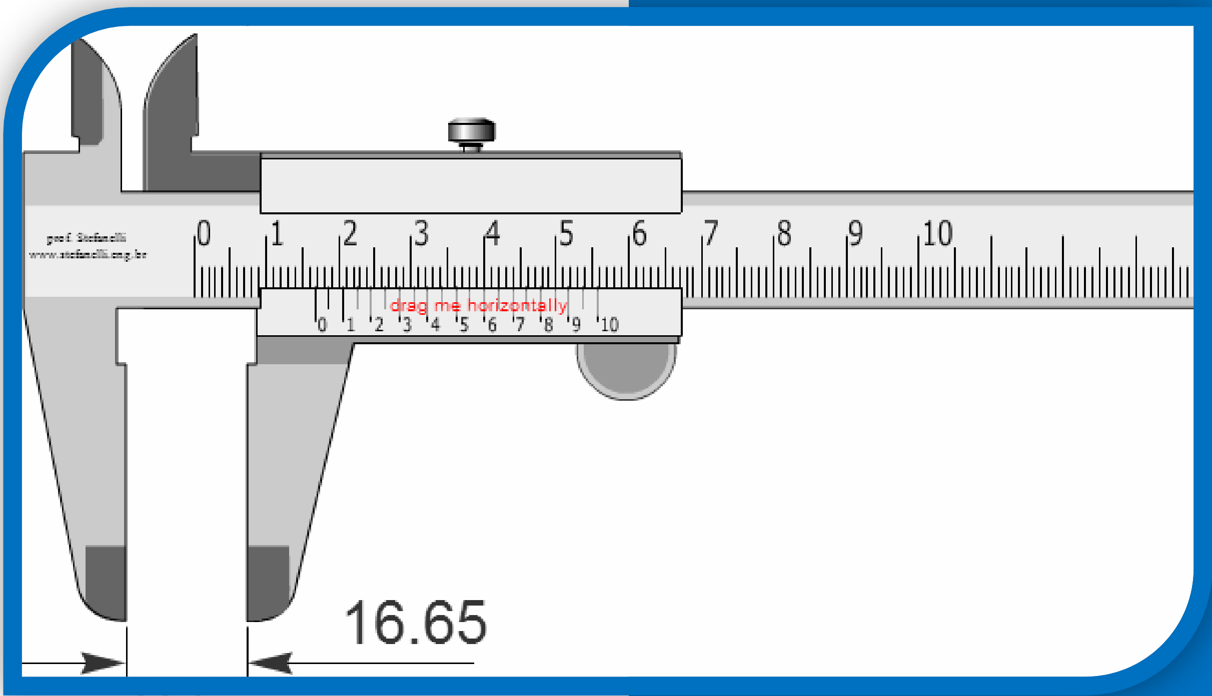
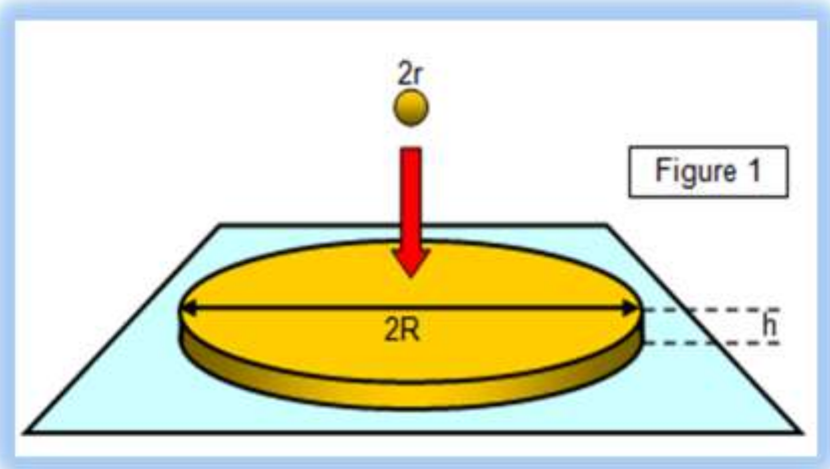
2020

MEASUREMENT II





TEACHERS OF PHYSICS

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9/14/2020

1. State any **two** factors that determine the choice of instrument for measuring length.

- *Level of accuracy desired*
- *Size of object to be measured*

2. A pharmacist measured the mass of a tablet and found to be **20mg**. Determine the mass of the tablet in SI units giving your answer in standard form. (2mk)

$$1mg = 0.000001k$$
$$20mg = ?$$
$$\frac{20mg \times 0.000001kg}{1mg}$$
$$= 0.00002kg$$
$$= 2.0 \times 10^{-5}kg$$

3. A drug manufacturer gives the mass of the active ingredient in a tablet as **5mg**. Express this quantity in kg and in standard form. (1mk)

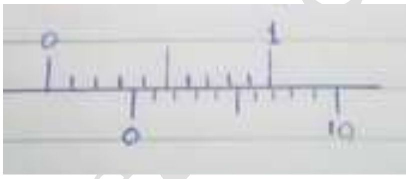
$$1Kg = 1 \times 10^{6}mg$$
$$? = 5mg$$
$$\frac{5mg \times 1kg}{1 \times 10^{6}mg}$$
$$= 5 \times 10^{-6}kg$$

