

# Chapter 1 – Measurement

Physical quantities can be measured. They have a magnitude and a unit.

Physical quantities	Unit	Symbol	Range	Apparatus used
<b>Length</b>	metre	m	0 cm - 30 cm	Ruler
	centimetre	cm	0 cm - 50 cm	Half - meter rule
	millimetre	mm	0 cm - 100 cm	Meter rule
	kilometre	km	> 100 cm	Measuring tape

Physical quantity	SI units	Instrument used
Length	Metre (m)	Metre rule, vernier caliper
Mass	Kilogram (kg)	Electronic balance, beam balance
Volume	Cubic metres (m <sup>3</sup> )	cylinder (liquids)
Time	Seconds(s)	Stopwatch
Temperature	Kelvin(K)	Thermometer

1 km	1000 m
1 m	100 cm
1 cm	10 mm
1 kg	1000 g

1 year	365 days or 12 months or 52 weeks
1 week	7 days
1 day	24 hours
1 hour	60 minutes or 3600 seconds
1 minute	60 seconds

## Scalar and vector quantities

A **scalar quantity** has magnitude only.

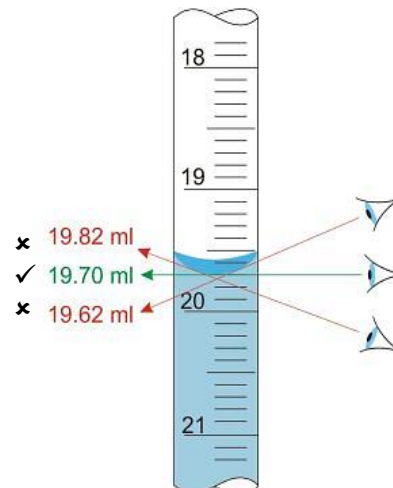
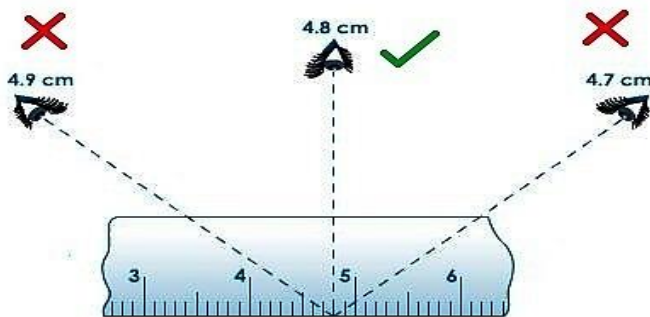
For example: mass, time, temperature, energy, power, volume

A **vector quantity** has both magnitude and direction.

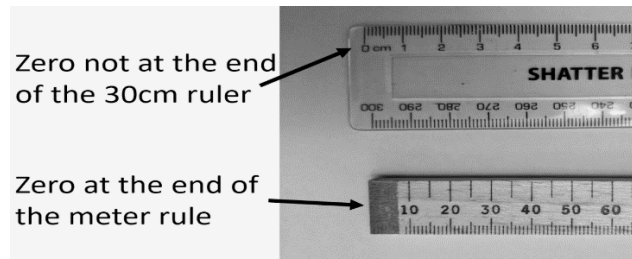
For example: force, pressure, acceleration, velocity, displacement

## Errors in measurement of length

- Parallax error occurs when the eye is not placed at 90° to the true value.

