FORCES SUPPORTING A METER RULE

1 A student investigates the forces supporting a metre rule.

He uses the apparatus shown in Fig. 1.1. The scale of the metre rule faces upwards.

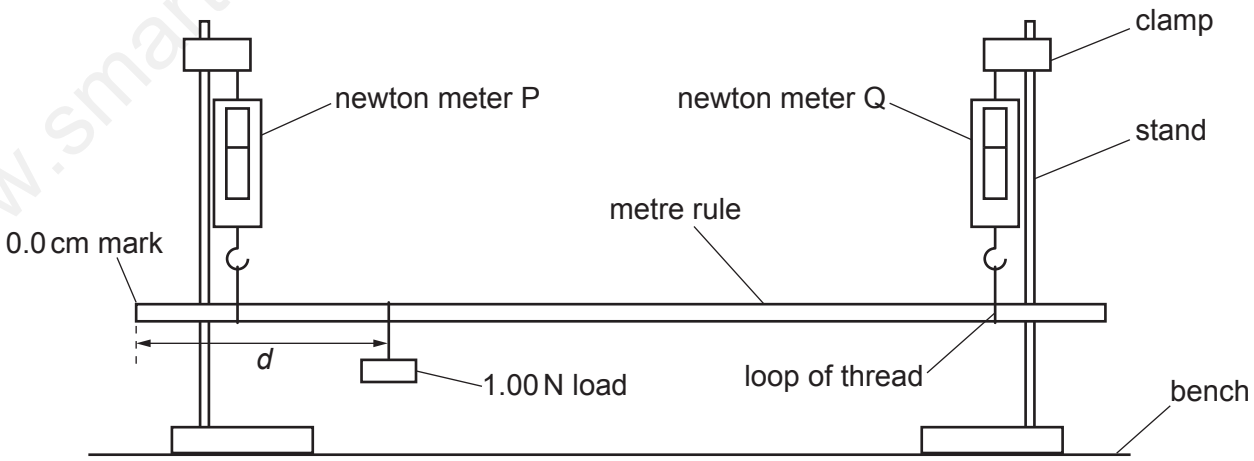

Fig. 1.1

(a) The student ensures that the metre rule is horizontal.

Briefly describe how to check that the rule is horizontal. You may draw a diagram if it helps to explain your answer.

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..... [1]

(b) **(i)** The student sets the distance *d* between the 0.0 cm mark and the 1.00 N load as shown in Fig. 1.1. He moves the thread supporting the 1.00 N load so that it is at the mark on the metre rule shown in Fig. 1.2.

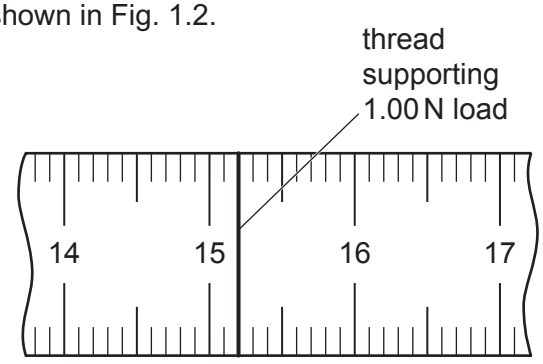


Fig. 1.2

Record the distance *d* indicated on Fig. 1.2.

d = ... cm [1]

(ii) The readings on newton meter P and newton meter Q are shown in Fig. 1.3.