VERNIER CALLIPERS

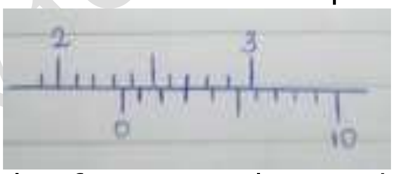
1. Suggest a suitable instrument that can be used for measuring the width of an object stated as **2.6 x 10^{-1}cm.**

- *Vernier calipers*

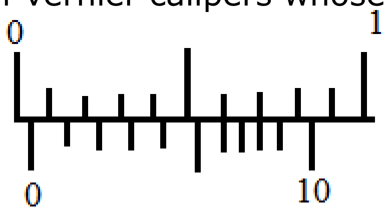
2. Sketch vernier calipers with an error of +**0.03** **(1mk)**



3. Sketch a section of vernier calipers showing a reading of **2.33 cm**. (2mk)



4. Draw a scale of vernier calipers whose reading is **0.06cm** (2mk)



5. Vernier calipers with a zero error of **-0.02** gave the diameter of a marble as **1.67cm**.

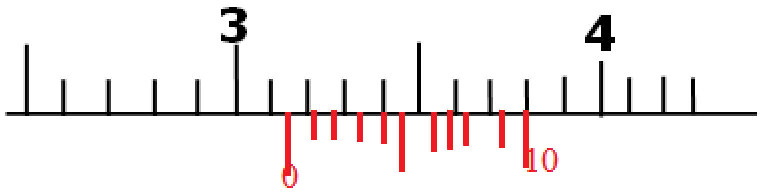
(i) Define the term zero error (1mk)

✓ *An error which occurs when the zero mark of the main scale does not coincide with the zero mark of the vernier scale.*

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

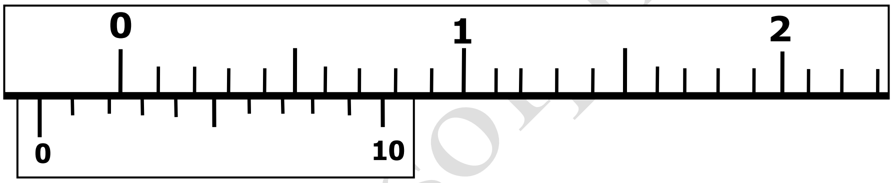
$$reading = 1.67 + 0.02$$
$$= 1.69cm$$

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



Insert the vernier scale to the main scale, to show a reading of 3.14cm. (1mk)

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



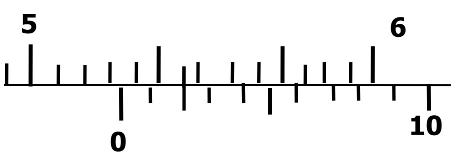
(i) **State** the error of the vernier callipers above. (1mk)

-0.02cm

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

$$actual\ diameter = 1.76 + 0.02$$
$$= 1.78cm$$

8. The figure below shows a vernier caliper scale.

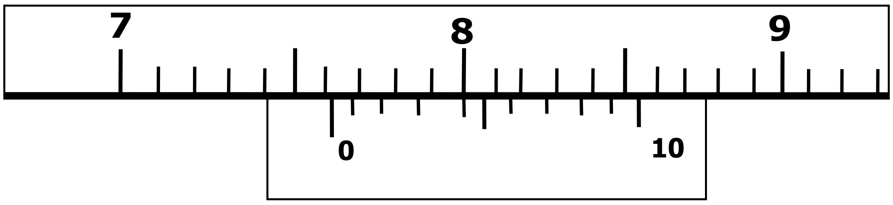


$$main\ scale\ reading = 5.3$$
$$vernier\ scale\ reading = 0.02$$
$$reading = 5.3 + 0.02 = 5.32cm$$

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

$$correct\ reading = 5.32 + 0.01 = 5.33cm$$

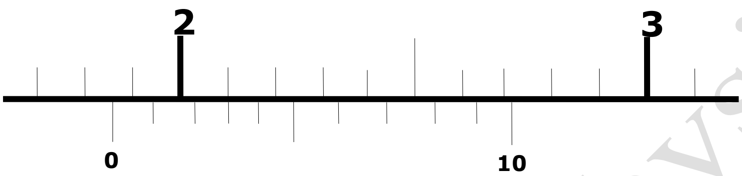
9. The figure below shows a vernier calipers scale



State the correct reading of scale if the instrument has a zero-error of **-0.02cm** 2mk

$$main\ scale\ reading = 7.6$$
$$vernier\ scale\ reading = 0.04$$
$$reading = 7.6 + 0.04 = 7.64cm$$
$$correct\ reading = 7.64 + 0.02 = 7.66cm$$

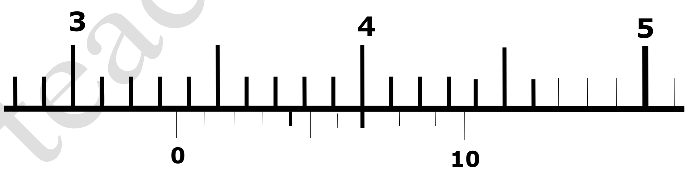
10. The vernier caliper in the figure below has a zero error of **-0.05cm**



State the actual reading of the measuring instrument. (2mks)

$$main\ scale\ reading = 1.8$$
$$vernier\ scale\ reading = 0.03$$
$$reading = 1.8 + 0.03 = 1.83cm$$
$$correct\ reading = 1.83 + 0.05 = 1.88cm$$

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**.



