

Question 1

- (c) Measurements 2/1/0
Write the number of readings as a ringed total next to the table of results.
Six sets of values for Δd and $F_1 - F_2$ scores 1 mark.
Check a value for $F_1 - F_2$. Underline checked value. Tick if correct and award 1 mark.
If incorrect write in correct value.
Minor help from Supervisor (e.g. with zero error) then -1.
Major help (equipment set up for the candidate) then -2.
No trend (i.e. random scatter of plots) then -2.
- (c) $\Delta d \geq 10$ cm scores two marks 2/1/0
 $\Delta d \geq 5$ cm scores one mark
 $\Delta d < 5$ cm scores zero
- (c) Quality of results 2/1/0
Judge by scatter of points about the line of best fit.
Six good trend plots on the graph grid needed for two marks to be scored.
Six plots with a little scatter or if a point is 'off-trend' then only one mark.
- (c) Column headings in the table 2/1/0
One mark for d heading correct.
One mark for $F_1 - F_2$ heading correct.
Ignore units in the body of the table.
- (c) Consistency of raw readings 2/1/0
One mark for d which must be to the nearest millimetre
One mark for F_1 and F_2 .
- (d) Axes 2/1/0
Sensible scales must be used. Awkward scales (e.g. 3:10, 6:10, 7:10) are not allowed.
The scales must be labelled with the quantities plotted. Ignore units.
Do not allow more than three large squares without a scale label.
Plotted points must occupy at least half the graph grid in both x and y directions (i.e. 4 x 6 large squares). If false origin, indicate with "FO"
One mark for each correct axis.
- (d) Plotting of points 2/1/0
Count the number of plots and write as a ringed number on the graph grid.
All observations must be plotted. Check a suspect plot. Tick if correct otherwise indicate the correct position.
If the plot is accurate \leq half a small square, then two marks awarded.
One mark if the plot is out by $>$ half a small square and $<$ than one small square.
- (d) Line of best fit 2/1/0
Judge by scatter of points about the line.
There must be a fair scatter of points either side of the line of best fit.
Allow line through five trend plots for full credit (if done well).
Do not allow a line through a curved trend.

- (e) Gradient 3/2/1/0
 Gradient must be negative – scores 1 mark. Circle and tick negative sign.
 The hypotenuse of the Δ must be \geq half the length of the drawn line. 1 mark.
 Read-offs must be accurate to half a small square and ratio correct. 1 mark.
- (e) y-intercept 1/0
 Expect the value to be read from the y-axis to an accuracy of half a small square.
 Or correct substitution from point on line into $y = mx + c$.
- (f) Gradient equated with $\frac{-2W}{L}$ (can be implied from working). 1
- (f) Correct working ($L = 0.980$ m, algebra OK and units of L and d are consistent) to give W . 1
 This mark **cannot** be scored if the gradient has not been equated with $\frac{-2W}{L}$.
- (f) Unit of W (N). 1
- (f) y-intercept equated with k . 1
- (f) Unit of k (N). 1
- (f) k and W within 10% of larger value of each other. 1
- (f) Significant figures in W 1
 Accept 2 or 3 sf only.
- (g) Improvement 1
 e.g. use spirit level to make sure that the rule is horizontal;
 use a thinner string.
 Do **NOT** allow more accurate meters or protractor unless qualified.

28 marks available