



21st International Mathematics and Science Olympiad (IMSO) Group and Individual Experiment Test

Wenzhou, China
04 October 2024

Instructions:

1. Do not turnover this page until you are told to do so.
2. Write your ID Number and Seat Number on the space provided.
3. Follow all the instructions carefully.
4. Write your answer only on the separate answer sheet. There are 5 pages in the answer sheet.
5. There are **two experiments** in this test. Make sure to answer BOTH papers to get full points.
6. For the group experiment: **ONLY** the procedure of the experiment is done by group. The paper must be answered **individually**.
7. Complete all the sections in English. There are **Section I, II** and **III** for the Group Experiment and **Section I** and **II** for the individual experiment.
8. The marks awarded for each section or question is shown in brackets, [].
9. There are 5 printed pages in this booklet, excluding this cover page.
10. You have 120 minutes to complete this test.

GROUP EXPERIMENT

Finding the Mass of the Ruler

Objective

To determine the unknown mass of a wooden ruler using the principle of moments.

Materials

- A. half-meter ruler
- B. retort stand
- C. 12 pcs. paper clips
- D. scissors
- E. ball of string
- F. electronic mass balance
- G. small plastic container

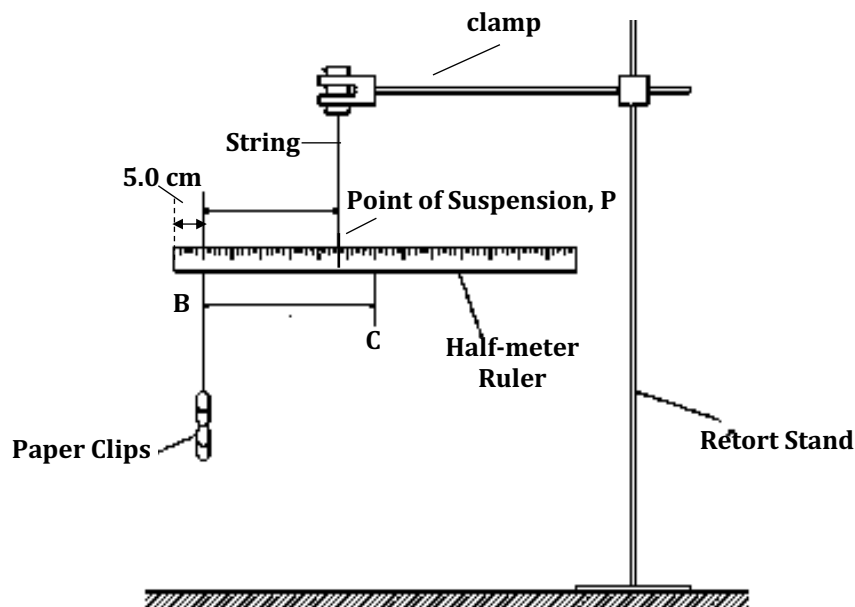
Section I: To find the mass of a paper clip

Procedures:

1. Use the electronic mass balance to measure the mass of the 10 paper clips.
2. Calculate the average mass of 1 paper clip, m .

Section II: To find the mass a wooden ruler

Diagram of Set-Up:



Procedures:

IMPORTANT NOTE: You will work as a group ONLY in doing the procedure of this experiment. You must answer your papers individually!

1. Tie the half-meter ruler using a string and suspend the ruler as shown on the retort stand by tying it to a suitable location on the clamp.
2. Adjust the point of suspension **P** until the ruler is horizontally balanced at point **C**. Record the position of **C** on the answer sheet.
3. Suspend 2 paper clips at 5.0 cm from the left end of the ruler at position **B**.
4. Measure and record the length, **L** from **B** to **C** on the answer sheet.
5. Adjust the point of suspension, **P** of the ruler until the ruler balance. Measure and record the distance **a** from **B** to the point of suspension of the ruler on the table provided on the answer sheet.
6. Calculate the value of $(L - a)$ and record the reading on the table provided on the answer sheet.
7. Calculate the value of $(n \times a)$ by multiplying the number of paper clips (**n**) to distance **a** and record the reading on the table provided on the answer sheet.
8. By increasing the numbers of paper clips, **n**, in intervals of two at a time, repeat steps 3 to 7 for 5 further values of **a**. (**Keep the position of B constant at all times**).
9. Plot a graph of $(n \times a)$ in cm against $(L - a)$ in cm on the graph paper provided and answer the rest of the questions.

Section I: To find the mass of a paper clip

Records of Measurements:

Mass of 10 paper clips = g

Mass of 1 paper clip, **m** = g

[1 mark]

Section II: To find the mass of a Ruler

Records of Measurements:

Position of **C** = cm

Distance of **B** to **C**, **L** = cm

[1 mark]

Section II... (cont)**Table of Readings:**

Number of Paper Clips, n	a (cm)	$(L - a)$ (cm)	$(n \times a)$ (cm)
2			
4			
6			
8			
10			
12			

[4 marks]

Section III: Guide Questions

- Plot a graph of $(n \times a)$ against $(L - a)$ on the grid provided. [3 marks]
- From the graph, calculate the slope of the graph in the space below. [3 marks]
- The mass of the ruler can be deduced using the formula below.

$$\text{Mass of the ruler} = m \times \text{slope}$$

Using your slope and mass of one paper clip, m , what is the approximate mass of the ruler?

[1 mark]

- Identify two possible sources of errors for this experiment. [2 marks]

THIS IS NOT YET THE END OF YOUR EXPERIMENT TEST
TURN TO **PAGE 4** FOR THE INDIVIDUAL EXPERIMENT

INDIVIDUAL EXPERIMENT

Which Magnet is Stronger?

There are only a few things which are attracted to a magnet, iron and steel being the main ones. Very few other metals do, and no non-metals like plastic, wood, glass, and cloth are attracted. The main strength of a magnet is at the poles which lie at each end of a magnet, or each side of a circular magnet.

Objective

To develop a plan to find the strongest magnet.

Materials

Each student will need:

- two bar magnets
- plotting compass
- ruler
- several paper clips
- a ballhead pin

Procedure

From the given materials, devise ways on determining the strength of the magnet provided. **You must draw and label your own procedure, create a data table, and gather necessary observations or results.** Limit the number of methods into three only.

Section I: Data Tables

Method #1

Procedure	Data Table and Result

Method #2

Procedure	Data Table and Result

Method #3

Procedure	Data Table and Result

[6 marks]

Section II: Guide Questions

1. Based on the three methods you devised, what variables did you look for when choosing the stronger magnet?

[1.5 marks]

2. How do you know which magnet is strongest for each method you devised? Explain.

[1.5 marks]

3. Which of the methods you devised is most reliable? Explain.

[1 mark]

--- END OF EXPERIMENT TEST ---