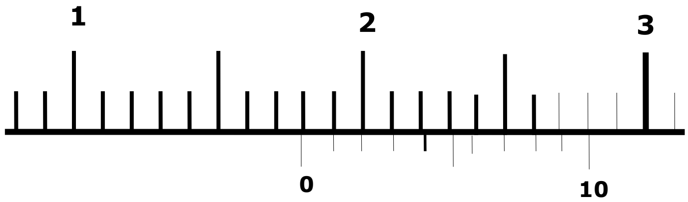
(i) Determine the actual length of the pipe. (2mk)

$$main\ scale\ reading = 3.3$$
$$vernier\ scale\ reading = 0.07$$
$$reading = 3.3 + 0.07 = 3.37cm$$
$$actual\ length = 3.37 + 0.13 = 3.50cm$$

(ii) Given that the radius of the pipe is **1.20 cm**, find its volume. (1mk

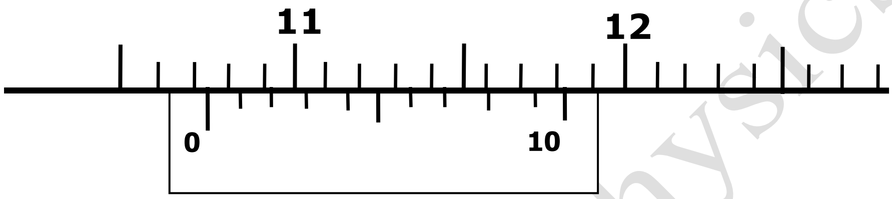
$$volume\ of\ cylinder = \pi r^2 h$$
$$= \frac{22}{7} \times 1.2^2 \times 3.5$$
$$= 15.84cm^3$$

12. The figure below shows a vernier calipers being used to measure the thickness of an object. It has a zero error of **+0.01cm,** state the correct measurement. (2mk)



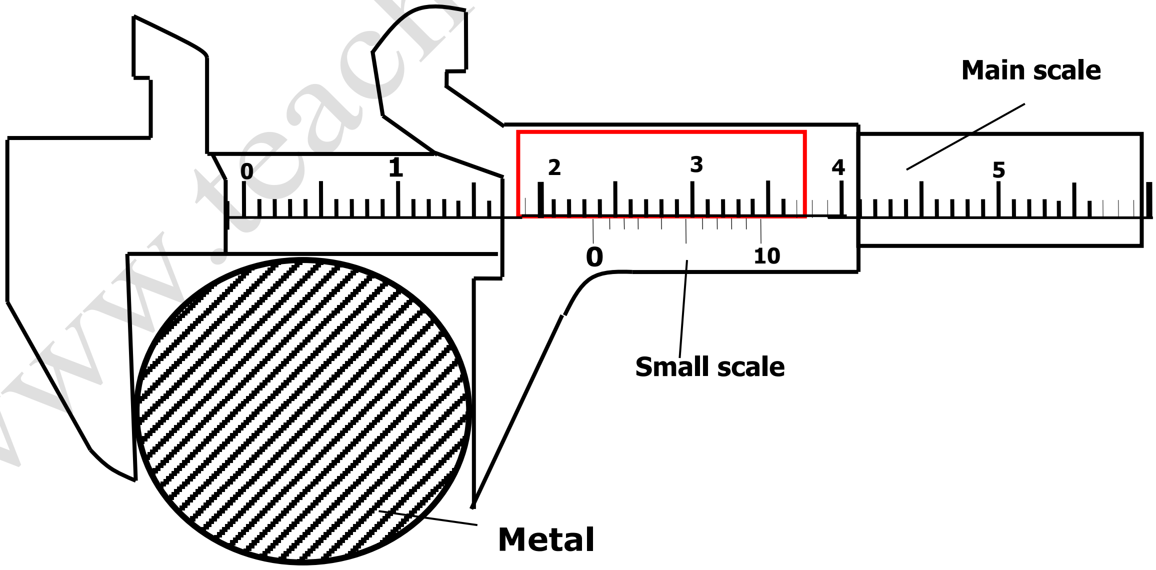
$$main\ scale\ reading = \ 1.7$$
$$vernier\ scale\ reading = 0.01$$
$$reading = 1.7 + 0.01 = 1.71cm$$
$$correct\ measurement = 1.71 - 0.01 = 1.70cm$$

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 (2mk)



$$main\ scale\ reading = \ 10.7$$
$$vernier\ scale\ reading = 0.08$$
$$reading = 10.7 + 0.08 = 10.78cm$$
$$correct\ reading = 10.78 - 0.03 = 10.75cm$$

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



(a) What is the diameter of the cylindrical metal? **(2mk)**

$$main\ scale\ reading = \ 2.3$$
$$vernier\ scale\ reading = 0.04$$
$$reading = 2.3 + 0.04 = 2.34cm$$
$$actual\ diameter = 2.34 - 0.08 = 2.26cm$$

(b) Calculate the volume of the cylindrical metal. **(3mk)**

$$volume\ of\ cylinder = \pi r^2 h$$
$$= \frac{22}{7} \times 1.13^2 \times 20$$
$$= 80.26 cm^3$$

(b) Determine the density of the cylindrical metal. **(3mk)**

$$density = \frac{mass}{volume}$$
$$= \frac{250}{80.26}$$
$$= 3.1149 gcm^{-3}$$

MICROMETER SCREWGAUGE

1. Name the instrument that would be most suitable for measuring the thickness of one sheet of paper.

✓ *Micrometer screw gauge*

2. Define the term zero error with regard to a micrometer screw gauge.(1mk)

An error which occurs when the zero mark of the sleeve scale does not coincide with the zero mark of the thimble scale.