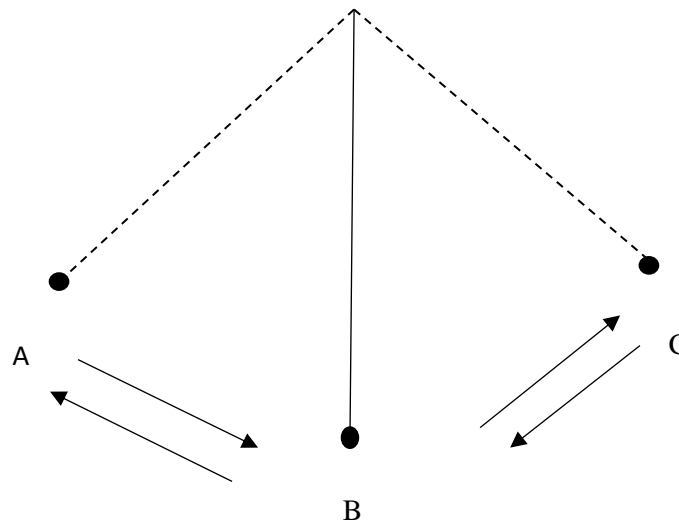


- End error occurs when the ends of a rule are broken.
- Zero error occurs when the zero mark of a rule is broken or measurement does not start from the zero mark of the rule.



Note: the blank space before the zero mark on a ruler is known as the dead space.

### The simple pendulum



- It consists of a light thread and a pendulum bob.
- One complete oscillation: from A to B to C and back to B and eventually A.
- The time taken to make one complete oscillation is known as the **time period.**

$$\text{Time period} = \frac{\text{time to make N oscillations}}{N}$$

### **Volume of irregular solids**

To find the volume of irregular solids we use the displacement method

Method 1 : using measuring cylinder

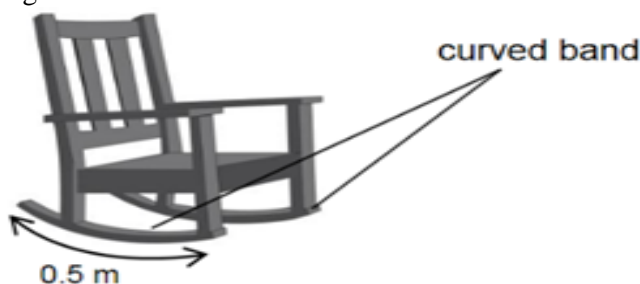
Method 2: using displacement can

Precautions:

1. The solid should be immerse completely in the liquid
2. Gently immerse the solid in water to avoid splashing
3. Perform the experiment on a flat surface

**Revision questions**

- (a) The smallest division on a metre rule \_\_\_\_\_ .  
A: 0.001 cm    B: 0.01 cm    C: 0.1 cm    D: 1.0 cm
- (b) The SI unit of mass is the \_\_\_\_\_ .  
A: newton    B: metre    C: joule    D: kilogram
- (c) Which one of the following quantities is a vector?  
A: time    B: length    C: force    D: speed
- (d) The figure below shows a rocking chair which has a curved band of about half a metre.



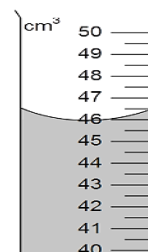
Which instrument will measure the length of the curved band **most** accurately?

- A: a metre rule    B: a tape measure  
C: a vernier caliper    D: a half metre rule
- (e) Ken uses a measuring cylinder to measure the volume of some water.

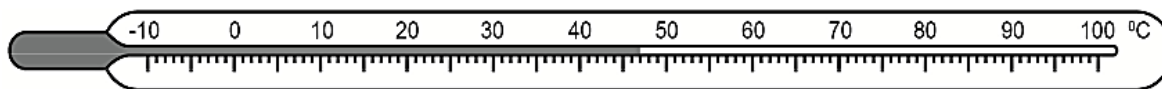
**Figure 1.1** below shows part of the measuring cylinder he uses.

What is the volume of water shown in **Figure 1.1**?

- A 46.5 cm<sup>3</sup>    B 46.0 cm<sup>3</sup>  
C 45.5 cm<sup>3</sup>    D 45.0 cm<sup>3</sup>



(f) The figure below shows a thermometer calibrated in degrees Celsius.



