2. MEASUREMENT II

1. State any **two** factors that determine the choice of instrument for measuring length.
2. A pharmacist measured the mass of a tablet and found to be **20 mg**. Determine the mass of the tablet in SI units giving your answer in standard form.
3. A drug manufacturer gives the mass of the active ingredient in a tablet as **5 mg**. Express this quantity in kg and in standard form.

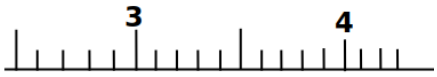
VERNIER CALLIPERS

1. Suggest a suitable instrument that can be used for measuring the width of an object stated as **2.6×10^{-1} cm.**
2. Sketch vernier calipers with an error of +**0.03**
3. Sketch a section of vernier calipers showing a reading of **2.33 cm**.
4. Draw a scale of vernier calipers whose reading is **0.06 cm**
5. Vernier calipers with a zero error of **-0.02** gave the diameter of a marble as **1.67 cm**.

(i) Define the term zero error.

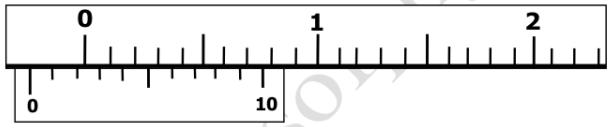
(ii) Use the above information to determine the vernier scale reading of the calipers.

6. The figure below shows part of the main scale of a vernier callipers.



Insert the vernier scale to the main scale, to show a reading of 3.14 cm

7. Figure below show parts of vernier callipers when the Jaws are closed without an object between them.



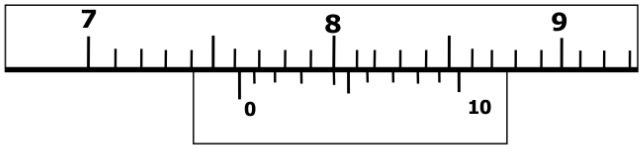
(i) **State** the error of the vernier callipers above.

(ii) A student used the vernier callipers to measure the diameter of the a test tube and read it to be **1.76 cm**. Determine the actual diameter of the test tube.

8. The figure below shows a vernier caliper scale.

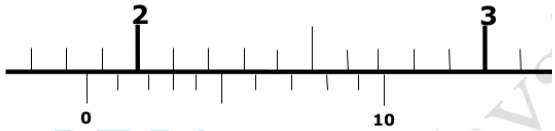
State the correct reading of the scale if the instrument has a zero error of -0.01 cm

9. The figure below shows a vernier calipers scale



State the correct reading of scale if the instrument has a zero-error of **-0.02 cm**

10. The vernier caliper in the figure below has a zero error of **-0.05 cm**



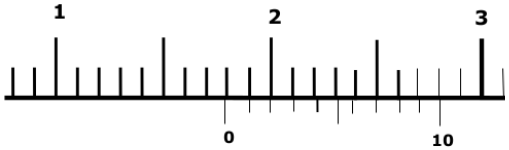
State the actual reading of the measuring instrument.

11. Figure shows the scales a pair of vernier callipers being used to measure the length of a pipe, whose radius is **1.20 cm**. The zero error of the device is **–0.13 cm**.

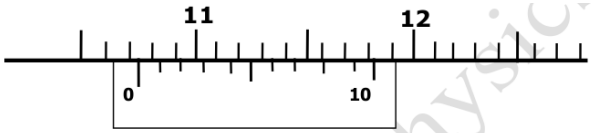
(i) Determine the actual length of the pipe.

(ii) Given that the radius of the pipe is **1.20 cm**, find its volume.