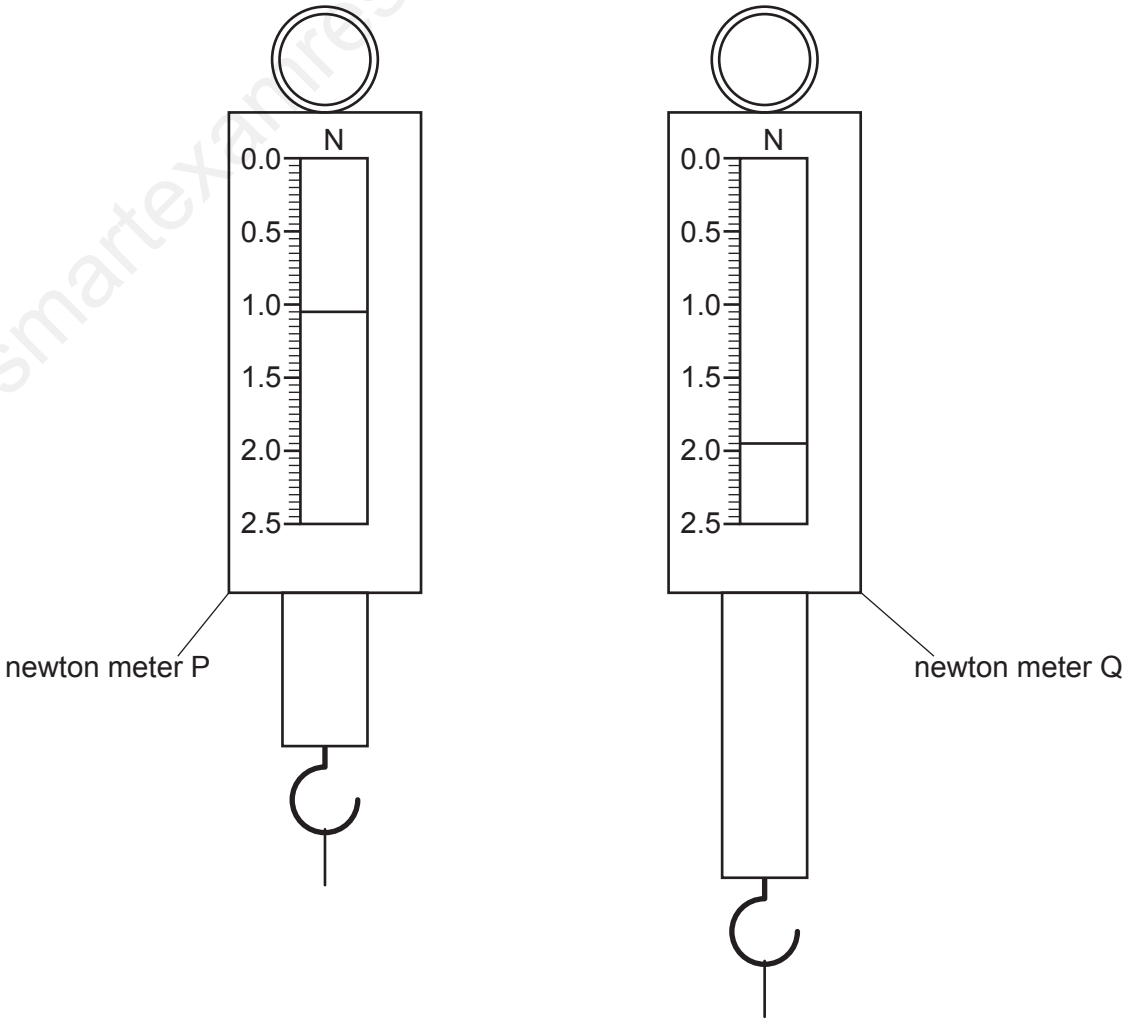


Fig. 1.3

Record F_P, the reading on newton meter P shown in Fig. 1.3.

Record F_Q, the reading on newton meter Q shown in Fig. 1.3.

F_P = ...

F_Q = ...

[1]

(c) The student moves the 1.00 N load to distances $d = 25.0$ cm, $d = 35.0$ cm, $d = 45.0$ cm, $d = 55.0$ cm and $d = 65.0$ cm.

He reads the value F_P on newton meter P and the value F_Q on newton meter Q. His readings are shown in Table 1.1.

