Determination of unknown masses by using the principle of moments
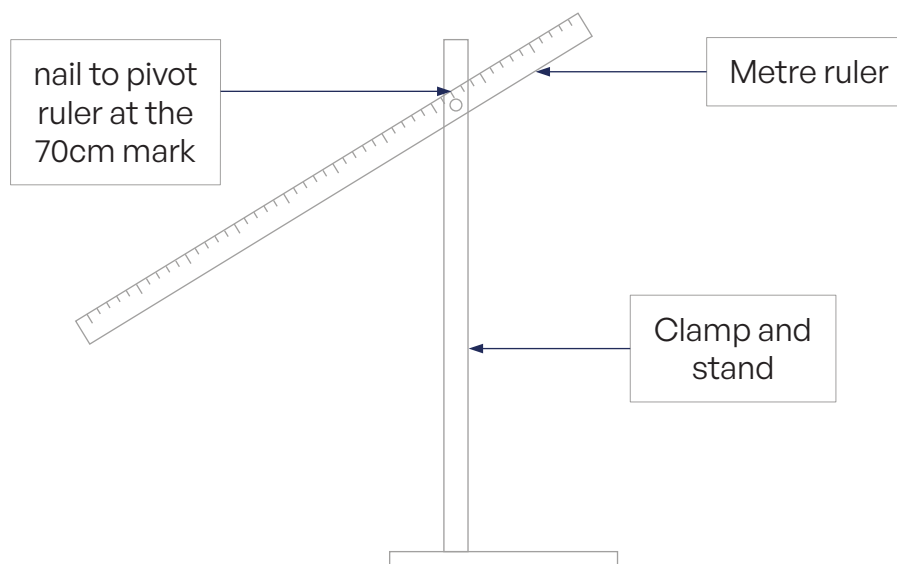
Specification reference: AS Unit 1.1 — Basic physics

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

–   Metre 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

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.

Note: *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.*

SPACE FOR NOTES

TABLE OF RESULTS

GRAPH
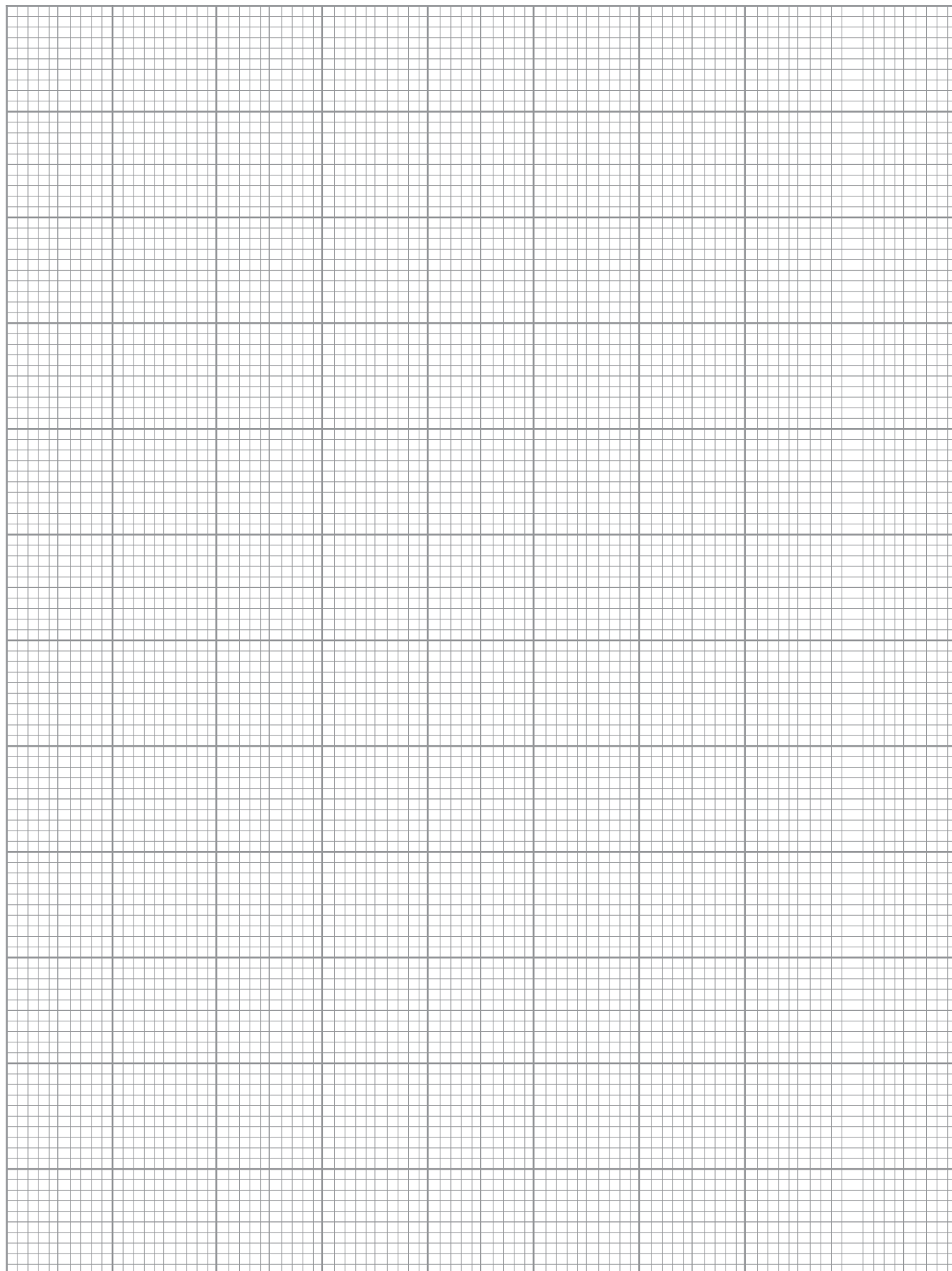
QUESTIONS

1. If the pivot point is not at the centre of the ruler, what additional moment must be included in your calculations?

2. What assumption is being made when taking the centre of mass of the ruler to be at its geometric centre?

3. Other than the principle of moments, what is the other condition required for an object to remain in equilibrium?

4. How is vertical force equilibrium maintained in this experiment?

DOWNLOADS

–   Physics 3 2004 Experiment 1

–   Physics 3 2009 Task A2

–   Physics 3 2013 Task A2

–   Experiment Flashcards