

## **DETERMINATION OF UNKNOWN MASSES BY USING THE PRINCIPLE OF MOMENTS**

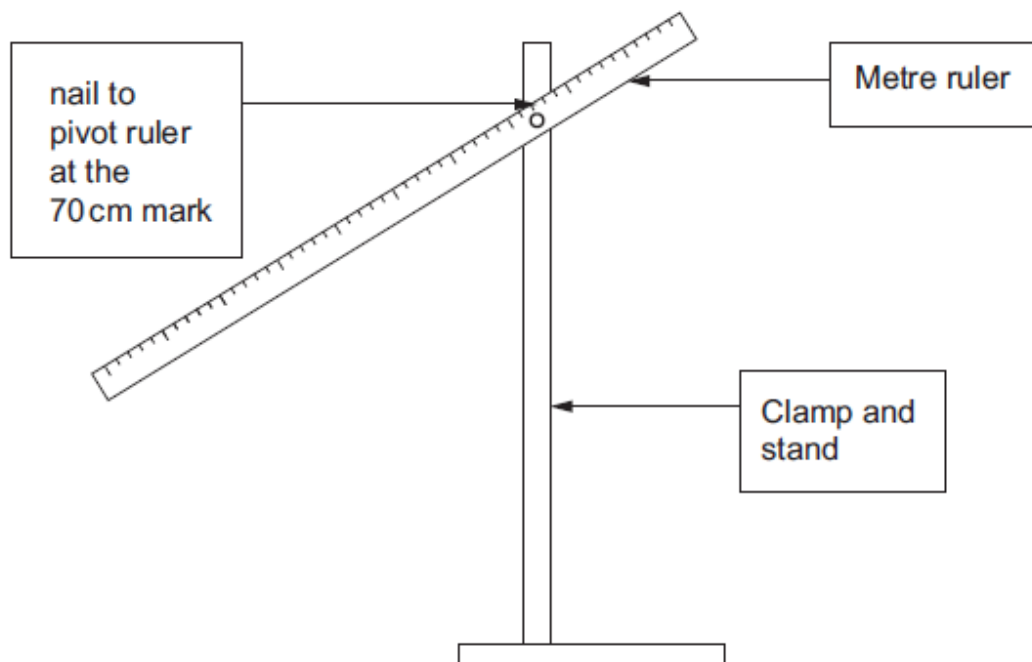
**Specification reference:** AS Unit 1.1 – Basic physics

### **Theory:**

Apply the principle of moments to a metre rule to first determine its mass and then determine the mass of an unknown object.

### **Apparatus:**

Meter rule  
Clamp and stand  
Nail  
200 g mass and hanger  
150 g mass (covered in tape and labelled as  $W$ ) and hanger  
Loops of thread



### **Further guidance for technicians:**

An alternative would be to pivot the metre rule off centre on a prism. The unknown weight could be a mass with the real value covered, a reel of wire or a glass bottle top.

**Experimental Method:**

Loop a 200 g (1.96 N) mass over the metre rule and adjust it until the ruler is horizontal. Note down the distance,  $l$ , of the mass from the pivot. The mass (or weight) of the metre rule can now be calculated using the principle of moments:

$$0.20 \times \text{metre rule weight} = l \times 1.96$$

Now remove the 200 g mass and replace it with the unknown weight,  $W$ , and again adjust the position of the weight until the ruler balances. Measure the distance,  $d$ , of the unknown weight from the pivot. The unknown weight can again be calculated by applying the principle of moments:

$$0.20 \times \text{metre rule weight} = d \times \text{unknown weight}$$

The unknown weight can be converted into a mass (in kilograms) by dividing by 9.81. This can then be checked using a top pan balance.

**Extension:**

This practical can be used to familiarise students with calculating uncertainties and combining percentage uncertainties. It can be further extended to include equilibrium of forces.

**Practical techniques:**

Use appropriate analogue apparatus to record a range of measurements (to include length/distance, temperature, pressure, force, angles, volume) and to interpolate between scale markings.

**Relevant previous practical past papers:**

- PH3 2004 Experiment 1
- PH3 2009 Task A2
- PH3 2013 Task A2