Table 1.1

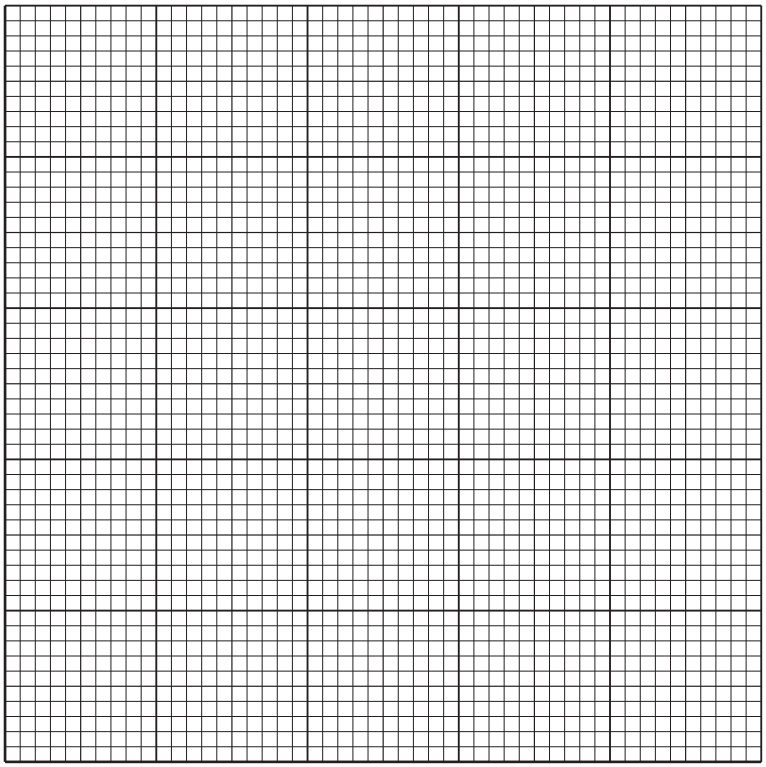
d / cm	F_P / N	F_Q / N
25.0	1.81	1.19
35.0	1.70	1.30
45.0	1.56	1.45
55.0	1.44	1.55
65.0	1.31	1.69

Using the values from Table 1.1, plot a graph of F_P / N (y-axis) against d / cm (x-axis).
On the same axes, and using the same scales, plot a graph of F_Q / N (y-axis) against d / cm (x-axis).

Draw two best-fit lines, one for each set of plots. Show clearly on your graph which line is for F_P and which line is for F_Q.

F_P / N

F_Q / N



[5]

(d) From your graph, determine F_0, the value of F_P where the two best-fit lines cross.

F_0 = ...

Calculate the weight W_R of the metre rule, using the equation $W_R = (2 \times F_0) - k$, where $k = 1.00\,\text{N}$.

W_R = ...
[2]

(e) Another student does the experiment with the same equipment. He reads values of F_P which are the same as those in Table 1.1 but his values of F_Q are all 0.10 N greater than those in Table 1.1.

Suggest a reason for this difference. Assume that the values in Table 1.1 are correct.

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..... [1]

[Total: 11]

MARK SCHEME:

Question	Answer	Marks
1(a)	any valid method e.g. check equal distance between rule and bench at two places OR use set square/protractor between stand and rule OR line up with suitable (named) surface	1
1(b)(i)	d = 15.2 (cm)	1
1(b)(ii)	F_P = 1.05 (N) and F_Q = 1.95 (N)	1
1(c)	graph: • x-axis labelled with quantity and unit	1
	• suitable scales (plots occupying at least 3 large squares in both directions)	1
	• plots all correct to ½ small square and precise plots	1
	• 2 well judged lines and thin lines	1
	• intersection at d = 50.0 cm to ±1 small square	1
1(d)	F_0 present and W_R in range 1.8 (N) to 2.2 (N)	1
	W_R expressed to 2 or 3 significant figures and with unit of N	1
1(e)	forcemeter Q has zero error OR has not been set to 0 at start	1