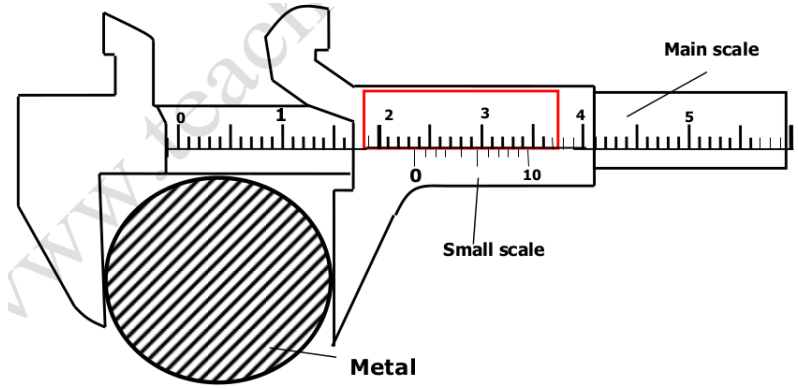
12. The figure below shows a vernier calipers being used to measure the thickness of an object. It has a zero error of **+0.01 cm,** state the correct measurement.



13. The figure below shows a scale of a part of a vernier caliper. If the instrument has a zero error of positive **0.03**, state the correct reading.



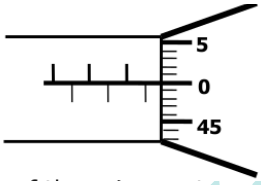
14. The figure below shows a vernier caliper being used to measure the diameter of a cylindrical metal of mass **250 g** and length **20cm**. The reading on the calipers when the jaws were fully closed without the metal was **+ 0.08 cm**.



(a) What is the diameter of the cylindrical metal?
(b) Calculate the volume of the cylindrical metal.
(b) Determine the density of the cylindrical metal.

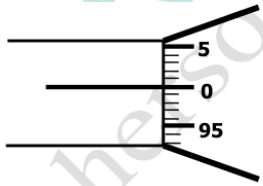
MICROMETER SCREWGAUGE

1. Name the instrument that would be most suitable for measuring the thickness of one sheet of paper.
2. Define the term zero error with regard to a micrometer screw gauge.
3. State the smallest measurement that can be made by the micrometer screw gauge
4. The Screw of micrometer screw gauge has a pitch of **0.5 mm**. The thimble is divided into **50** equal divisions. What is the smallest unit it can measure?
5. (a) Draw a diagram to represent a scale of a micrometer screw gauge of thimble scale 50 divisions and reading 3.68 mm.
   (b) Determine the actual reading if the micrometer screw gauge above has a zero error of **0.03 mm**.
6. Draw a diagram of a micrometer screw gauge scale showing a reading of **5.71 mm** if it has a pitch of **0.5 mm**.
7. Figure below shows part of a micrometer screw gauge. Use the information and the figure to answer questions **(i)** and **(ii)**

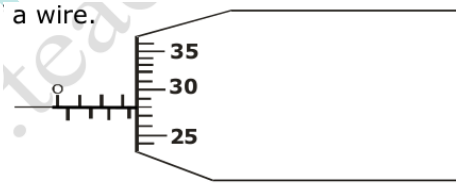


(i) State the pitch of the micrometer screw gauge
(ii) What are the two limitations of the micrometer screw gauge

8. State the pitch of the micrometer screw gauge below

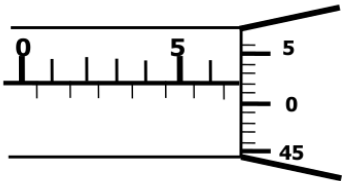


9. The micrometer screw gauge in figure below gives the reading of the diameter of a piece of a wire.



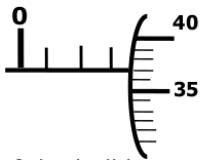
Given that the length of the wire whose diameter was read above is 4 cm, determine the volume of the wire.

10. Figure below shows part of a micrometer screw gauge with a zero error of negative **0.01**.



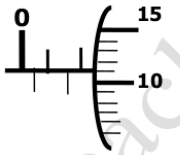
(i) What is the **pitch** of the micrometer screw gauge
(ii) What is the reading of the instrument above.
(iii) State one limitation of a micrometer screw gauge

11. The micrometer screw gauge with an error of 0.04 mm shows the diameter of a ball bearing.

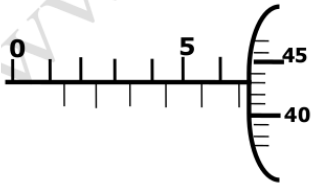


Find the diameter of the ball bearing.

