DETERMINATION OF UNKNOWN MASSES BY USING THE PRINCIPLE OF MOMENTS
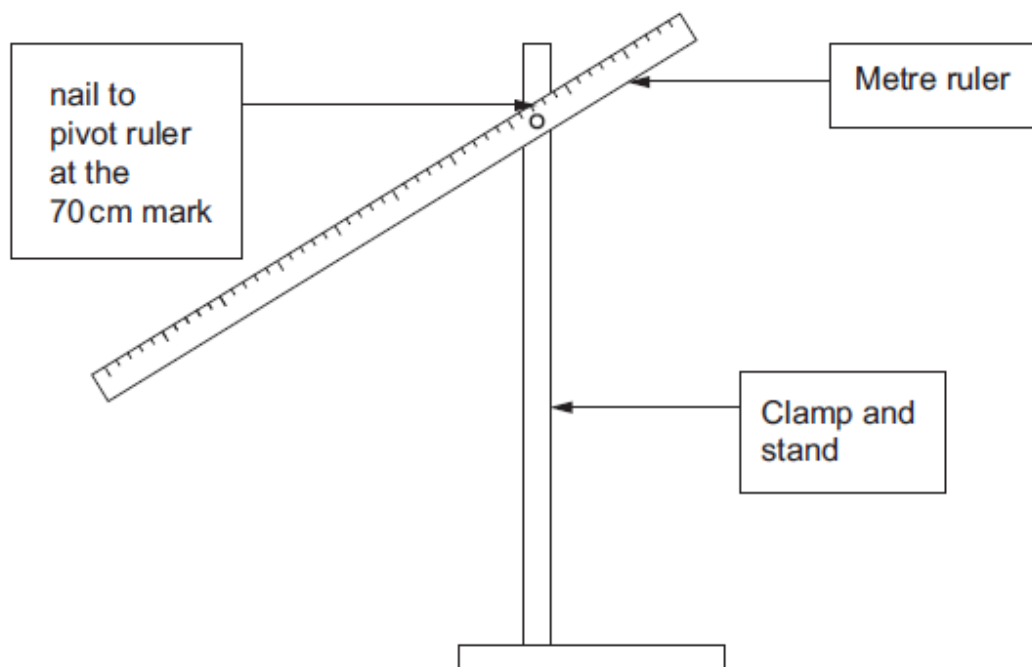
Specification reference: AS Component   1.1 – Basic physics

                                       A level Component   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