Or

An error which occurs if the zero of the thimble scale is above or below the zero of the sleeve scale

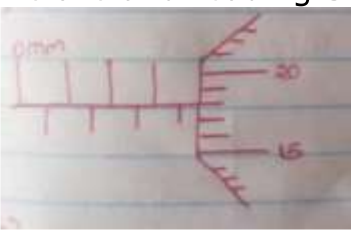
3. State the smallest measurement that can be made by the micrometer screw gauge. **(1mk)**

0.01mm

4. The Screw of micrometer screw gauge has a pitch of **0.5mm**. The thimble is divided into **50** equal divisions. What is the smallest unit it can measure?

$$smallest\ unit = \frac{0.5}{50} = 0.01mm$$

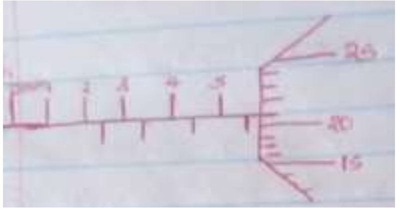
5. (a) **Draw** a diagram to represent a scale of a micrometer screw gauge of thimble scale 50 divisions and reading **3.68mm**. (1mk)



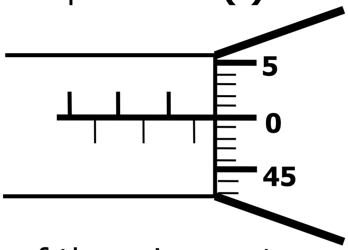
(b) **Determine** the actual reading if the micrometer screw gauge above has a zero error of **0.03mm**. (1mk)

$$actual\ reading = 3.68 - 0.03 = 3.65mm$$

6. Draw a diagram of a micrometer screw gauge scale showing a reading of **5.71mm** if it has a pitch of **0.5mm**. **(2mk)**



7. Figure below shows part of a micrometer screw gauge. Use the information and the figure to answer questions **(i)** and **(ii)**



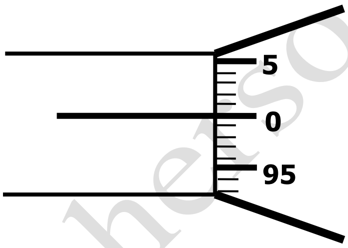
(i) State the pitch of the micrometer screw gauge **(1mk)**

0.5mm

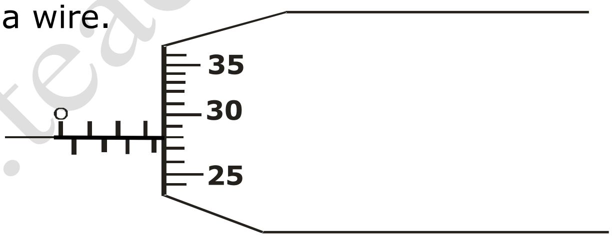
(ii) What are the two limitations of the micrometer screw gauge **(2mk)**

1. *Has limited range hence can only measure some lengths*
2. *Can only measure external diameters*

8. State the pitch of the micrometer screw gauge below **(1mk)**



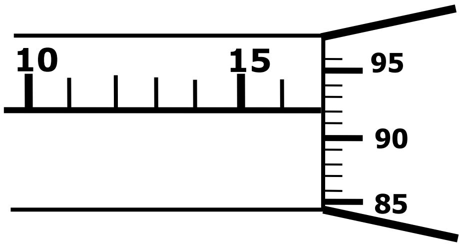
9. The micrometer screw gauge in figure below gives the reading of the diameter of a piece of a wire.



Given that the length of the wire whose diameter was read above is 4cm, determine the volume of the wire. (2mk)

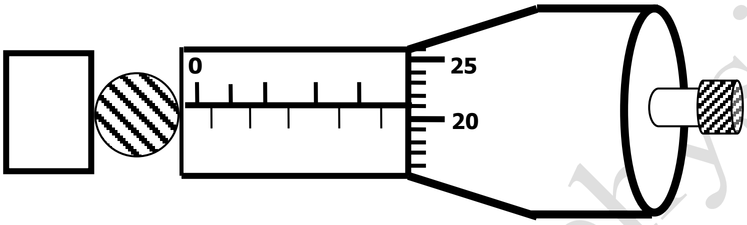
$$sleeve\ scale\ reading = 3.5$$
$$thimble\ scale\ reading = 0.28$$
$$reading = 3.5 + 0.28 = 3.78mm$$
$$volume = \pi r^2 l$$
$$= \frac{22}{7} \times 1.89^2 \times 40$$
$$= 449.064mm^3$$

10. The micro-meter screw gauge below has a zero error of negative **0.19mm**. State its actual reading. (2mk)



$$sleeve\ scale\ reading = 16.0$$
$$thimble\ scale\ reading = 0.92$$
$$reading = 16.0 + 0.92 = 16.92mm$$
$$actual\ reading = 16.92 + 0.19 = 17.11mm$$

11. 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 0.11mm.