12. What is the micrometer screw gauge reading shown in the diagram below?

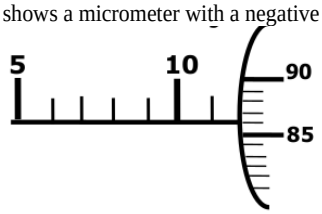


13. Figure shows a micrometer with a negative error of 0.02 mm, used to measure the diameter of a ball bearing.



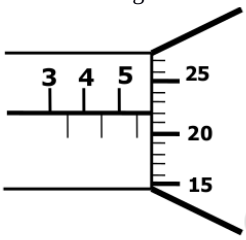
Record the diameter of the ball

14. Figure below shows a micrometer with a negative error of **0.02 mm**, used to measure the diameter of a ball bearing.



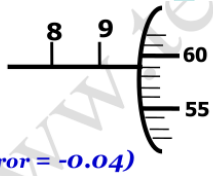
Record the diameter of the ball

15. What is the reading on the micrometer screw gauge shown below with an error of **+0.5 mm?**



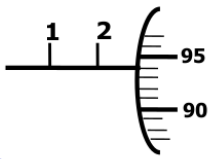
16. Determine the reading of the micrometer screw gauges below with the zero error in brackets.

(g)



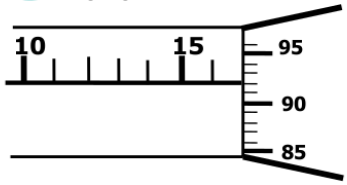
(Error = -0.04)

(h)

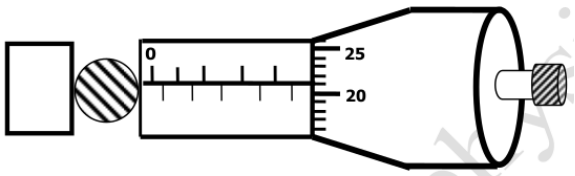


Error = +0.01

17. The micro-meter screw gauge below has a zero error of negative **0.19 mm**. state its actual reading.



18. A spherical ball bearing of mass **0.0024 kg** is held between the anvil and spindle of a micrometer screw gauge. The reading on the gauge when the jaws are closed without anything in between is 0.11 mm.

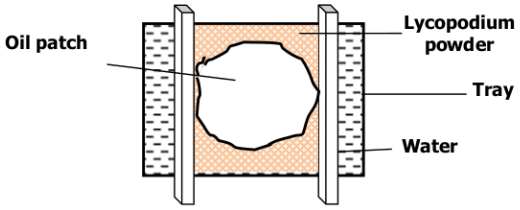


What is the diameter of the ball bearing?

Find the density of the ball bearing correct to 3 significant figures.

OIL DROP EXPERIMENT

1. Describe one method of determining the diameter of the oil drop?
2. An oil drop of volume **V m^3** introduced on the surface of water spreads to form a patch whose area is **A m^2**.
   a) Derive an expression for obtaining the diameter, **d** of a molecule of oil
   b) State why this is an estimate.
3. Figure below shows part of an experimental set up of estimating the diameter of an oil molecule.



