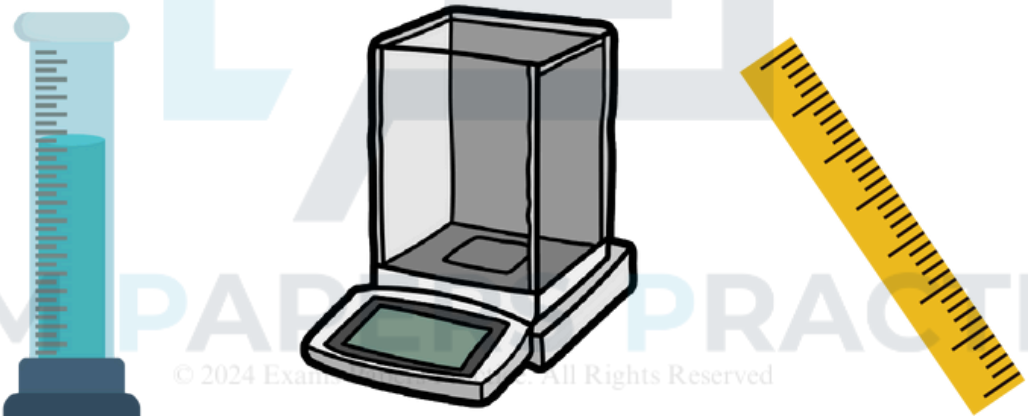
Chapter 1: Making Measurements



1.1 Measuring Length

1. In the lab, a ruler is frequently used to measure **lengths**.
2. It is crucial to **critically** analyze your measurements, no matter how simple they may appear.

Example 1: Measuring the length of a piece of wire

Precautions:

1. The wire needs to be **straight**.
2. The wire should **align** with the 0 mark on the scale.
3. The ruler must be accurately **calibrated**.

Example 2: Measuring the thickness of a sheet of paper

Method:

1. Measure the thickness of a stack of 500 sheets using a **ruler**.
2. Next, **divide** the total thickness by 500 to find the thickness of a single sheet.

Example 3: Measuring curved line

Method:

1. Place a thread along the line.
2. Mark the thread at both ends of the line, then lay it on a ruler to measure the length.

SI Unit for Length

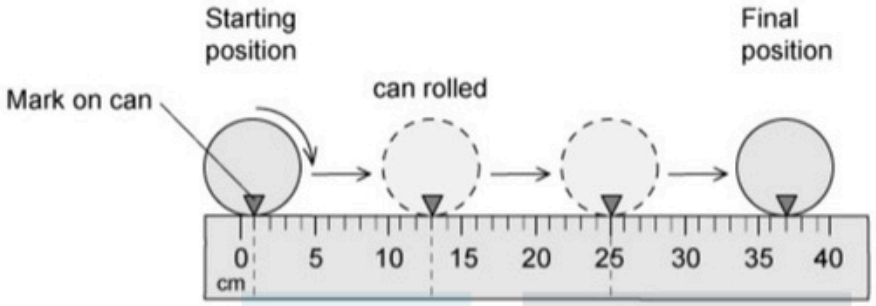
1. Metre (m)

1 decimetre (dm)	= 0.1m
1 centimetre (cm)	= 0.01m
1 millimetre (mm)	= 0.001m
1 micrometre (μm)	= 0.000001m
1 kilometre (km)	= 1000m

Past Year Question

A student uses a ruler to determine the circumference of a wooden dowel.

She puts a mark onto the dowel, then rolls it along the ruler three times, before reading the position on the ruler at which it stopped.



What is the circumference of the dowel?

A 12 cm

B 12.3 cm

C 37 cm

D 36 cm

1.2 Measuring Volumes

A.Measuring the volume of regular shapes

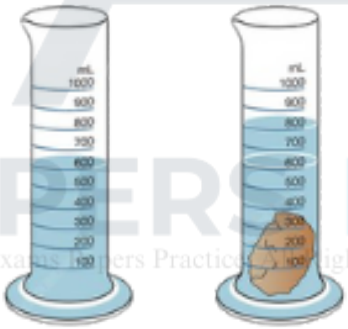
height) and then use the volume **formula**.
Often, we only need to measure one or two dimensions (such as radius and

B. Measuring the volume of irregular shapes

- The technique used to measure irregular shapes is called **displacement**.

Steps:

1. Choose a measuring cylinder that is **bigger** than the object.
2. Fill the cylinder partially with water and record the water **volume**.
3. **Submerge** the object in the water.
4. The volume increase corresponds to the volume of the object.



C. Measuring the volume of liquid

- Measuring cylinder is used.
- Note: Use a small size measuring cylinder to measure small volume.

SI Unit for Volume

1. **Cubic Metre (m^3)**

1 cubic centimetre (cm^3)	= 0.000001 m^3
1 cubic decimetre (dm^3)	= 0.001 m^3

1.3 Measuring Time

1. In the laboratory, you may need to measure the temperature of a container of water every minute or determine the duration an electric current is flowing.
2. There are 2 types of timing device:
    a. Analogue clock
    b. Digital clock

Analogue clock

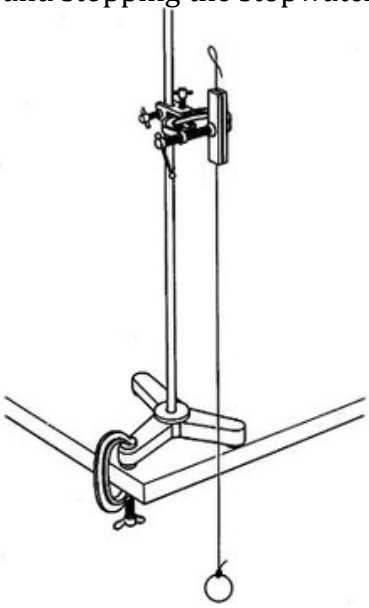
- It can measure time intervals only to the nearest second.

Digital clock

- Example: Stopwatch

Introducing the lab pendulum

1. The duration of one pendulum swing is known as its **period**.
2. Since a pendulum swings consistently, you can use a stopwatch to time many oscillations and then find the **average time per swing.**
3. Measuring the total time for many oscillations **reduces** the impact of any inaccuracies in starting and stopping the stopwatch.

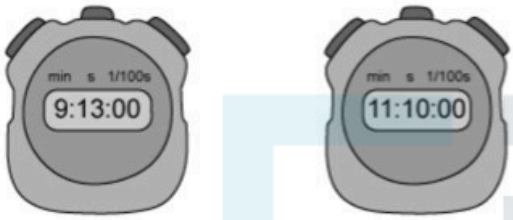


Past Year Question

A student is trying to see how quickly they can run 5.0 km on a standard 400 m running track. They reason that, if they know how fast they can run one lap, they can assume they will run at the same speed for 5.0 km, and can calculate their predicted time.

They, correctly, reason that they will not be able to maintain their initial pace throughout the whole 5.0 km, so they decide to time lap 5.

The diagram shows the reading on the stopwatch at the beginning and the end of lap 5.



Start of lap End of lap

Calculate how long it should take the student to run 5.0 km.

A 36 minutes 52.5 seconds

B 24 minutes 22.5 seconds

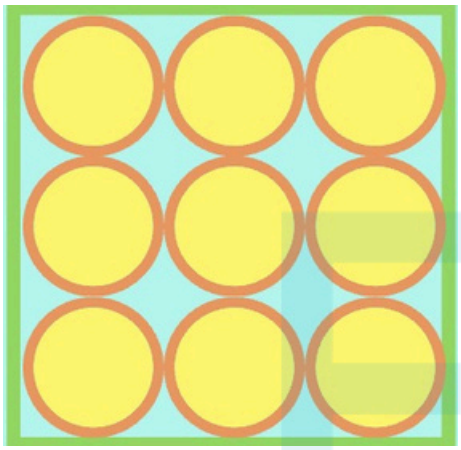
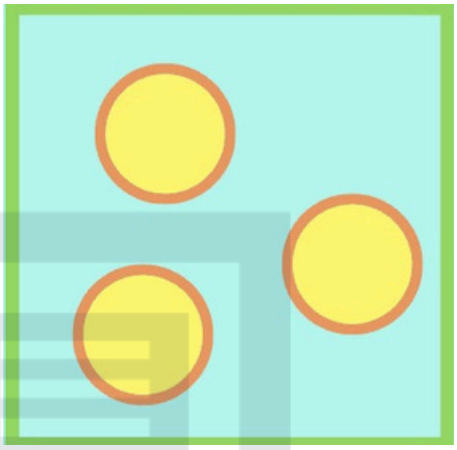
C 13 minutes 0 seconds

D 9 minutes 45 seconds.

1.4 Measuring Density

1. The mass of an object is the quantity of matter it is made of.
2. The density tells us how concentrated an object's mass is.