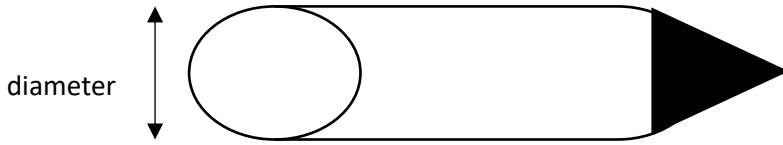
What is the reading shown on the thermometer?

- A: 27°C    B: 37°C    C: 47°C    D: 57°C
- (g) A measuring cylinder is used to measure the volume of water.  
Which one of the following would **decrease** the accuracy of the measurement?
- A: Using a measuring cylinder with clear markings.  
B: Reading the top of the meniscus.  
C: Placing the measuring cylinder on a horizontal surface.  
D: Using a measuring cylinder with an appropriate scale.

(h) Which information does a vector quantity has more than a scalar quantity?  
**A.** unit                                      **B.** direction                                      **C.** magnitude                                      **D.** SI unit

(i) Which pairs consist of only physical quantity?  
**A.** metre, centimeter                                      **B.** mass, length  
**C.** kilogram, ,metre                                      **D.** temperature, gram

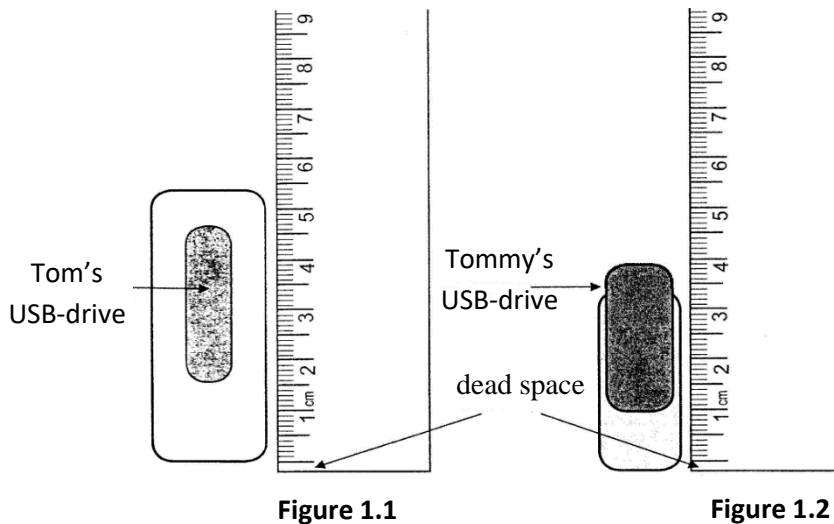
(j) The figure shows a regular pencil. Which one of the following is likely to be the diameter of the pencil?



- A** 6 km                                      **B** 6 m                                      **C** 6 cm                                      **D** 6 mm

**Question 1**

Tom and Tommy measure the height of their USB-drives as shown in **Figure 1.1** and **1.2** respectively.



(a) Write down the height of Tom's USB-drive. Height of Tom's USB-drive = \_\_\_\_\_ cm. [2]

(b) Tommy **does not** pay attention to the dead space on his ruler. Write down the reading he observes.

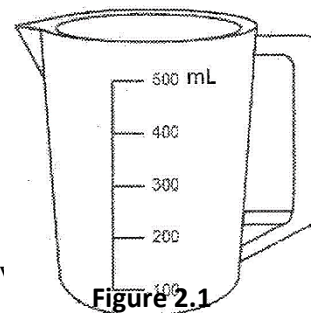
Apparent height of Tommy's USB-drive = \_\_\_\_\_ cm. [2]

(c) What type of error is associated with the value which Tommy obtains?  
 \_\_\_\_\_ [1]

(d) Given that the dead space has a length of 2 mm, write down the correct value for the height of Tommy's USB-drive.  
 Height of Tommy's USB-drive = \_\_\_\_\_ cm [3]

**Question 2**

(a) Sonia uses the measuring jug shown in **Figure 2.1** to pour 200 mL of water.