   (i) Describe how the oil patch is formed.
   (ii) What is the purpose of lycopodium powder?
4. State two assumption made in the oil drop experiment.
5. A drop of olive oil is placed on the surface of water sprinkled with lycopodium powder in a large dish. The oil spreads out to form a circular film.
   i) State the measurement to be made in order to find the area of the film.
   (ii) What else need to be known for the thickness of the oil film to be found?
   (iii) What is the purpose of lycopodium powder?
6. An oil drop at room temperature is placed on the surface of water in a trough. The drop spreads to form a circular patch of area **154 cm^2**. **150** such drops occupy a volume of **0.1 cm^3.**
   (i) Estimate the size of an oil molecule. ***ANS 0.000004329 mm***
   (ii) Give one reason why the value obtained in (i) above in but an estimate.
   (iii) If the temperature of the oil drop is raised above room temperature, and then placed on the water surface state and explain what is likely to be observed in terms of the size of patch formed. (*Temperature of water is the same as that of oil*)
7. A small drop of oil has a volume **5 x 10 $^{-10}$ m^3** when it is put on surface of some clean water it forms a circular film of **0.02 m^2** in area.
   (i) Describe how the oil patch /film is formed.
   (ii) Why does the film form into a circular shape
   (iii) What in the size of a molecule of oil? ***ANS 2.5 x 10 $^{-8}$ m***
8. An oil drop of volume of **6.546 x 10^{-5} cm^3** spread to form a circular patch of radius **9 cm**. Determine the diameter of the oil molecule
9. A small drop of oil has a volume of **6 x 10^{-5} cm^3**. When it is put on the surface of some clean water, it forms a circular film of **2 x 10^4 cm^2** in area; What is the size of a molecule of oil? ***ANS 0.3 cm***
10. In an experiment to estimate the size of a molecule of olive oil, a drop of oil of volume **0.12 cm^3** was placed on a clean water surface. The oil spread on a patch of diameter **6.0 x 10^6 mm^2**. Calculate the size of the molecule. ***ANS 2.0 x 10 $^{-6}$ m***
11. Estimate the size of an oil molecule if a drop of the oil of volume **2.5 x 10^{-6} m^3** forms a patch of diameter **16 cm** on the surface of water ***ANS 1.243 x 10 $^{-4}$ m***
12. An oil drop of volume **0.004 cm^3** spread into a film of diameter **28 cm**. Estimate the diameter of one molecule of the oil. (Leave your answer in standard form) ***ANS 6.494 x 10 $^{-5}$ cm***
13. In an experiment to estimate the diameter of an oil molecule, an oil drop of diameter **0.05 cm** spread over a circular patch whose diameter is **20cm**
    Determine:
    (i) The volume of the oil drop. ***ANS 6.548 x 10 $^{-6}$ cm^3***
    (ii) The area of the patch covered by the oil ***ANS 314.3 cm^2***
    (iii) The diameter of the patch covered by the oil. ***ANS 2.083 x 10 $^{-7}$ cm***
    (iv) State any assumption made in (b) above.
    (v) State two possible sources or errors in this experiment.
14. In an experiment to estimate the diameter of an oil molecule, an oil drop of radius **2.5 x 10^{-4} m** spreads over a circular patch whose diameter is **20cm**. Determine:
    (i) The volume of the oil drop. ***ANS 6.548 x 10 $^{-11}$ m^3***
    (ii) The area of the patch covered by the oil ***ANS 0.03143 m^2***
    (iii) The thickness of the oil molecule ***ANS 2.083 x 10 $^{-9}$ m***
    (iv) State one assumption made in (b) (iii) above
15. In an experiment to estimate the diameter of an oil molecule, an oil drop of diameter **0.06 cm** spreads over a circular patch whose diameter is **20cm**. Determine:-
    i) The volume of the oil drop ***ANS 1.131 x 10 $^{-4}$ cm^3***
    ii) The area of the patch covered by the oi l ***ANS 314.3 cm^2***
    iii) The diameter of the oil molecule ***ANS 3.60 x 10 $^{-7}$ cm***
    iv) State any two assumptions made in b (iii) above
16. In an experiment to estimate the radius of oil molecule **200** identical drops of oil of density **800 kg/m^3** are run from a burette. The reading on the burette changes from **0.0 cm^3** to **0.5 cm^3**.One of these drops is placed on a large water surface dusted lightly using chalk dust. It spreads forming a uniform patch of area **0.2 m^2**.
    i) What is the purpose of the chalk dust?
    ii) What is the mass of one drop of oil in kg? ***ANS 0.002 g***
    iii) What is the volume of one oil drop in m^3? ***ANS 2.5 x 10 $^{-9}$ m^3***
    iv) What is the thickness of the oil film? ***ANS 1.25 x 10 $^{-6}$ m***
    v) State the assumption (s) made in this experiment