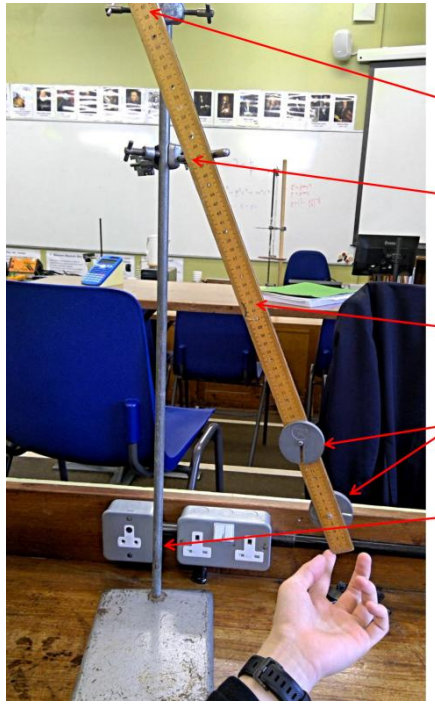
COMPOUND PENDULUM

NAME: .... HOUSE: .....

CLASS: .... DATE: ..... TEACHER: .....

Aims of this experiment:

1. **Measure the period of a compound pendulum consisting of masses attached to a 1 metre ruler, with holes drilled every 5cm.**
2. **Period should be measured for a variety of pivot positions**
3. **Measured period should be compared (via a graph) to a calculation based upon a Simple Harmonic Motion (SHM) model, which involves computation of both the *centre of mass* and the *moment of inertia* of the system.**



Equipment

Boss, clamp and thin metal rod pivot

Boss, clamp and thick metal rod to ensure initial amplitude of all oscillations are the same

1.00m ruler with holes drilled every 5cm

2x 0.1kg masses

Retort stand

G-clamp for retort stand
Stopwatch
Mass balance

TASK1: Using a mass balance, record the mass of the ruler and the pair of added masses:

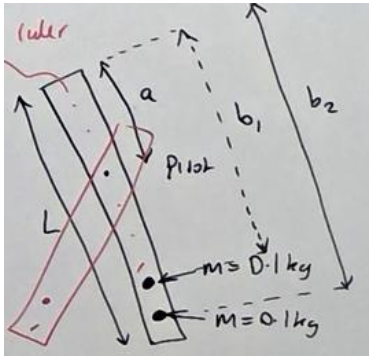
Ruler mass: $M = \ldots\ldots\ldots\ldots\ldots\ldots$ kg

Weight + screw mass (i.e. one of the pair): $m = \ldots\ldots\ldots\ldots\ldots\ldots$ kg

TASK2: Set up the experiment as per the diagram on the right. Confirm with your teacher before proceeding any further.

Make sure the added masses are screwed at b_1 = 0.85m and b_2 = 0.95m from the end of the ruler, respectively.

TASK3: Calculate the centre of mass of the system, measured from the unweighted end of the ruler (of length L = 1.00m).



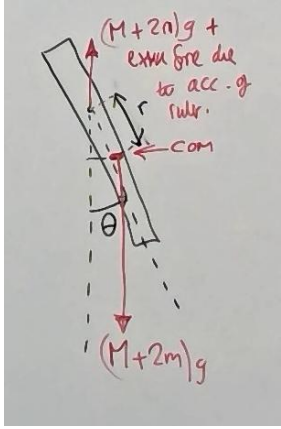
$$\bar{x} = \frac{M \times \frac{1}{2}L + mb_1 + mb_2}{M + 2m}$$

$\bar{x} = \ldots\ldots\ldots\ldots\ldots\ldots$ m

TASK4: Explain why the initial angle of oscillation must be **less than one radian** for a *Simple Harmonic Motion* (SHM) model to be assumed.

TASK5: Use the table below to record the times of **ten periods**, for the pivot positions stated:

Pivot position a /m	Ten periods 10T /s REPEAT 1	Ten periods 10T /s REPEAT 2	Ten periods 10T /s REPEAT 3	Mean value of period T /s	Error in T /s (Standard deviation)	Pivot to centre of mass distance r/m	Moment of inertia I /kgm²	Model period /s
0.01								
0.05								
0.10								
0.15								
0.20								
0.25								
0.30								
0.35								
0.40								
0.45								
0.50								



TOP TIP:

USE A **SPREADSHEET** FOR THE CALCULATIONS AND COPY YOUR ANSWERS ACROSS TO THSI SHEET

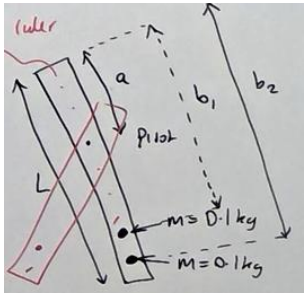
TASK6: Calculate the **moment of inertia** I and hence the model period T /s for *each* pivot position. Take the strength of gravity as g = 9.81N/kg.

