Learner resource 1 Determining the mass of a metre rule using the Principle of Moments

Introduction

In this experiment, you will determine the mass of a metre rule using a 1 N weight, a single pivot point and the Principle of Moments. As an extension task, you could introduce more pivot points and more weights to use the Principle of Moments to determine the value of unknown quantities in equilibrium systems with more than one pivot point.

Equipment required:

- Uniform metre rule with graduated scale

- A loop of light string or cotton

- A 1 N weight Hanger. (preferably one with a hook on the end to attach to the loop of light string or cotton)

- A clamp stand with a clamp attached (the metal bar on the stand acts as the pivot point)

- Laboratory scales (to check your value for the weight of the ruler)

Method

- Attach the 1 N weight to the metre rule by tying it to the rule using the loop of string. Locate the loop at the 90 cm mark on the rule.

- Then balance the metre rule on the metal bar protruding from the boss on the clamp stand. You will need to take care to ensure that the clamp stand is clamped to the bench, be careful not to overbalance the ruler, or to drop the weight. The setup is shown in Figure 1 next page.

- Record the location of the pivot point on the ruler.

- Now calculate the weight of the ruler using the Principle of Moments. You may assume that the centre of mass of the ruler is at the 50 cm point.

- You should find the anticlockwise moment around the pivot point by measuring the distance from the loop of string to the pivot, and multiplying it by the weight of the Hanger?

- You should find the clockwise moment by measuring the distance between the pivot point and the 50 cm mark on the ruler, and multiplying it by the unknown weight of the ruler.

- The Principle of Moments states that for a system in equilibrium, the total anticlockwise moment around a pivot point should equal the total clockwise moment.

- Use the Principle of Moments to calculate the weight of the ruler.

- Use the laboratory scales to check your answer.

- What is the main cause of uncertainty in your answer?

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Extension

- Use more than one Hanger with different weights, and more than one pivot point. Can you use the Principle of Moments to predict the location of pivot points with different arrangements of weights, and could you use it to find unknown weights?

Figure 1

Loop of string or cotton

1 N Hanger

Uniform 1

Clamp bar