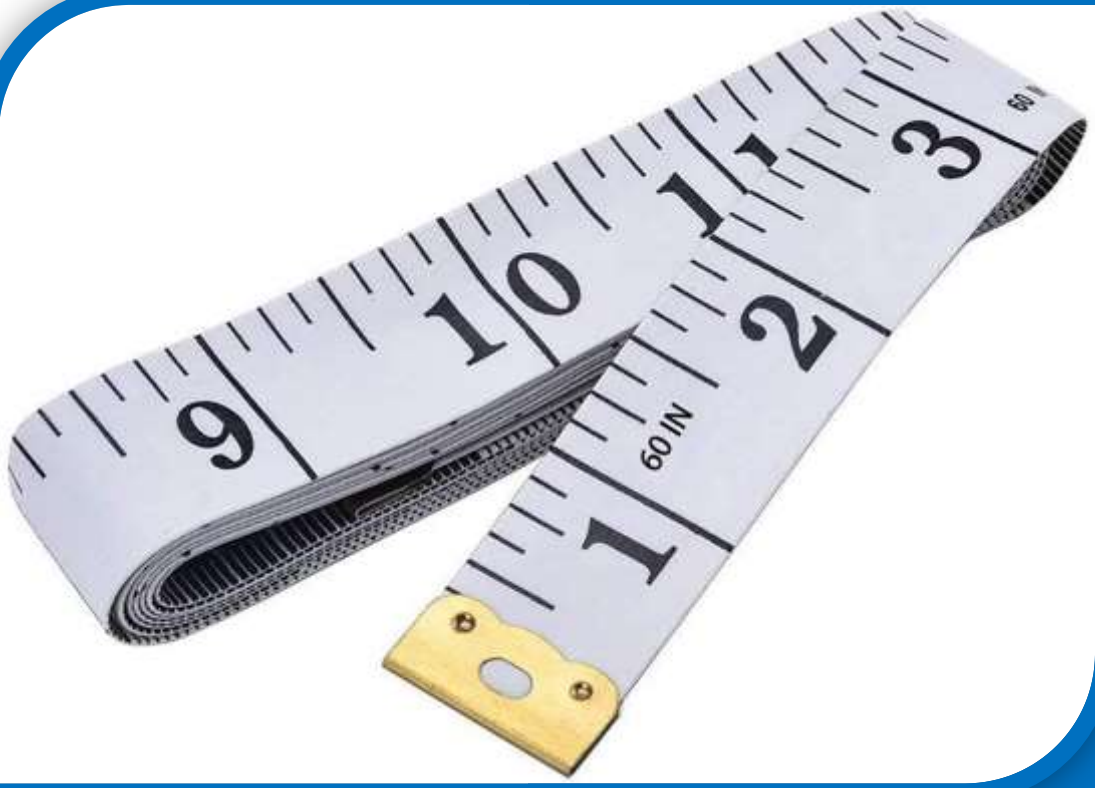
PHYSICS KNOWLEDGEBASE

2020

MEASUREMENT I



TEACHERS OF PHYSICS

www.teachersofphysics.com

11/5/2020

1. What is **Physics**? (2mk)

Physics is the study of matter and its relation to energy.

2. Differentiate fundamental quantities from derived quantities and give an example of each

Fundamental quantities are quantities that cannot be obtained from physical quantities e.g Length, mass, time etc. while derived quantities are quantities that are obtained by either division or multiplication of basic physical quantities e.g Area, Volume, density etc

3. State what the following branches of physics deals with:

(i) Mechanics

This branch deals majorly with motions under the influence of forces. Under this branch, we look into details the aspects of linear, circular and oscillatory motions as well as motion of fluids.

(ii) Electricity and magnetism

This branch looks at the interaction between electric fields and magnetic fields and the applications of such interactions.

(iii) Thermodynamics

This branch looks at how heat as a form of energy is transformed to/from other forms of energy

(iv) Geometric optics

This branch takes a keen look at the behavior of light in various media.

(v) Waves

It deals with the study of the propagation of energy through space.

(vi) Atomic physics

This area of study is targeted at the behavior of particles of the nucleus and the accompanying energy changes.