$\bar{x} =$ ..... m $\quad L = 1.00\text{m}$

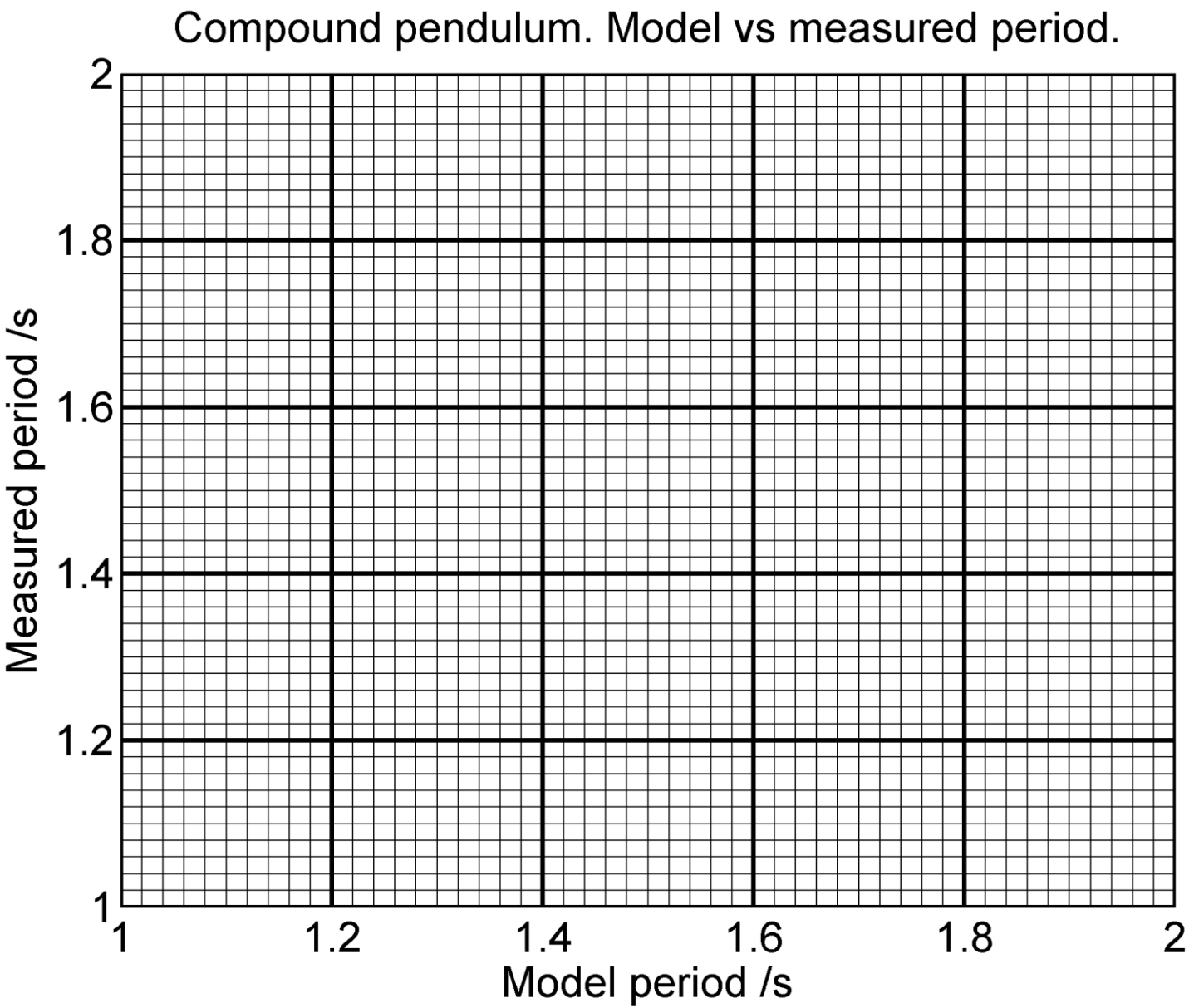
$M =$ ..... kg

$m =$ ..... kg

$$T = 2\pi\sqrt{\frac{I}{(M+2m)gr}} \qquad I = \frac{M}{3L}\left((L-a)^3 + a^3\right) \qquad r = \bar{x} - a$$



TASK7: Plot measured vs model periods using the axes below. Determine a **line of best fit** from the origin and measure the **gradient**. If using Excel, determine the (square of) the product moment correlation coefficient R^2. In the text box below, comment on the **correlation** between model and measurement. BE QUANTITATIVE.



Comments: