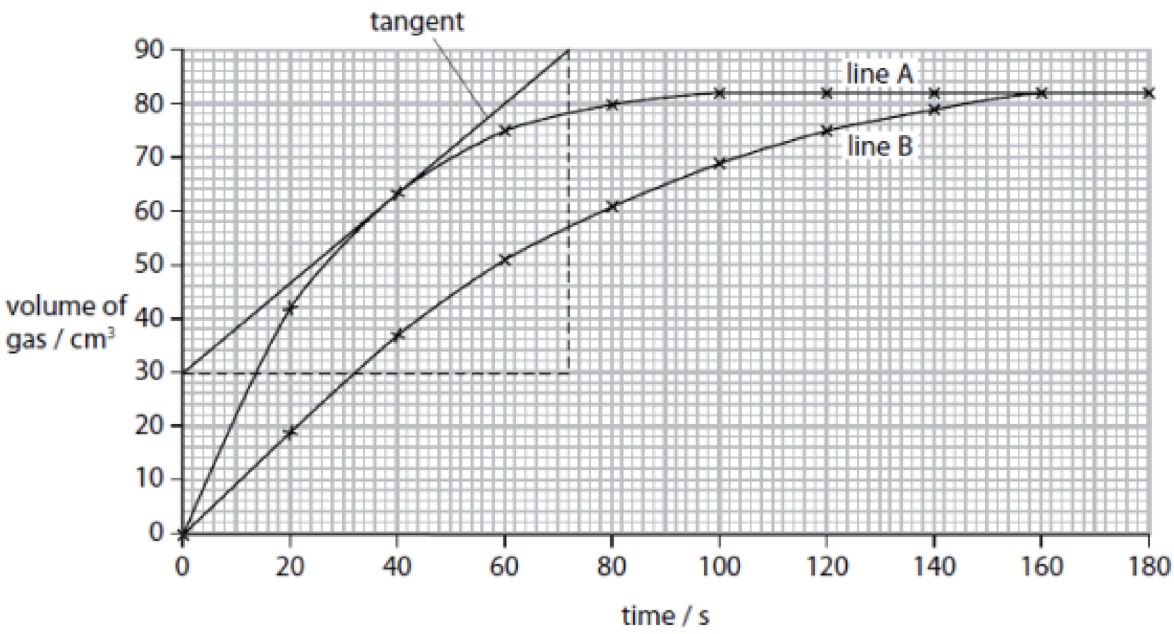


Figure 8

(i) State how the graph shows that line B gives the results for the larger marble chips. (1)

....

..

....

..

(ii) (ii) A tangent has been drawn on line A.

Calculate the rate of reaction at this point. (2)

rate of reaction = ... cm^3 s^{-1} (Total for question = 3 marks)

Q3.

The reaction between calcium carbonate and dilute hydrochloric acid was investigated at different temperatures.

(i) State what could be used to keep the temperature of the conical flask and its contents at a temperature of 45 °C throughout the reaction.

(1)

....

....

(iii)
(iv) Figure 6 shows a graph of volume of gas collected in this investigation.