4. State and explain **two** basic laboratory safety rule

a. *Locations of electrical switches, firefighting equipment, first aid kit, gas supply and water supply systems must be noted.*
b. *Windows and doors should be kept open while working in the laboratory.*
c. *Any instructions given must be followed carefully. NEVER attempt anything while in doubt.*
d. *There should no eating, drinking or chewing in the laboratory.*
e. *Ensure that all electrical switches, gas and water taps are turned off when not in use.*
f. *When handling electrical apparatus, hands must be dry.*
g. *Never plug in foreign materials into electrical sockets.*
h. *Shirts and blouses must be tucked in and long hair tied up.*
i. *Keep floors and working surfaces dry. Any spillage should be wiped off immediately.*
j. *All apparatus must be cleaned and returned to correct location of storage after use.*
k. *Laboratory equipment should not be taken out of laboratory unless authorized.*
l. *Any waste after an experiment must be disposed of immediately.*
m. *Hands must be washed before leaving the laboratory*

5. State the **SI** units of the following quantities **(3mk)**

Length =...*Metre(m)*……
Mass =.....*Kilograms(kg)*……
Temperature =.....*Kelvin(k)*……

6. Name two branches of physics. **(2mk)**

1. *Mechanics*
2. *Thermodynamics*
3. *Geometric optics*
4. *Waves*
5. *Electricity and magnetism*
6. *Atomic physics*

7. Name two career opportunity in physics. (2mk)

a. Bachelor of education (science)
b. Bachelor of Science (civil engineering)
c. Bachelor of medicine
d. Bachelor of architecture
e. Bachelor of technology (production engineering)
f. Diploma in computer science

8. State the relationship between physics and the following subjects.

(i) Biology (1mk)

Knowledge of lenses studied in physics has led to the manufacture of microscopes used in the study of the cell and diseases.

(ii)Geography (1mk)

Accurate use of weather instruments like thermometer, wind vane, rain gauges etc. require physics knowledge.

Concepts like heat transfer by convection which explain the formation of convectional rainfall and pressure variation can be best explained in physics.

LENGTH AND AREA

1. Convert the following values into **SI** units

(i) 86400cm^2 **(1mk)**

1M^2-----10000cm^2

86400cm/10000 = 8.64m^2

(iii) 204000cm^3

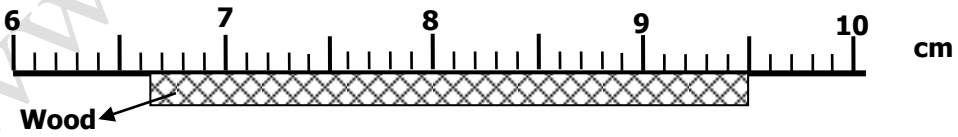
(1mk)

2040000cm^3/1000000 = 0.204m^3

2. A student measured the length of a wire four times using a meter rule and obtained the following readings: **18.6cm**; **18.5cm**; **18.6cm**; and **18.5cm**. Determine the length the student should record. (2mk)

$\frac{18.6+18.5+18.6+18.5}{4}$ = 18.55cm

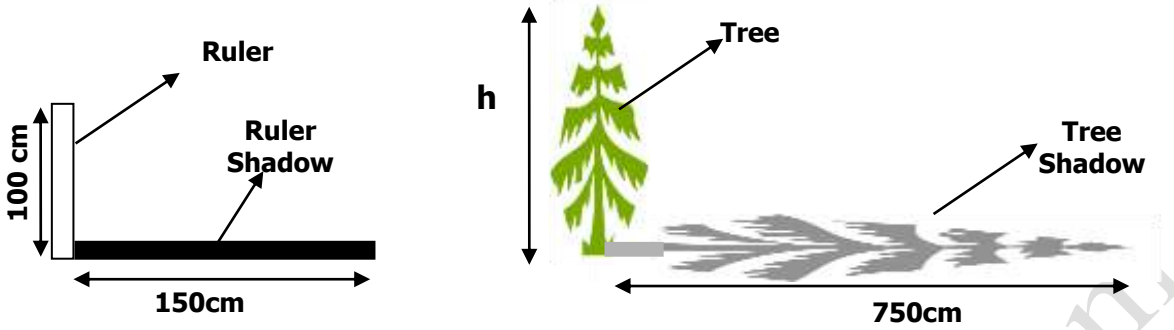
3. The figure below shows a section of a meter rule used to measure length of a piece of wood.



Find the length of the wood (2mk)

9.5 – 6.7 = 1.8cm

4. In an experiment to estimate the height of a tree using its shadow, a ruler of height **100cm** is placed next to the tree as shown below. If the ruler and the tree forms shadows of **150cm** and **750cm** respectively.