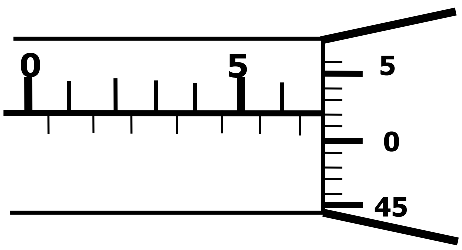
a) What is the diameter of the ball bearing? (2mk)

$$sleeve\ scale\ reading = 4.5$$
$$thimble\ scale\ reading = 0.21$$
$$reading = 4.5 + 0.21 = 4.71mm$$
$$actual\ diameter = 4.71 - 0.11 = 4.60mm$$

b) Find the density of the ball bearing correct to 3 significant figures. (4mk)

$$volume = \frac{4}{3}\pi r^3$$
$$= \frac{4}{3} \times \frac{22}{7} \times 2.30^3$$
$$= 50.9855mm^3$$
$$density = \frac{mass}{volume}$$
$$= \frac{0.0024}{5.09855 \times 10^{-8}}$$
$$= 47072.2068\text{kgm}^{-3}$$
$$= 47100kgm^{-3}\ correct\ to\ 3\ s.f$$

12. 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 (1mk)

0.5mm

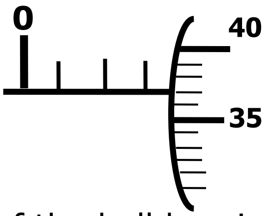
(ii) What is the reading of the instrument above? (2mk)

$$sleeve\ scale\ reading = 6.5$$
$$thimble\ scale\ reading = 0.02$$
$$reading = 6.5 + 0.02 = 6.52mm$$
$$actual\ reading = 6.52 + 0.01 = 6.53mm$$

(iii) State one limitation of a micrometer screw gauge (1mk)

1. *Has limited range hence can only measure some lengths*
2. *Can only measure external diameters*

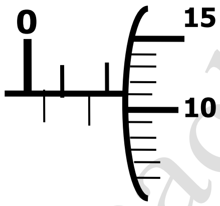
13. The micrometer screw gauge with an error of 0.04mm shows the diameter of a ball bearing.



Find the diameter of the ball bearing. (2mks)

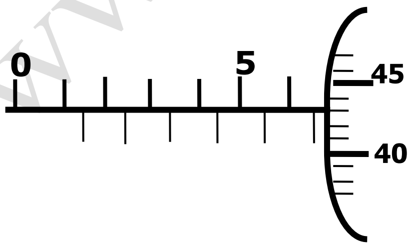
$$sleeve\ scale\ reading = 3.0$$
$$thimble\ scale\ reading = 0.37$$
$$reading = 3.0 + 0.37 = 3.37mm$$
$$actual\ diameter = 3.37 - 0.04 = 3.41mm$$

14. What is the micrometer screw gauge reading shown in the diagram below? (2mks)



$$sleeve\ scale\ reading = 2.0$$
$$thimble\ scale\ reading = 0.11$$
$$reading = 2.0 + 0.11 = 2.11mm$$

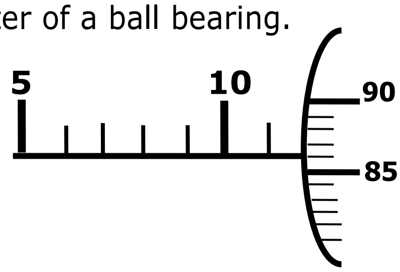
15. Figure shows a micrometer with a negative error of 0.02 mm, used to measure the diameter of a ball bearing.



Record the diameter of the ball (2mks)

$$sleeve\ scale\ reading = 6.5$$
$$thimble\ scale\ reading = 0.43$$
$$reading = 6.5 + 0.43 = 6.93mm$$
$$actual\ diameter = 6.93 + 0.02 = 6.95mm$$

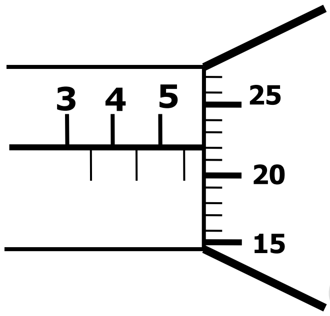
16. Figure below shows a micrometer with a negative error of **0.02 mm**, used to measure the diameter of a ball bearing.