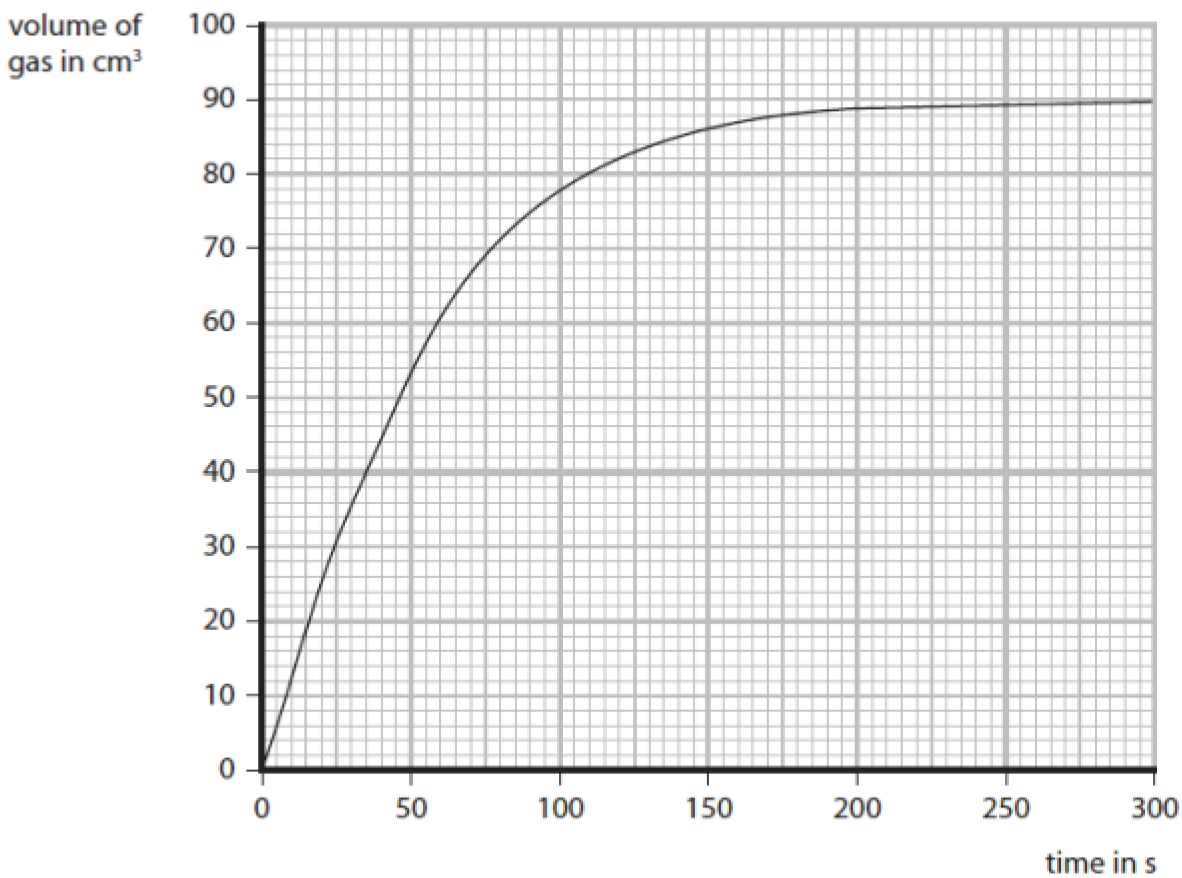


Figure 6

Draw a tangent at 100 seconds on Figure 6.

Use this tangent to calculate the rate of reaction at this time.

(2)

....

..

....

..

rate of reaction = ... $cm^3\ s^{-1}$

Examiners' reports for Exam Style Questions

Q1

Results Plus: Examiner Tip

A line of best fit is not always one straight line.

Results Plus: Examiner Comments

Joining the points with straight lines and a ruler was not credited.

Results Plus: Examiner Tip

A curve of best fit should be one single line, drawn freehand.

Q2 Rather than just saying steeper, use the titles on this axes,

Q3

(i) A lot of correct responses were seen here, although there were two common mistakes. Candidates often wrote to use a thermometer to control the temperature, or suggested the use of a Bunsen Burner to get the mixture to 45°C.

(ii) This question was very poorly answered, and most candidates did not correctly draw any sort of tangent onto the curve. Many candidates simply read the volume of gas produced at 100 seconds and divided the two numbers. Other incorrect attempts at drawing a tangent included drawing a triangle underneath the curve.

Mark schemes

Q1

Question number	Answer	Additional guidance	Mark
	6 or 7 points plotted correctly (2) or 4 or 5 points plotted correctly (1) best fit curve starting at (0,0) (1)	allow +/- half a square. for MP3, curve must be a single smooth curved line going through most or all of THEIR plotted points (ecf allowed), or if the points are not visible, through most or all of the correct values. reject curves going above or below $100cm^3$ by more than half a square. reject straight line / dot to dot straight lines bar charts – max 2 marks for plotting points if time value is clear	**(3)** **AO2-1**

Q2

Question number	Answer	Mark
(i)	(line B) less steep/(line B) flattens later (1)	**(1)**

Question number	Answer	Mark
(ii)	• Slope = 60 ÷ 72 (1) • = 0.83(3) (cm^3 s^{-1}) (1)	**(2)**

Q3

Question number	Answer	Additional guidance	Mark
(i)	conical flask in water bath [could be shown on diagram]	Reject heat with a Bunsen burner warm water alone is not enough.	**(1)** **AO3**

Question number	Answer	Mark
(ii)	Using tangent drawn on graph eg $\frac{\text{vertical difference}}{\text{horizontal difference}}$ $\frac{(100 - 52)}{180}$ (1) (1) (= 0.267) (cm^3 s^{-1}) calculation will depend on final graph 2 marks for rate being within a range eg 0.250 – 0.290 1 mark for rate being in range 0.230 – 0.249 or 0.291 – 0.310	**(2)** **AO3**

Mathematics within Practical Work

In your science practicals, always verify that you're using the correct units for each measurement.

- Familiarise yourself with prefixes like "kilo-" and "milli-" to make handling data easier.
- Remember to convert units when necessary to maintain consistency, and whenever possible, use SI units to ensure your work is clear and standardised.
- Choose the right number of decimal places and significant figures, this is normally stated in the question.
- Also, remember to repeat your results, calculate mean for more reliable results and watch out for any odd data points that don't fit the pattern.