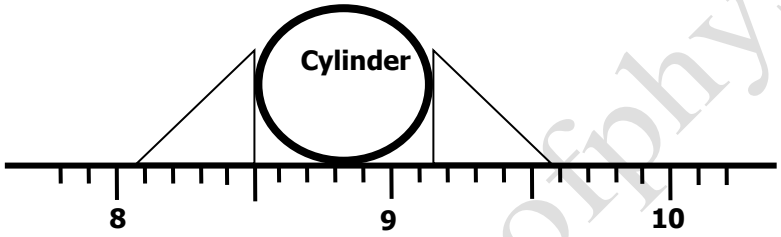
Calculate the height **h** of the tree. (3mk)

$$\frac{heigth\ of\ the\ tree, x}{heigth\ of\ the\ rod} = \frac{length\ of\ shadow\ of\ tree}{length\ of\ shadow\ of\ rod}$$

$$\frac{x}{100} = \frac{750}{150}$$

$$x = 500cm = 5.0m$$

5. A Figure below is an arrangement of two set squares and a rule being used to determine the external diameter of a cylinder.



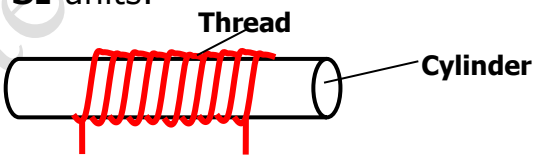
(a) State the accuracy of the rule. (1mk)

0.1cm = 1mm

(b) What is the radius of the cylinder? (2mk)

9.1 – 8.5 = 0.6cm

6. A thin wire was wound **10** times closely over a boiling tube. The total length of the wire wound around was found to be **440mm**. Calculate the radius of the boiling tube in **SI** units.



no of turns = 10times
length of the wire = 440mm
radius of the boiling tube =
10turns = 440mm
1turn = x
440/10 = 44mm
D = 44/π = 14
R = 14/2 = 7cm

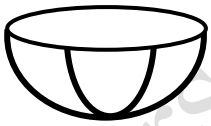
7. A thin wire was wound **30** times closely over a boiling tube. The total length of the windings was found to be **9.3 mm**. Calculate the radius of the wire.

no of turns = 30times
length of the wire = 9.3mm
radius of the boiling tube =
30turns = 9.3mm
1turn = x
9.3/30 = 0.31mm
D = 0.31/π = 0.09864
R = 0.09864/2 = 0.04932cm

8. A length of 550cm of them thread wraps around a cylindrical tin exactly 25times. Calculate the radius of the cylinder (2mks)

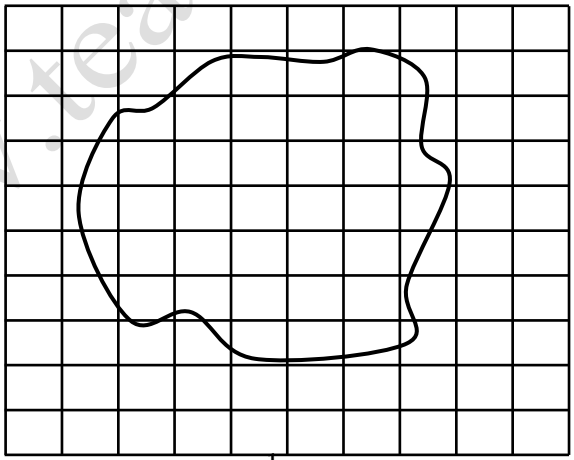
no of turns = 25times
length of the wire = 550mm
radius of the boiling tube =
25turns = 550mm
1turn = x
550/25 = 22mm
D = 22/π = 7
R = 7/2 = 3.5cm

9. The figure below shows a half spherical bowl of radius **3cm**. calculate its volume.



$V = 4/3\pi r^3 = 2/3 \times \pi \times 3^3 = 56.57cm^3$

10. The figure below shows the map of a school compound. Each square is equivalent to **1cm²**. Calculate the total area covered by the school on the map. (3mk)



- $Area = \left(number\ of\ complete\ squares + \frac{1}{2} \times number\ of\ incomplete\ squares\right) area\ of\ one\ square$

Full squares = 22sqaures cm^2
½ squares = 21/2 =10.5sqaures cm^2
Total area = 22 + 10.5 = 32.5cm^2

11. Express the area of land of **0.0025km²** in **S.I** units and in standard form

$0.0025km^2 \times 1000000m^2 = 2500m^2 = 2.5 \times 10^3 m^2$

VOLUME

1. Define volume and give its **SI** units.

Volume refers to the amount of space occupied by matter.