(i) What measuring instrument could Sonia use to measure the volume of water **more accurately** than with the measuring jug?

\_\_\_\_\_ [1]

(ii) Sonia now wants to measure the temperature of the water.

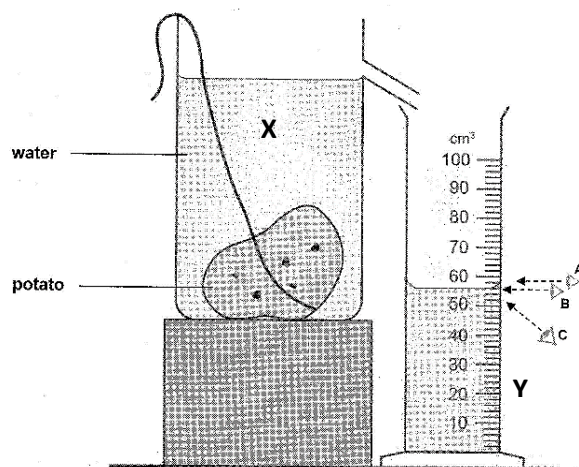
1. Suggest which instrument Sonia can use to measure the temperature of the water.

\_\_\_\_\_ [1]

2. State the **SI unit** of temperature.

\_\_\_\_\_ [1]

(b) A student measures the volume of a potato using the method shown in **Figure 2.2**.



**Figure 2.2**

(i) Name the **method** used in **Figure 2.2** to find the volume of the potato.

\_\_\_\_\_ [1]

(ii) Explain why placing the eye at **A** or at **C** gives a **less** accurate reading of the volume compared to placing the eye at **B**.

Eye at **A**: \_\_\_\_\_ [1]

Eye at **C**: \_\_\_\_\_ [1]

(iii) The initial volume of water in measuring instrument **Y** **before** the student lowers the potato into **X** is 8 cm<sup>3</sup>. What is the **volume** of the potato?

**Volume** = \_\_\_\_\_ cm<sup>3</sup> [2]

**Question 3**

**Figure 3.1** shows a pile of 10 identical glass slides.



**Figure 3.1:** Pile of 10 identical glass slides

(a) What instrument is most appropriate for measuring the thickness of one slide?

\_\_\_\_\_ [1]

(b) The same instrument in **part (a)** is used to measure the thickness of the pile of slides in **Figure 3.1**.

(i) Give **one** type of error that should be avoided when making the measurement of the thickness of the pile.

\_\_\_\_\_ [1]

(ii) What precaution(s) must be taken to avoid the error mentioned in **part (b)(i)**?

\_\_\_\_\_ [1]

(iii) A student determines the thickness of one slide by measuring the thickness of the pile of 10 identical slides and dividing it by the number of slides instead of measuring the thickness of one slide only.

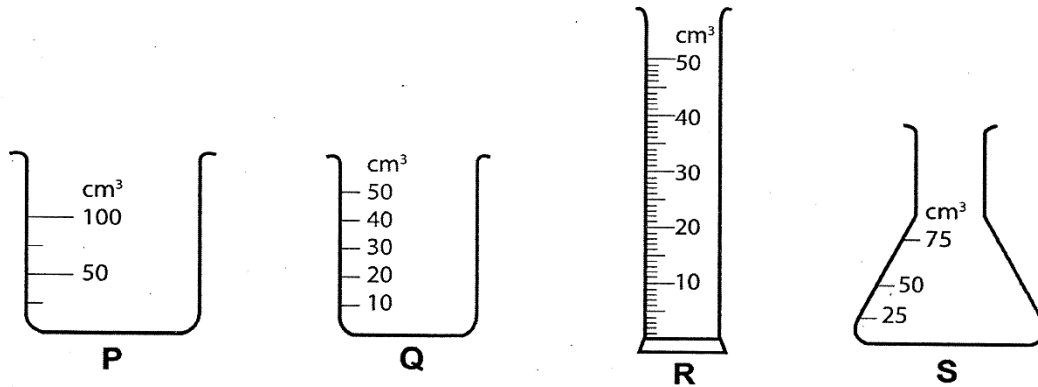
Explain why this is **more accurate**.