Record the diameter of the ball **(1mk**

$$sleeve\ scale\ reading = 11.0$$
$$thimble\ scale\ reading = 0.86$$
$$reading = 11.0 + 0.86 = 11.86mm$$
$$actual\ diameter = 11.86 + 0.02 = 11.88mm$$

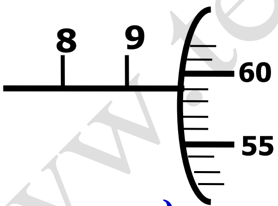
17. What is the reading on the micrometer screw gauge shown below with an error of **+0.5mm?** (1mk)



$$sleeve\ scale\ reading = 5.5$$
$$thimble\ scale\ reading = 0.22$$
$$reading = 5.5 + 0.22 = 5.72mm$$
$$actual\ reading = 5.72 - 0.5 = 5.22mm$$

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

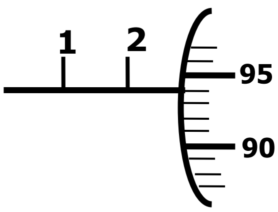
(g)



(Error = -0.04)

$$sleeve\ scale\ reading = 9.0$$
$$thimble\ scale\ reading = 0.59$$
$$reading = 9.0 + 0.59 = 9.59mm$$
$$actual\ reading = 9.59 + 0.04 = 9.63mm$$

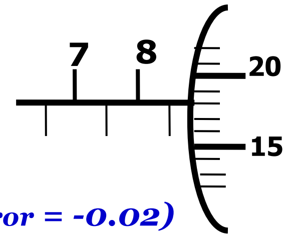
(h)



Error = +0.01

$$sleeve\ scale\ reading = 2.0$$
$$thimble\ scale\ reading = 0.94$$
$$reading = 2.0 + 0.94 = 2.94mm$$
$$actual\ reading = 2.94 - 0.01 = 2.93mm$$

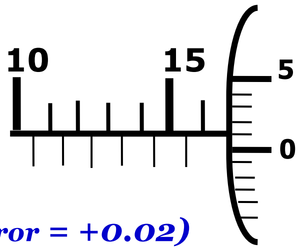
(i)



(Error = -0.02)

$$sleeve\ scale\ reading = 8.5$$
$$thimble\ scale\ reading = 0.18$$
$$reading = 8.5 + 0.18 = 8.68mm$$
$$actual\ reading = 8.68 + 0.02 = 8.70mm$$

(j)



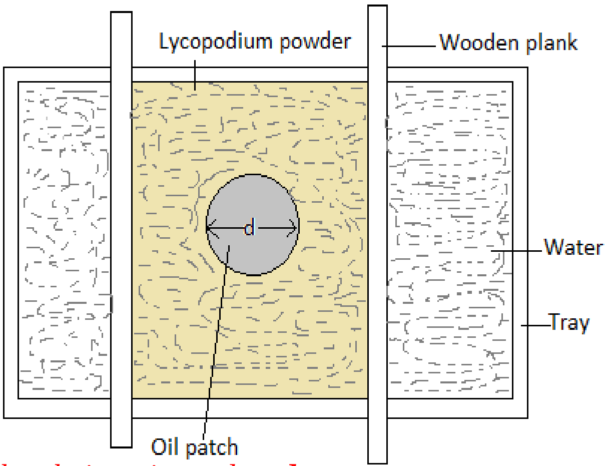
(Error = +0.02)

$$sleeve\ scale\ reading = 16.0$$
$$thimble\ scale\ reading = 0.01$$
$$reading = 16.0 + 0.01 = 16.01mm$$
$$actual\ reading = 16.01 - 0.02 = 15.99mm$$

OIL DROP EXPERIMENT

1. Describe one method of determining the diameter of the oil drop? **(3mk)**

- *Fill a tray with water to the brim, and sprinkle lycopodium powder lightly on the water surface.*
- *Carefully place an oil drop at the centre of the tray and allow it to spread on the surface of water until it is one molecule thick. This forms a patch whose diameter is measured*



- *Thickness of oil molecule is estimated as* ***d***

Volume of oil drop = volume of oil patch

$$\frac{4}{3}\pi r^3 = \pi\left(\frac{d}{2}\right)^2 \times \boldsymbol{thickness, t, of\ oil\ patch\ (or\ molecule)}$$

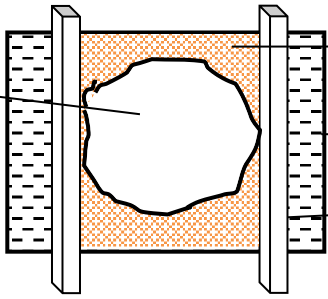
2. An oil drop of volume **V m³** introduced on the surface of water spreads to forma patch whose area is **A m²**. Derive an expression for obtaining the diameter, **d** of a molecule of oil. (2mk)

$$volume\ of\ oil\ drop = volume\ of\ oil\ pach$$
$$V = A \times d$$
$$d = \frac{V}{A} m$$

3. State why this is an estimate **(1mk)**

a. Error in measuring the diameter (or volume) of oil drop
b. Error in measuring diameter of oil patch

4. 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. **(2mk)**
When the drop is placed on the water surface, it spreads out into a monolayer. The intermolecular forces hold the film in the monolayer conditions.

(ii) What is the purpose of lycopodium powder? (1mk)
1. It enables the boundary of the oil to be seen clearly.
2. It weakens the surface tension of the oil and the water so that the oil spreads to the maximum diameter.

5. State two assumption made in the oil drop experiment. **(2mks)**
a. The oil drop is perfectly spherical
b. The oil patch is perfectly cylindrical
c. The oil patch is one molecule thick.

6. 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. (1mk)
- *Radius of oil patch (internal diameter of the dish)*

(ii) What else need to be known for the thickness of the oil film to be found? (1mk)
- *Volume of oil drop*

(iii) What is the purpose of lycopodium powder? (1mk)
1. It enables the boundary of the oil to be seen clearly.
2. It weakens the surface tension of the oil and the water so that the oil spreads to the maximum diameter.

