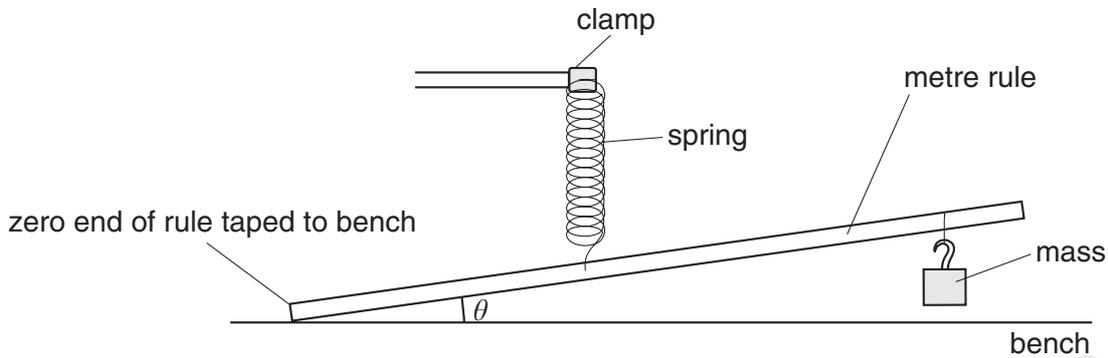


- 1** The IGCSE class is investigating the effect of a load on a rule attached to a spring. The apparatus used is shown in Fig. 1.1.



**Fig. 1.1**

The rule has the zero end taped to the bench so that it does not slip. The rule is attached to a spring at the 40.0 cm mark. The students hang masses, starting with a 10 g mass, on the rule at the 90.0 cm mark. For each mass, they measure the angle  $\theta$  between the rule and the bench.

One student's readings are shown in the table.

$m/$	$\theta/$
0	29
10	28
20	26
30	25
40	22
50	19

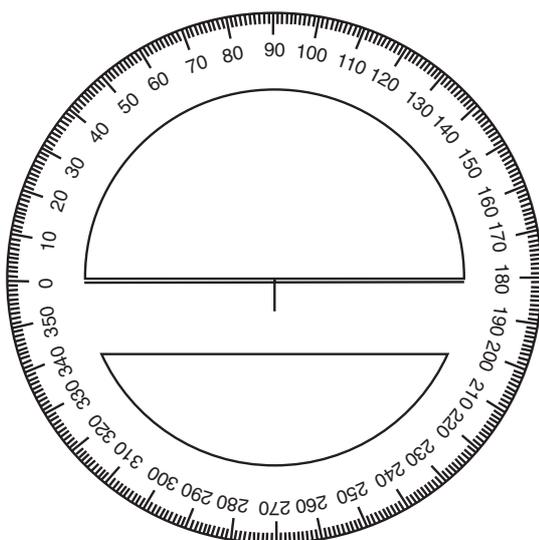
- (a) Complete the column headings in the table. [1]
- (b) A student suggests that  $\theta$  should be directly proportional to  $m$ . State, with a reason, whether the readings in the table support this suggestion.

statement .....

reason .....

..... [2]

- (c) A student carries out this experiment using the 360° protractor shown in Fig. 1.2.



**Fig. 1.2**

Explain how the student could use this protractor to measure the angle  $\theta$  between the metre rule and the bench. You may draw a diagram if you wish.

.....  
 ..... [2]

- (d) The range of angles measured in this experiment may be quite small. Using the same apparatus and with the masses and spring in the same positions, suggest another method of investigating as reliably as possible the extent by which the rule is pulled down by the masses. This method must not use a protractor but an additional rule may be used. You may draw a diagram if you wish.

.....  
 ..... [2]

## -----Marking Scheme-----

(a)	m in g and $\theta$ in degrees	1
(b)	$\theta$ <i>not</i> directly proportional to m as m increases $\theta$ decreases	1 1
(c)	clear in words or diagram that 'centre point' of protractor is at point where bottom edge of rule meets protractor and 0 – 180 line is horizontal	1
	similarly clear how 'dead space' is dealt with, e.g. protractor stuck to edge of bench with 0 – 180 line at top of bench level OR rule placed on block that is same height as 'dead space'	1
(d)	words or diagram to show rule at end of metre rule to measure height above bench level clear that rule is vertical (e.g. use set square)	1
	OR clamped at constant angle	1
		<b>TOTAL 7</b>