



Belmont City College
YEAR 12 PHYSICS

Part 2: /17

PRACTICAL ASSESSMENT, PART 2

TORQUE PRACTICAL INVESTIGATION

NAME: Solutions

MYSTERY MASS NUMBER: _____

Time allowed: 55 mins

DIRECTIONS:

- Fully label all diagrams
- Show **clear and complete working** for all calculations.
- Record all data and give all answers to **2 significant figures**

EQUIPMENT:

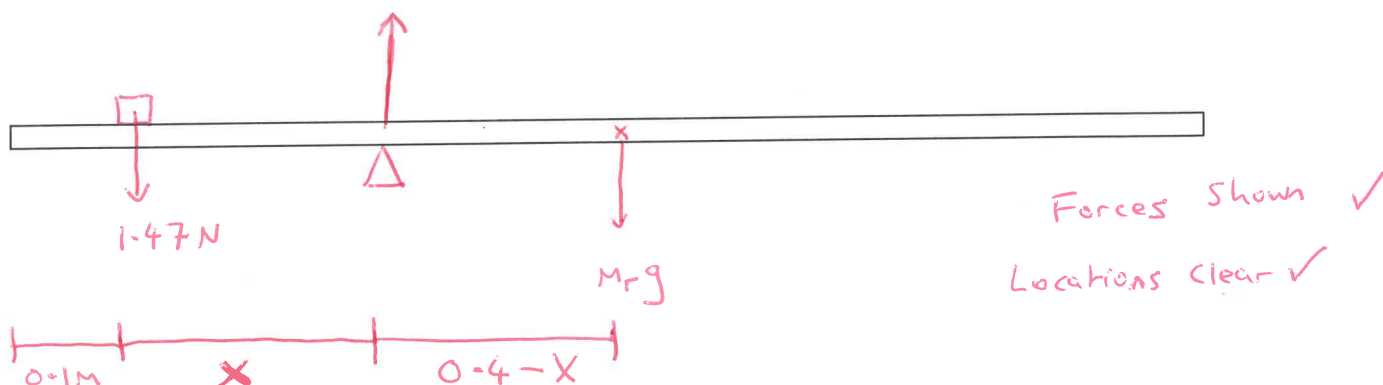
- One 1 metre rule
- One fulcrum or pivot
- One approximately 150 g mass (3 brass masses taped together). For the first 2 tasks, this mass must be located 10 cm from one end of the ruler.
- One mystery mass (numbered)



Task 1 – Determine the mass of the ruler.

Place the 150g mass, 10 cm from one end of the ruler. Keep it there for Task 1 and Task 2. Set the fulcrum up so that the ruler is balanced and take note of the position of the fulcrum. With this information, you will be able to calculate the mass of the ruler.

- a. Draw a free body diagram of the ruler showing the location and nature of all forces acting on it (2 marks)



- b. Calculate the mass of the ruler based on your measurements (2 marks)

$$\sum \tau_{cw} = \sum \tau_{ccw}$$

Equilibrium
condition ✓

$$\therefore M_r g (0.4 - x) = 1.47 x$$

$$\therefore M_r = \frac{1.47 x}{g (0.4 - x)}$$

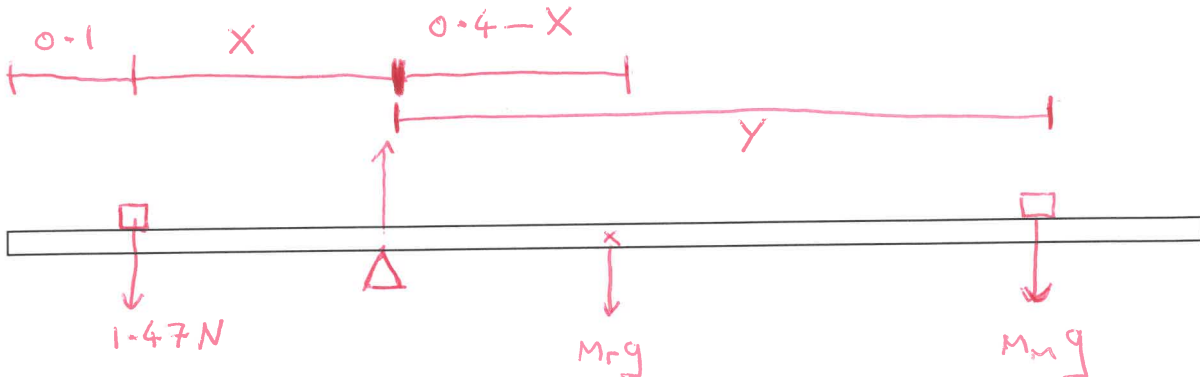
$$M_r = \text{_____ grams.}$$

Working out
&
solution ✓

Task 2 – Determine the mystery mass

Keeping the 150 g mass on the 10 cm mark of your ruler, use this equipment and the mass of the ruler you determined in Task 1 to determine the mass of the mystery object. **You may set the fulcrum anywhere you like.**

- a. Label all the forces acting on the ruler and show their locations clearly (2 marks)



Forces shown ✓
Locations clear ✓

- b. Calculate the mass of the mystery object based on your measurements. (3 marks)

$$\sum \tau_{cw} = \sum \tau_{ccw}$$
$$\therefore m_r g (0.4 - X) + M_m g Y = 1.47 X$$
$$\therefore \frac{1.47 X - M_r g (0.4 - X)}{g Y} = M_m$$