7. 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 **154cm^2**. **150** such drops occupy a volume of **0.1cm^3.**
(ii) Estimate the size of an oil molecule. (3mk)

$$Volume\ of\ oil\ drop = \frac{0.1}{150} = 0.0006667cm^3$$

$$size\ of\ oil\ molecule = \frac{0.0006667}{154}$$

$$= 0.000004329cm$$

(ii) Give one reason why the value obtained in (i) above in but an estimate. (1mk)

a. *Error in measuring the diameter (or volume) of oil drop*
b. *Error in measuring diameter of oil patch*

(iv) 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*) (2mk)

The size increases. This is because as the temperature is increased the kinetic energy of the particles is increased causing them to move further apart.

8. A small drop of oil has a volume **$5x10^{-10}m^3$** when it is put on surface of some clean water it forms a circular film of **$0.02m^2$** in area.

(i) **Describe** how the oil patch /film is formed. (2mks)

When the drop is placed on the water surface, it spreads out into a monolayer. The intermolecular forces hold the film in the monolayer conditions.

(ii) **Why does** the film form into a circular shape (1mk)

Due to the effect of the water particles pulling away from the oil drop

(iii) **What** is the size of the molecule of oil? (3mks)

$$size\ of\ oil\ molecule = \frac{5\times10^{-10}}{0.02}m$$
$$= 2.5\times10^{-8}$$

9. An oil drop of volume of **6.546×10^{-5} cm^3** spread to form a circular patch of radius **9cm**.Determine the diameter of the oil molecule

$$area\ of\ patch = \frac{22}{7}\times 0.09^2$$
$$= 0.025457m^2$$
$$diameter\ of\ oil\ molecule = \frac{6.546\times10^{-5}}{0.025457}$$
$$= 2.5714\times10^{-3}m$$

10. A small drop of oil has a volume of **6×10^{-5} cm^3**. When it is put on the surface of some clean water, it forms a circular film of **2×10^4 cm^2** in area; What is the size of a molecule of oil?

$$size\ of\ oil\ molecule = \frac{6\times10^{-5}}{2\times10^4}$$
$$= 0.3cm$$

11. In an experiment to estimate the size of a molecule of olive oil, a drop of oil of volume **0.12cm^3** was placed on a clean water surface. The oil spread on a patch of diameter **6.0×10^6 mm^2**. Calculate the size of the molecule. 3mk

$$size\ of\ molecule = \frac{0.12}{6\times10^4}$$
$$= 2\times10^{-6}cm$$

12. Estimate the size of an oil molecule if a drop of the oil of volume **$2.5x\ 10^{-6}$ m^3** forms a patch of diameter **16cm** on the surface of water (3mk)

$$area\ of\ patch = \frac{22}{7}\times 0.08^2$$
$$= 0.020114m^2$$
$$diameter\ of\ oil\ molecule = \frac{2.5\times10^{-6}}{0.020114}$$
$$= 1.2429\times10^{-4}m$$

13. An oil drop of volume **0.004cm^3** spread into a film of diameter **28cm**. Estimate the diameter of one molecule of the oil. (Leave your answer in standard form). (3mk)

$$area\ of\ patch = \frac{22}{7} \times 14^2$$
$$= 616cm^2$$
$$diameter\ of\ oil\ molecule = \frac{0.004}{616}$$
$$= 6.4935 \times 10^{-6} cm$$

14. 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. (2mk)

$$volume\ of\ oil\ drop = \frac{4}{3}\pi r^3$$
$$= \frac{4}{3} \times \frac{22}{7} \times 0.025^3$$
$$= 6.5476 \times 10^{-5} cm^3$$

(ii) The area of the patch covered by the oil (2mk)

$$area\ of\ patch = \pi r^2$$
$$= \frac{22}{7} \times 10^2$$
$$= 314.286cm^2$$

(iii) The diameter of the patch covered by the oil. (3mk)

$$diameter\ of\ oil = \frac{6.5476 \times 10^{-5}}{314.286}$$
$$= 2.0833 \times 10^{-7} cm$$

(iv) State any assumption made in (b) above. (1mk)

a. The oil drop is perfectly spherical
b. The oil patch is perfectly cylindrical
c. The oil patch is one molecule thick.

(v) State two possible sources or errors in this experiment. (2mks)

a. Error in measuring the diameter (or volume) of oil drop
b. Error in measuring diameter of oil patch

15. In an experiment to estimate the diameter of an oil molecule, an oil drop of radius **2.5x10^{-4}m** spreads over a circular patch whose diameter is **20cm**.

Determine:

(i) The volume of the oil drop. (3mk)

$$volume\ of\ oil\ drop = \frac{4}{3}\pi r^3$$
$$= \frac{4}{3} \times \frac{22}{7} \times (2.5 \times 10^{-4})^3$$
$$= 6.5476 \times 10^{-11} m^3$$

(ii) The area of the patch covered by the oil (3mk)

$$area\ of\ patch = \pi r^2$$
$$= \frac{22}{7} \times 0.10^2$$
$$= 0.0314286 m^2$$

(iii) The thickness of the oil molecule (3mk)

$$thickness\ of\ oil = \frac{6.5476 \times 10^{-11}}{0.0314286}$$
$$= 2.0833 \times 10^{-9} m$$

(iv) State one assumption made in (b) (iii) above (1mk)

a. The oil drop is perfectly spherical
b. The oil patch is perfectly cylindrical
c. The oil patch is one molecule thick.

