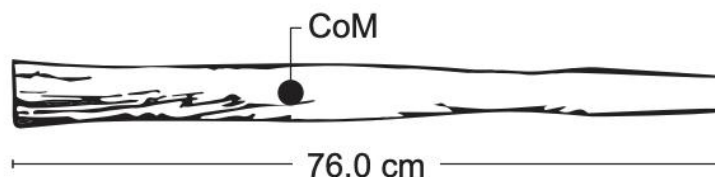


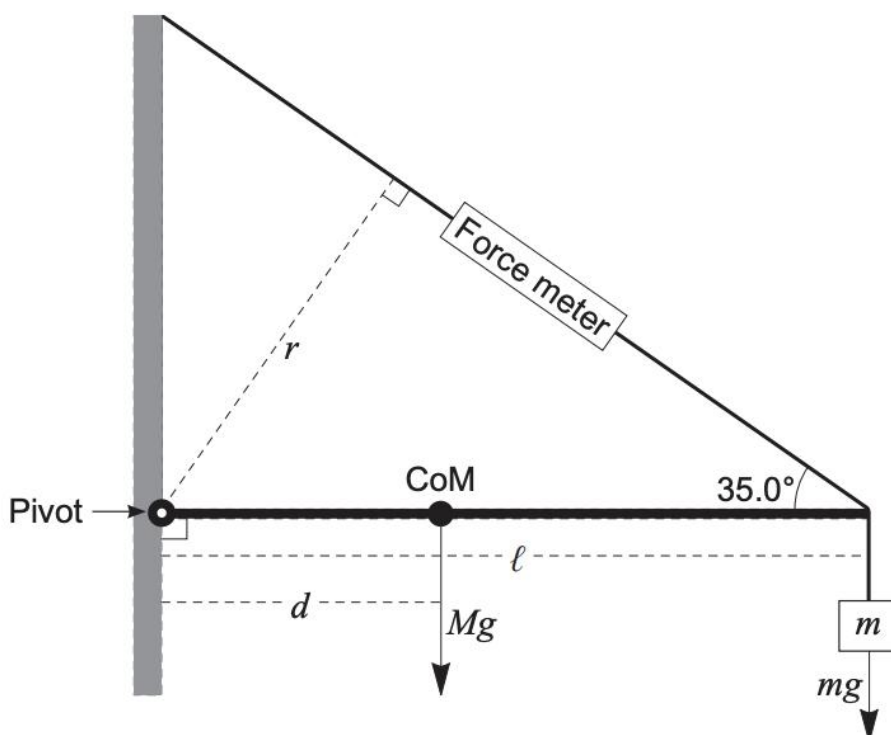
Question 16

(19 marks)

A group of students designed an experiment to estimate the value of g (the acceleration due to gravity at ground level), and to locate the centre of mass (CoM) of a non-uniform piece of wood, as shown in the diagram below.



They drilled a small hole in one end of the piece of wood to make a pivot, then attached a strong wire with a force meter to the other end, as shown in the diagram below. They hung different masses m from the end of the piece of wood and measured the tension T in the wire.



The length ℓ of the piece of wood was 76.0 cm and it had a mass M of 257 g. The distance d was from the pivot to the centre of mass of the piece of wood. The angle between the piece of wood and the wire was kept constant at 35.0° .

The results are in the table below.

Mass m (kg)	0.200	0.300	0.400	0.500	0.600	0.700
Tension T (N)	5.30	6.50	8.10	10.4	11.9	13.2

Taking moments around the pivot, they established the following relationship:

$$\Sigma acm = \Sigma cm \quad \Rightarrow \quad T \times r = (mg \times \ell) + (Mg \times d) \quad \Rightarrow \quad T = \frac{mg\ell}{r} + \frac{Mgd}{r}$$

This allowed the students to graph tension T against the hanging mass m and use their graph to estimate the acceleration due to gravity g and to locate the centre of mass of the piece of wood.