Units	Units tell us what we're measuring. Always make sure to use the right unit for whatever you're measuring. This helps to eliminate any power of 10 issues with calculations. SI units (International System of Units) are the standard units used in science worldwide. These include metres (m) for length, kilograms (kg) for mass, and seconds (s) for time.
Prefixes	Prefixes are used to make very large or very small numbers easier to work with. For example, "kilo-" (k) means 1,000 times the unit, so 1 kilometre (km) is 1,000 metres. "Milli-" (m) means one-thousandth, so 1 milligram (mg) is 0.001 grams.
Decimal Places	Decimal places are the digits that come after the decimal point in a number. It's important to use the right number of decimal places to match the accuracy of your measuring tools.
Significant Figures	Significant figures are the digits in a number that tell you something about its precision. These include all non-zero digits, any zeros between them, and zeros after the decimal point if they're at the end of the number.
Unknown Equations	Sometimes, you'll need to figure out a number you can't measure directly, and you will need to use an equation. It is important that you ensure the units are correct and you have taken account of any prefixes in the question.
Mean	In experiments, the mean is just the sum of all your measurements divided by the number of measurements. This helps smooth out any random errors and gives you a better idea of the true value. It is important not to use any anomalous results within your calculation.
Identifying Anomalous Results	Anomalous results are those odd numbers that don't fit in with the rest of your data. They might happen because of a mistake or a problem with your equipment. We normally exclude them when analysing your results or working out averages.

Sample Questions

Q1

A student wants to estimate the number of daisy plants in a 500 m2 field.

She uses a 1 m2 quadrat to sample the field.

Figure 9 shows the results for the number of daisy plants counted in six areas sampled with the quadrat.

sample number	number of daisy plants	mean diameter of daisy plants / cm
1	5	7
2	2	2
3	6	9
4	3	3
5	4	5
6	4	6

Figure 9

(i) Calculate the mean number of daisy plants for the six samples.

(1)

mean number of daisy plants = ...

Q2

Figure 3 shows some titration results obtained from an experiment in which an alkali is titrated with an acid.

	titration		
	rough	1	2
final burette reading in cm^3	25.75	49.35	23.70
initial burette reading in cm^3	0.00	25.75	0.00
volume of acid used in cm^3	25.75	23.60	23.70

Figure 3

Figure 3 Calculate the accurate volume of acid reacting with the alkali. **(2)**

....

....

....

accurate volume of acid reacting .... cm^3

(Total for question = 2 marks)

Examiners' report

Q1 Show working out.

Q2

Results Plus: Examiner Comments

Where learners did not score it was often because they had tried to give a midpoint of the values or simply gave the last value in the table.

Mark scheme

Q1

Question number	Answer	Mark
(i)	$\frac{5+2+6+3+4+4}{6} = 4$ (1)	**(1)**

Q2

Question Number	Answer	Additional guidance	Mark
	23.65 with or without working scores 2 OR $\frac{23.60+23.70}{2}$ (1) = 23.65 (1)	allow 1 mark for all 3 averaged (24.35)	**(2)** AO 3 2a AO 3 2b

Exam Style Questions

Q1

The results of titrations to determine how much of an acid is required to neutralise a given volume of an alkaline solution are shown in Figure 14.

	titration 1	titration 2	titration 3	titration 4
final burette reading (cm^3)	27	27.40	29.20	29.30
initial burette reading (cm^3)	0	2.10	4.00	3.50
volume of acid used (cm^3)	27	25.30	25.20	25.80

Figure 14

Two of the titrations in Figure 14 should not be used to calculate the mean volume of acid required.

Identify each titration and give a reason why it should not be used in the calculation of the mean.

(2)

....

....

....

....

Q2

Scientists use a technique called mark and recapture to estimate animal populations in a habitat.

A sample of the population is captured and a harmless mark is added to each animal.

These animals are released and after a period of time the population is sampled again.

This second sample includes some recaptured animals that have marks on them.

$$\text{population size} = \frac{\text{number marked in the first sample} \times \text{size of the second sample}}{\text{number recaptured in the second sample}}$$

The population can be estimated using this equation A scientist used this technique to determine the change in the population size of snails in a pond from March to July.

month	number marked in the first sample	size of the second sample	number of recaptured animals	population size
March	18	22	8	50
July	12	18	10	

Figure 9

Figure 9 shows the results.

(i) Using data from Figure 9, calculate the difference in the population size from March to July.

(3)

Difference in the population size ....

Q3

A radio station transmits on 97.4MHz. To receive the waves an aerial needs a length equal to half the wavelength of the radio waves being transmitted.

Calculate the length of the aerial needed.

The speed of the radio waves is 3.00 × 108m/s.

(3)

length of aerial = ... m

Q4

(i) Show that a speed of 31m/s is less than a speed of 130 km/h.