\_\_\_\_\_  
\_\_\_\_\_ [2]

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**Question 4 (2 marks)**

**Figure 4.1** below shows measuring containers **P, Q, R** and **S**.



**Figure 4.1**

(a) Which container would you use to measure 18 cm<sup>3</sup> of water? Choose **one** letter from **P, Q, R** and **S**.

\_\_\_\_\_ [1]

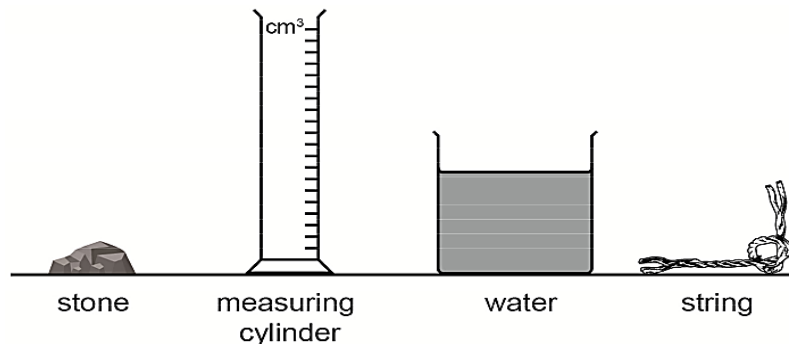
(b) Give a reason for your answer to part (a).

\_\_\_\_\_  
\_\_\_\_\_ [1]

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**Question 5**

A student uses the equipment shown in **Fig. 5.1** to determine the volume of a stone. He begins by pouring some water into the measuring cylinder.



**Fig. 5.1**

(a) Write down the next step he should take.

..... [1]

(b) Give **one** precaution he should take in the step you mentioned in part (a).

..... [1]

(c) He then drops the stone carefully into the measuring cylinder.

Why is it better to lower the stone into the measuring cylinder by using a piece of string?

..... [1]

(d) What will he observe after dropping the stone into the measuring cylinder?

..... [1]

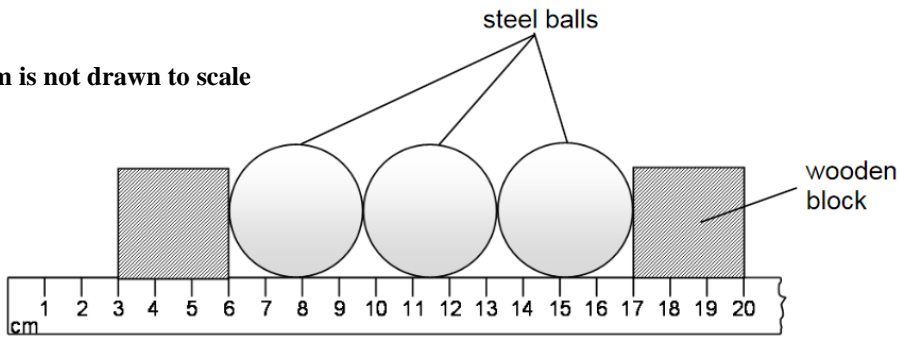
(e) Explain how the student can find the volume of the stone.

..... [1]

**Question 6A**

To find the diameter of a steel ball, Drew arranges three identical steel balls along a graduated ruler as shown in **Figure 9.1**.

**Diagram is not drawn to scale**



**Figure 9.1**

(i) Use **Figure 9.1** to calculate the diameter of **one** steel ball. Show all your workings.

