

6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

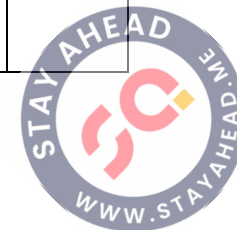
7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

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Question	Answer	Marks
1(a)	Value of L in range 52.5–53.5 cm.	1
1(b)	Value of T in the range 1.00–2.00 s.	1
	At least two measurements of nT where $n \geq 5$.	1
1(c)	Six (or more) sets of readings of S (different values) and T with the correct trend (as S increases T decreases) and without help from the Supervisor scores 4 marks, five sets scores 3 marks, etc.	4
	Range: Includes $S \leq 10.0$ cm and $S \geq 40.0$ cm.	1
	Column headings: Each column heading must contain a quantity and a unit where appropriate. The presentation of quantity and unit must conform to accepted scientific convention e.g. $\sqrt{(L - S)} / \text{cm}^{1/2}$.	1
	Consistency: All values of S must be given to the nearest 0.1 cm.	1
	Calculation: Values of $\sqrt{(L - S)}$ are correct.	1
1(d)(i)	Axes: Axes must be labelled with the correct quantities. Scales must be chosen so that the plotted points occupy at least half the graph grid in both the x and y directions. Scale markings are no more than 2 cm (one large square) apart. Sensible scales must be used. Scales must not be awkward (e.g. 3:10 or fractions).	1
	Plotting of points: All observations in the table must be plotted on the grid. Diameter of plotted points must be \leq half a small square. Points must be plotted to an accuracy of half a small square in both x and y directions.	1
	Quality: Trend of points must be positive. All points in the table must be plotted on the grid (at least 5). It must be possible to draw a straight line that is within $\pm 0.2 \text{ cm}^{1/2}$ ($\pm 0.02 \text{ m}^{1/2}$) on the $\sqrt{(L - S)}$ axis of all plotted points.	1



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Question	Answer	Marks
1(d)(ii)	<p>Line of best fit: 'Best fit' is judged by the balance of all points on the grid (at least 5 points) about the candidate's line. There must be an even distribution of points either side of the line along the full length. Lines must not be kinked or thicker than half a square.</p> <p>Some candidates may choose to identify an anomalous point. If they identify one point as anomalous (e.g. by circling or labelling) then this point is to be disregarded when judging the line of best fit. There must be at least 5 points left after the anomalous point is disregarded.</p>	1
1(d)(iii)	<p>Gradient: The hypotenuse of the triangle used should be greater than half the length of the drawn line. Both read-offs must be accurate to half a small square in both the x and y directions. The method of calculation must be correct, not $\Delta x / \Delta y$. The gradient sign on the answer line must be consistent with the graph drawn.</p>	1
	<p>y-intercept: Intercept read directly from the graph, with read-off at $x = 0$, accurate to half a small square in y direction. or Correct read-off from a point on the line and substituted correctly into $y = mx + c$ or an equivalent expression. Read-off accurate to half a small square in both x and y directions.</p>	1
1(e)(i)	<p>Value of A = candidate's gradient and value of B = candidate's y-intercept. The values must not be written as fractions or surds or given to only one significant figure.</p>	1
	<p>Unit for A: $s\ m^{-1/2}$ or $s\ cm^{-1/2}$ and unit for B: s.</p>	1
1(e)(ii)	<p>g calculated correctly using $g = \pi^2 / A^2$ and with correct unit.</p>	1



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Question	Answer	Marks
2(a)(i)	x , y and z measured to the nearest millimetre and x in the range 0.495–0.505 m.	1
	Correct calculation of volume.	1
2(a)(ii)	Justification for significant figures in V linked to significant figures in x , y and z .	1
2(b)(i)	d in the range 0.145–0.155 m.	1
2(b)(ii)	F measured to the nearest 0.01 N and final F in range 0.10–1.00 N.	1
	At least two measurements of F .	1
2(b)(iii)	Percentage uncertainty in F based on an absolute uncertainty in the range 0.02–0.06 N. Correct method of calculation to obtain percentage uncertainty, e.g. (absolute uncertainty \times 100 / final value from (b)(ii)). If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is shown clearly.	1
2(b)(iv)	Second value of d and second value of F .	1
	Second value of F larger than first value of F .	1
2(c)	Two values of k calculated correctly. The final k values must not be written as fractions or given to only one significant figure.	1
2(d)	Calculation of percentage difference between candidate's two k values. Comparison of percentage difference with 15% leading to a consistent conclusion.	1
2(e)	Correct calculation of ρ with correct unit e.g. kg m^{-3} .	1



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Question	Answer	Marks
2(f)(i)	<p>A Two readings are not enough to draw a (valid) conclusion (not “not enough for accurate results”, “few readings”).</p> <p>B y is small so uncertainty is large or large <u>percentage</u> uncertainty in measuring y.</p> <p>C Difficult to measure d with a reason e.g. difficult to judge the centre of the mass, parallax error, difficult to hold/maintain ruler parallel to strip.</p> <p>D Difficult to get a value of F <u>with reason</u> e.g. reading changes suddenly or difficult to determine when strip leaves the rod.</p> <p>E Difficult to keep/ensure/maintain the newton meter vertical.</p> <p>F Newton meter not at the end of the strip.</p> <p>G Mass of adhesive putty not taken into account.</p> <p><i>1 mark for each point up to a maximum of 4.</i></p>	4
2(f)(ii)	<p>A Take more readings (for different values of d) <u>and</u> plot a graph or take more readings <u>and</u> compare k values (not “repeat readings” on its own).</p> <p>B Improved method to measure y e.g. use micrometer or (vernier/digital) calipers.</p> <p>C Improved method to measure d e.g. measure to the edge of the mass <u>and</u> add on the radius of the mass or clamp ruler.</p> <p>D Improved method to get value F e.g. video/record/film <u>with newton meter</u> (and strip) <u>in view</u> or force sensor <u>and</u> data logger.</p> <p>E Improved method to ensure vertical e.g. use a clamped metre rule <u>and</u> a set square to ensure vertical or use a plumb line as reference.</p> <p>F Add a hook/tape at end or tape string to strip or glue string to strip.</p> <p>G Subtract weight of putty from F or add mass of putty onto the mass or tape mass (instead of putty).</p> <p><i>1 mark for each point up to a maximum of 4.</i></p>	4