(2)

(ii) The driver's reaction time is the time between the driver seeing an emergency and starting to brake.

A car is travelling at a speed of 31m/s.

The car travels 46m between the driver seeing an emergency and starting to brake.

Calculate the driver's reaction time.

Give your answer to 2 significant figures.

(3)

driver's reaction time .... s

Additional Examiners' report

Q1 Write down the titration number and then quote the volume.

Q2

Results Plus: Examiner Tip

Always show workings to calculations in case you make a mistake.

Results Plus: Examiner Tip

Remember when working with organisms you cannot have a fraction of an organism.

Q3

Many were able to recall and rearrange $v = f \times \lambda$. The main sources of error involved powers of 10 and the length of the aerial was $\lambda/2$.

Q4(i)

ResultsPlus
Examiner Comments

Some candidates worked from 31m/s and converted to m/min then m/hr before dividing by 1000.

ResultsPlus
Examiner Tip

Always show the conversion of units, that will get a mark. Then convert one unit at a time.

ResultsPlus
Examiner Comments

Candidates must learn the multiples of units and be able to use the common knowledge that there are 60 seconds in a minute and 60 minutes in an hour.

ResultsPlus
Examiner Tip

Always show the conversion of units, that will get a mark. Then convert one unit at a time.

For km to m multiply by 1000, for hours to seconds divide the metre answer by 60x60.

(ii)

ResultsPlus
Examiner Comments

Once the equation is rearranged the value obtained for the reaction time is 1.48s.

However it is required that the answer is given to 2 significant figures and should therefore be correctly rounded to 1.5s.

ResultsPlus
Examiner Tip

If rearranging equations is demanding, then write down the equation as it is seen and substitute the values that are given. In many cases a mark is given for correct substitution.

Mark schemes

Q1

Question number	Answer	Mark
(d)	• {titration 1/27 cm^3} should not be used because burette readings {not precise/not accurate/not read to 2 d.p.} (1) • {titration 4/25.80 cm^3} should not be used because volume of used (25.80 cm^3) not concordant with other two (1)	(2)

Q2

Question Number	Answer	Additional Guidance	Mark
(i)	substitution (12 x 18 ÷10) = 21.6 (1) whole organism (1) = 21 / 22 (50 – 21 / 22) = 28 / 29	award full marks for correct answer with no working e.c.f. from incorrect substitution **using data from the table** e.c.f. from incorrect whole organism award two marks for 28.4 or 27.9 or 22 or 21 without working	**(3)** **AO2**

Q3

Question number	Answer	Additional guidance	Mark
5 (a)	recall **and** rearrangement (1) $\lambda = \frac{v}{f}$ evaluation (1) 3.08 (m) (so) length of aerial = 1.54 m (1) check working $\frac{3 \times 10^8}{2} = 1.5 \times 10^8$ gets only 1 mark for ecf	$\frac{3.0\ (\times 10^8)}{97.4\ (\times 10^6)}$ accept 3.1 (m) award 1 mark for wavelength that rounds to 3.1 to any other power of 10 independent mark. allow ECF from candidate's wavelength accept 1.5 (m) award 2 marks for 1.5 to any other power of 10 award full marks for the correct answer without working Allow 1.46 rounded to 1.5 for 1 mark only if it is ecf from mp2	**(3)**

Q4

	Answer	Additional guidance	Mark
3(a)(ii)	convert **either** distance or time (1) (31 m =) $\frac{31}{1000}$ (km) or 0.031 (km) **OR** (1 s =) $\frac{1}{3600}$ (h) = $\frac{1}{60\times60}$ (h) or 0.000 28 (h) evaluation (1) (31 m/s =) 110 (km/h)	(130 km =) 130 × 1000 (m) or 130 000 (m) **OR** (1 h =) 60 x 60 (s) or 3600 (s) (130 km/h =) 36(.1) (m/s) accept 111.6 or 112 (km/h) for 2 marks if no other marks awarded accept <u>1860 m/min</u> and <u>2167 m/min</u> for 1 mark each award full marks for the correct answer without working	**(2)** **AO2**

	Answer	Additional guidance	Mark
3(a)(iii)	select and substitute into distance travelled = average speed x time (1) 46 = 31 x t rearrangement and evaluation (1) (t=) 1.48(3) (s) evaluation given to 2 sf (1) (t =) 1.5 (s)	$31 = \frac{46}{t}$ (t =) $\frac{46}{31}$ award two marks for the correct evaluation without working any answer written to 2 sf independent mark 1.5 scores 3 marks 1.4 scores 2 marks 1.50 scores 2 marks 0.67 scores 2 marks 1400 scores 2 marks 0.673(9) scores 1 mark 1426 scores 1 mark	(3) AO2