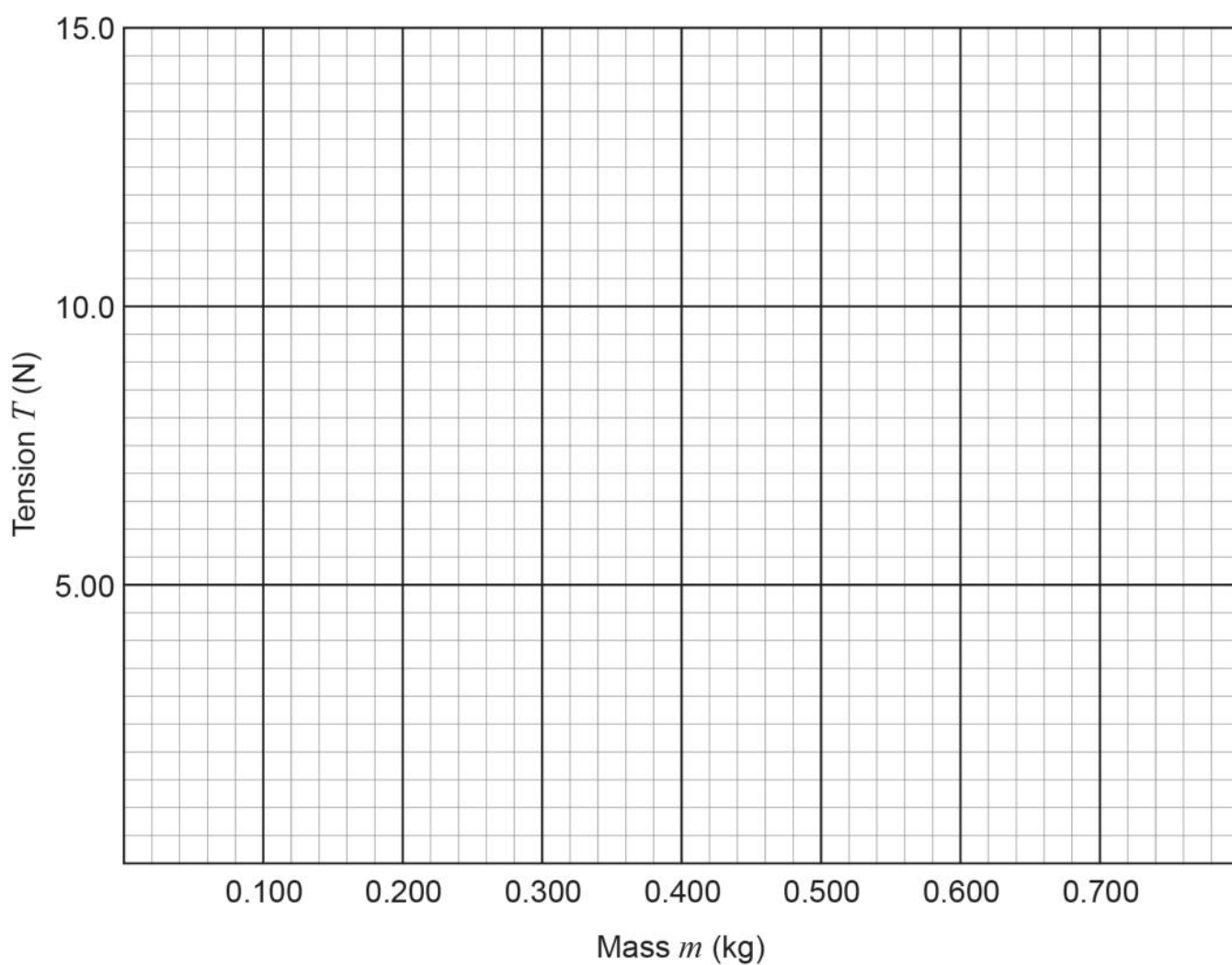
(a) Calculate the distance r from the pivot to the wire.

(2 marks)

Answer: _____ m

(b) Graph T versus m on the grid below. Include a line of best fit.

(3 marks)



A spare grid is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt and indicate that you have redrawn it on the spare grid.

- (c) Calculate the gradient of your line of best fit from part (b) on page 23. Indicate clearly on the graph the **two** points used in your calculation. Express the gradient to **three** significant figures and include the unit for the gradient. (5 marks)

Answer: _____ Unit _____

- (d) Use the calculated gradient from part (c) to estimate the students' experimental value for g . Give your answer to **two** significant figures. (4 marks)

Answer: _____ m s^{-2}

- (e) Use the line of best fit from part (b) on page 23 and the value of g found in part (d) to calculate the distance d from the pivot to the centre of mass of the piece of wood. Give your answer to **two** significant figures. (5 marks)

Answer: _____ m