Illustration:

Dense Object	Less Dense Object
	

Formula of density:

$$density = \frac{mass}{volume}$$

Units of density:

Unit of mass	Unit of volume	Unit of density	Density of water
g	cm^3	$g\ cm^3$	$1\ g\ cm^3$
kg	cm^3	$kg\ cm^3$	$0.001kg\ cm^3$
kg	m^3	$kg\ m^3$	$1000kg\ m^3$

Density implication:

1. If an object is denser than water, then it will sink.
2. If an object is less dense than water, then it will float.

Worked Example 1:

A sample of metal has a volume of 180 cm^3. Its mass is measured to be 270.0 grams. What is the density of the metal?

$$density = \frac{mass}{volume}$$

$$= \frac{270g}{180cm^3}$$

$$= 1.5\ g/cm^3$$

Worked Example 2:

In a workshop, a container holds 50 bolts with a total mass of 450 grams. The container itself weighs 50 grams.

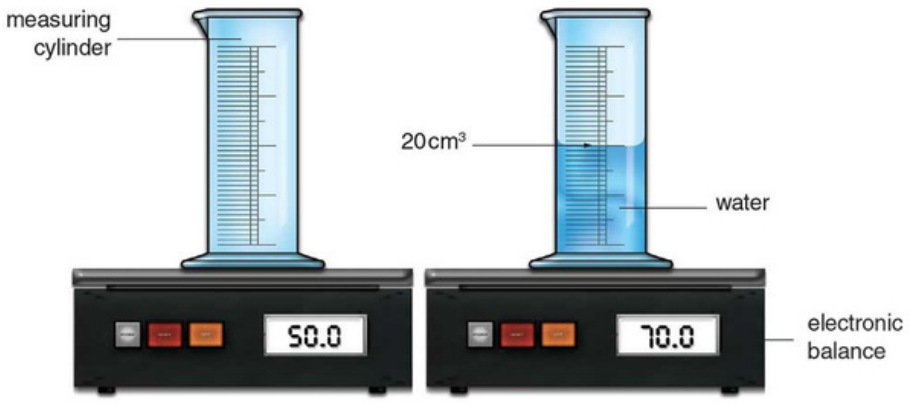
a. What is the mass of one bolt in grams?

b. Calculate the volume (in cm^3) of each bolt. Each bolt has dimensions of 3.5 cm x 0.5 cm x 0.5 cm.

c. Determine the density of the bolts.

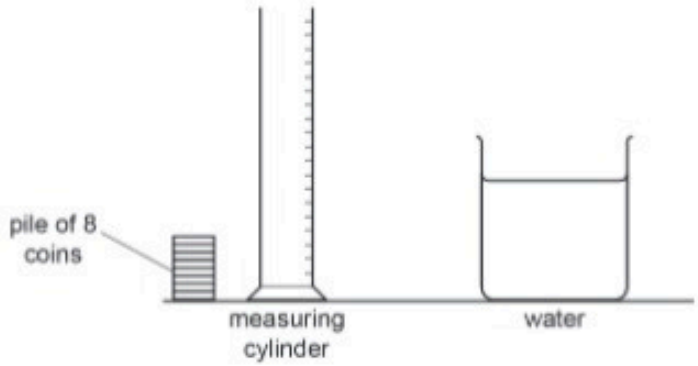
Finding the density of liquid

1. Position a measuring cylinder on a balance.
2. Reset the balance to its initial state.
3. Pour the liquid into the cylinder.
4. Record the volume indicated by the cylinder's scale and the mass shown on the balance.
5. Compute the liquid's density using the appropriate formula.



Past Year Questions

1 The diagram shows a pile of coins, a measuring cylinder and a beaker containing some water.



Describe how the student can measure the volume of **one** of the coins using the set-up shown in the diagram.

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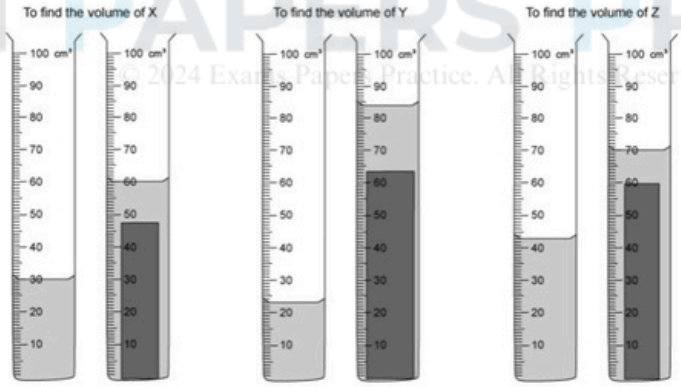
..... [4]

[Total: 4]

2.

Three blocks are placed into three measuring cylinders. These are shown below.



Which row in the table shows the blocks in order of increasing volume?

	Smallest volume →		Largest volume
A	X	Y	Z
B	Y	X	Z
C	Z	Y	X
D	Z	X	Y