16. In an experiment to estimate the diameter of an oil molecule, an oil drop of diameter **0.06cm** spreads over a circular patch whose diameter is **20cm**. Determine:-

i) The volume of the oil drop (2mk)

$$volume\ of\ oil\ drop = \frac{4}{3}\pi r^3$$
$$= \frac{4}{3} \times \frac{22}{7} \times 0.03^3$$
$$= 1.13143 \times 10^{-4} cm^3$$

ii) The area of the patch covered by the oil (2mk)

$$area\ of\ patch = \pi r^2$$
$$= \frac{22}{7} \times 10^2$$
$$= 314.286 cm^2$$

iii) The diameter of the oil molecule (1mk)

$$diameter\ of\ oil = \frac{1.13143 \times 10^{-4}}{314.286}$$
$$= 3.60 \times 10^{-7}\ cm$$

iv) State any two assumptions made in b (iii) above (2mk)

a. The oil drop is perfectly spherical
b. The oil patch is perfectly cylindrical
c. The oil patch is one molecule thick.

17. An oil drop of volume **1×10^{-2}cm^3** is placed on a clean water surface. The drop spreads to form a oil film of radius **2cm**.

(i) Calculate the area of the oil film (2 mk)

$$area\ of\ film = \frac{22}{7} \times 2^2$$
$$= 12.5714 cm^2$$

(ii) Determine the diameter of an oil molecule (2 mk)

$$diameter\ of\ oil\ molecule = \frac{1 \times 10^{-2}}{12.5714}$$
$$= 7.9546 \times 10^{-4} cm$$

(iii) State two assumption made in these experiment (1 mk)

a. *The oil drop is perfectly spherical*
b. *The oil patch is perfectly cylindrical*
c. *The oil patch is one molecule thick.*

18. An oil drop of average diameter **0.7mm** spreads out into a roughly circular patch of diameter **75cm** on the surface of water in a trough. Calculate the average diameter of a molecule of oil. (3mk)

$$volume\ of\ oil\ drop = \frac{4}{3}\pi r^3$$
$$= \frac{4}{3} \times \frac{22}{7} \times 0.035^3$$
$$= 1.79667 \times 10^{-4} cm^3$$
$$area\ of\ patch = \pi r^2$$
$$= \frac{22}{7} \times 37.5^2$$
$$= 4419.6429 cm^2$$
$$average\ diameter\ of\ oil = \frac{1.79667 \times 10^{-4}}{4419.6429}$$
$$= 4.0652 \times 10^{-8}\ cm$$

19. Estimate the of an oil molecule if a drop of oil volume 6 **x 10^{-9} m^3** forms a patch of area **0.0755 m^2** on a water surface. (2mk)

$$size\ of\ oil\ molecule = \frac{6 \times 10^{-9}}{0.0755}$$
$$= 7.9470 \times 10^{-8} m$$

20. In an oil drop experiment a student estimated the diameter of the oil patch to be **0.16m**, given that the volume of the oil drop was **0.048cm^3**, determine the thickness of the oil patch. (3mk)

$$area\ of\ patch = \frac{22}{7} \times 8 \times 8 cm^2$$
$$= 201.1429 cm^2$$
$$thickness\ of\ oil\ patch = \frac{0.048}{201.1429}$$
$$= 2.386 \times 10^{-4} cm$$

21. Oil accidentally spilt on an ocean and spread into a monolayer film of area **2.0x10^{12}cm^2**. The oil was found to consist of molecules of thickness **5x10^{-9}m** each. Calculate the volume of oil that split. (3mk)

$$volume\ of\ oil\ spilt = area\ of\ oil\ patch \times thickness\ of\ oil\ molecule$$
$$= 2.0 \times 10^{12} \times 5 \times 10^{-7}$$
$$= 1000000 cm^3$$

22. In an experiment to estimate the radius of oil molecule **200** identical drops of oil of density **800kg/m³** are run from a burette. The reading on the burette changes from **0.0cm³** to **0.5cm³**.One of these drops is placed on a large water surface dusted lightly using chalk dust. It spreads forming a uniform patch of area **0.2m²**.

i) What is the purpose of the chalk dust?

a. It breaks surface tension

b. it clearly shows the extent of spread of the oil drop

ii) What is the mass of one drop of oil in kg?

$$mass\ of\ one\ drop = \frac{Density \times volume}{200}$$
$$= \frac{0.8 \times 0.5}{200}$$
$$= 0.002g$$

iii) What is the volume of one oil drop in m^3?

$$volume\ of\ one\ drop = \frac{0.5}{200}$$
$$= 2.5 \times 10^{-9} m^3$$

iv) What is the thickness of the oil film?

$$thickness = \frac{2.5 \times 10^{-9}}{0.2}$$
$$= 1.25 \times 10^{-8} m$$

v) State the assumption (s) made in this experiment

i. The oil drop is perfectly spherical

ii. The oil patch is perfectly cylindrical

iii. The oil patch is one molecule thick.

