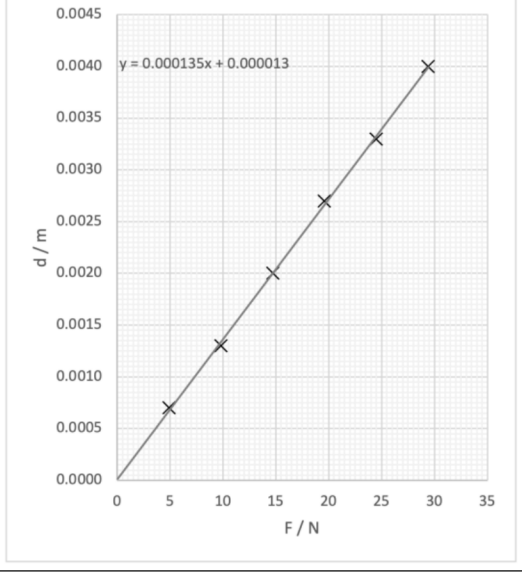
Question Number	Answer	Mark
4(a)	• No repeat measurements **(1)** • Inconsistent d.p. for *d* **Or** all values of *d* should be recorded to the same d.p. **Or** measurements of *d* are not all recorded to the same resolution (of the device) **(1)**	**2**
4(b)	• Labels axes with quantities and units **(1)** • Sensible scales **(1)** • Plotting **(2)** • Line of best fit **(1)**	**5**



F/N	d/ m
4.9	0.0007
9.8	0.0013
14.7	0.002
19.6	0.0027
24.5	0.0033
29.4	0.004

Question Number	Answer	Mark
4(c)(i)	**EITHER** • Re-arranges equation and compares to $y = mx$ (+ c) **(1)** • Shows that $m = \frac{l^3}{4wh^3E}$ **(1)** **OR** • Re-arranges equation to $\frac{d}{F} = \frac{l^3}{4wh^3E}$ **(1)** • States that $\frac{d}{F}$ = gradient of the graph plotted **(1)**	**2**
4(c)(ii)	• Calculates gradient using large triangle **(1)** • Gradient in the range 1.30×10^{-4} to 1.40×10^{-4} (m N^{-1}) **(1)** <u>Example of calculation:</u> Gradient = (0.0035 – 0.0010) / (26 – 7.5) = 1.35×10^{-4}	**2**
4(c)(iii)	• Use of gradient $= \frac{l^3}{4wh^3E}$ **(1)** **Or** use of substituted values of F and d into $E = \frac{l^3F}{4wh^3d}$ **(1)** • E value in the range 2.41 GPa to 2.60 GPa Ecf for gradient value in (c)(ii) – but not power of 10 errors in substitution of l, w, or h <u>Example of calculation:</u> $E = \frac{l^3}{4wh^3m}$ $E = \frac{(0.30\ \text{m})^3}{4 \times\ 0.020\ \text{m} \times (0.010\ \text{m})^3 \times\ 1.35\times10^{-4}\ \text{m N}^{-1}} = 2.5 \times 10^9\ \text{Pa}$	**2**
4(d)	• A thinner beam would cause a larger d (for the same force) **(1)** • Reducing <u>percentage</u> uncertainty (in d) **(1)** MP2 dependent on MP1	**2**
4(e)	• Identifies physics relating to health & safety **(1)** • Suggests a relevant safety issue **(1)** <u>Examples</u> • Glass is brittle, so will snap/break • Sharp edges could cause injury by causing cuts • Glass is stiffer, so a larger force/mass would be needed • A large mass could cause injury if the mass falls on feet	**2**
	Total for question 4	**17**