Diameter of one steel ball = \_\_\_\_\_ [2]

(ii) Suggest a reason why Drew uses wooden blocks in the measurement.

..... [1]

(iii) State **two** precautions which have to be taken to get an accurate measurement of the diameter of the rubber ball.

Precaution 1 : \_\_\_\_\_

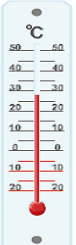


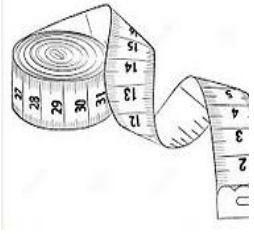
\_\_\_\_\_

Precaution 2 : \_\_\_\_\_

\_\_\_\_\_ [2]

### Question 6B

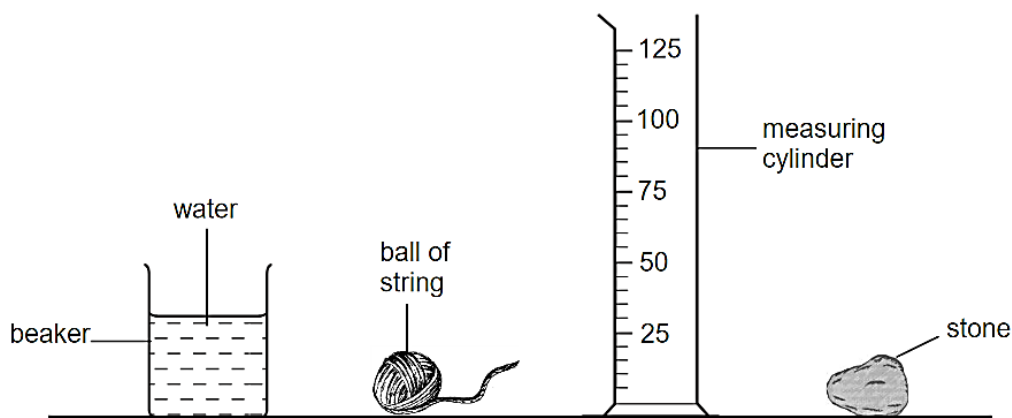
The instruments shown below are used to investigate the factors that affect the speed of a tennis ball. By drawing an arrow, match each piece of **instrument** to the **measurement** made and to the correct **unit**. An example is given.

Instrument	measurement	unit
	measures the <b>time</b> of flight of the table-tennis ball	m
	measures the <b>temperature</b> of the air	grams
	measures the <b>distance</b> travelled by the table-tennis ball	seconds
	measures the <b>mass</b> of the table-tennis ball	°C



**Question 7**

(a) Terry uses the apparatus in **Fig. 7.1** to find the volume of a stone.



**Figure 7.1**

The sentences below describe the procedure which Terry follows, but they are not in the correct order.

- A:** Attach the stone using a piece of string.
- B:** Record the new volume of water in the cylinder.
- C:** Pour 75 cm<sup>3</sup> of water in the measuring cylinder.
- D:** Subtract 75 cm<sup>3</sup> from the volume recorded.
- E:** Gently lower the stone into the measuring cylinder.
- F:** Fully submerge the stone in the water.

Write the correct order in the boxes. The first one has been done for you.

[3]

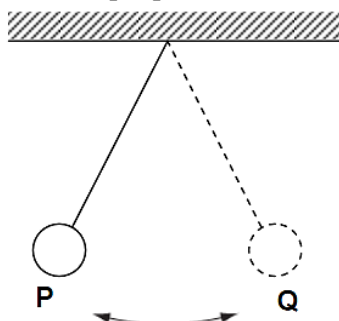
(b) State **two** precautions which Terry should take when following the above procedure.

\_\_\_\_\_

\_\_\_\_\_

[2]

(c) **Figure. 7.2** below shows the bob of a simple pendulum moving between points **A** and **B**.



**Figure 7.2**