$M_m = \underline{\hspace{2cm}} \text{ grams}$

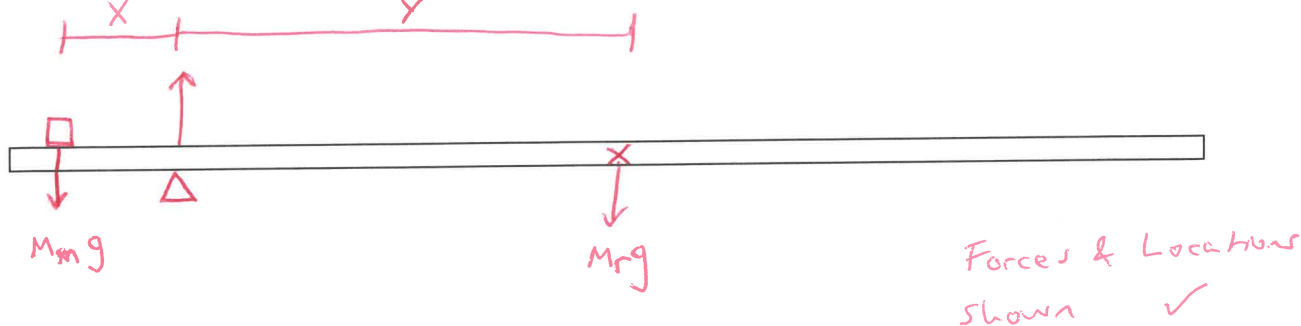
Correct ✓
 $\sum \tau_{cw}$ ✓
Correct ✓
 $\sum \tau_{ccw}$ ✓
Working & solution ✓

⊗ Other solutions possible;
i.e. they might place
fulcrum at ruler COM,
eliminating that term from
subsequent calculation.

Task 3 – Determine the mystery mass using only the ruler

Remove the 150 g mass. Using *only* the ruler and the fulcrum to determine the mass of the mystery object.

- a. Label all the forces acting on the ruler and show their locations clearly (1 mark)



- b. Calculate the mass of the mystery object based on your measurements. (2 marks)

$$\sum \tau_{cw} = \sum \tau_{ccw}$$

$$\therefore M_r g Y = M_m g X$$

$$\therefore M_m = \frac{M_r g Y}{g X}, \quad M_m = \text{--- grams.}$$

Equilibrium condition ✓
working & solution ✓

- c. Consider the two processes used in Task 2 and Task 3 to measure the mystery mass. Comment on any difference in result that you obtained. In theory, both methods accurately measure the mass; however, it is unlikely that you got exactly the same result. Which result would you expect to be more accurate? Why? (Hint: consider the number and nature of the terms in your calculation) (2 marks) ~~✗~~ Multiple acceptable answers.

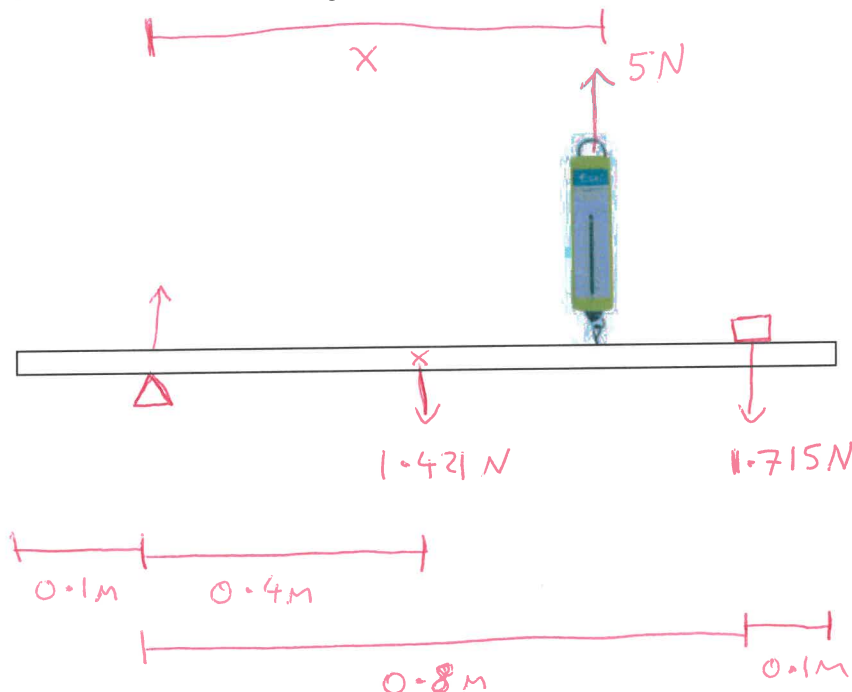
Answer ✓

Justification ✓ Task 3 involves fewer measurements, therefore fewer measurement errors are likely to impact the result, \therefore Task 3 result more reliable.
OR (if they placed fulcrum @ com for ruler in Task 2)
 Task 2 involves a mass that is precisely known, whereas the mass of the ruler in Task 3 is a calculated value, with greater potential for error, \therefore Task 2 result is more reliable.

PTO

Task 4 – Further calculation

The 100-cm ruler in the diagram below has a mass of 145 g. The pivot is located at the 10.0-cm mark and a 175 g mass is placed at the 90.0 cm mark. At what location should the spring scale be placed in order to show a reading of 5.00 N? (3 marks)



Sensible
Diagram ✓

$$\sum \tau_{cw} = \sum \tau_{ccw}$$

$$\therefore (1.421)(0.4) + (1.715)(0.8) = 5X$$

$$\therefore 1.9404 = 5X$$

$$X = 0.388 \text{ m from pivot point}$$

\therefore Spring scale should be placed at 43.9 cm mark

working
&
solution

for
X ✓

Final
Answer ✓