The SI unit of volume is ***the cubic meter (m^3)***

2. Find the volume of a spherical ball of radius **3cm**. **(3mk)**

$V = 4/3\pi r^3 = 4/3 \times \pi \times 3^3 = 113.1cm^3$

3. Calculate the volume of a Cuboid that measures **4cm** by **5cm** by **3cm** in **SI** Units.

$V = l \times w \times h$

$0.04m \times 0.05m \times 0.03m = 6 \times 10^{-5}m^3$

4. Find the capacity of a cylinder of radius **70cm** and height **20cm** in litres.

$22/7 \times 70 \times 70 \times 20 = 308000cm^3$

$308000/1000 = 308l$

5. A sphere of radius **6cm** is moulded into a thin cylindrical wire of length **32cm**. Calculate the radius of the wire in SI Units.

$V = 4/3\pi r^3 = 4/3 \times \pi \times 6^3 = 905.1cm^3$

$V = \pi r^2 h = 22/7 \times r^2 \times 32 = 100.6r^2$

$R^2 = 905.1/100.6 = 8.9970cm^2$

$R = 2.9995cm = 0.029995m$

6. A solid Cuboid of dimensions **11cm x 14cm x 5cm** is melted in to a cylindrical solid of diameter **28 cm**. calculate the height of the cylinder

Volume of cuboid = l x w x h

$11 \times 14 \times 5 = 770cm^3$

$V = \pi r^2 h = 22/7 \times 14 \times 14 \times h = 616h$

Volume of cuboid = volume of cylinder

$H = 770/616 = 1.25cm$

7. A cylinder of height **25cm** is completely melted and a sphere of the same radius made. Determine the radius of the sphere in metres and express your answer in ***standard form***. (3mk)

$Volume\ of\ cylinder = \pi r^2 h = \pi r^2(25) = 25\pi r^2$

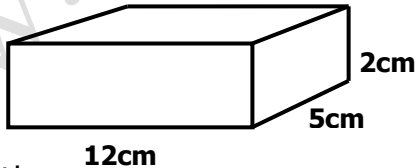
$Volume\ of\ sphere = 4/3\pi r^3$

$25\pi r^2 = 4/3\pi r^3$

$25 = 4/3r$

$R = 18.75cm = 0.1875m = 1.875 \times 10^{-1}m$

8. The figure below shows a block of mass **360g**.



Calculate the

(i) Volume of the block.

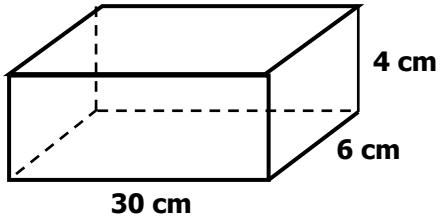
Volume of cuboid = l x w x h

$12 \times 5 \times 2 = 120cm^3$

(ii) Density of the block in **SI** unit.

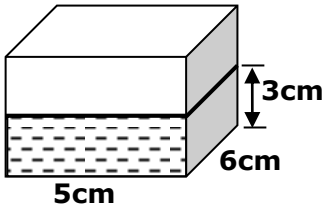
$Density = mass/volume = 360/120 = 3g/cm^3 = 3000kg/m^3$

9. The diagram below shows a brick of mass **120g**.The brick measures **30cm x 6cm x 4cm**. Calculate the density of the brick



Density = mass/volume = 120/720 = 0.167g/cm^3 = 167kg/m^3

10. The figure below shows Perspex container with a base of sides **5** by **6 cm** carrying water to a height of **3cm**.



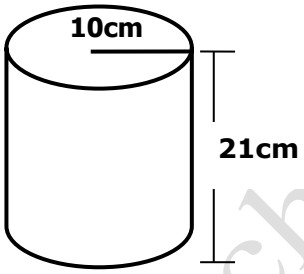
When pebble is immersed into the water, the level rise to **10 cm**. what is the volume of the pebble?

Initial volume of water = 5 x 6 x 3 = 90cm^3

Final volume of water = 5 x 6 x 10 = 300cm^3

300 – 90 = 210cm^3

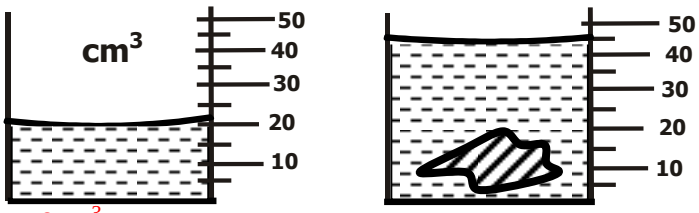
11. The figure below shows a cylinder of radius **10cm** and height **21cm**. Calculate its capacity in litres.



V =πr^{2}h = 22/7 x 14 x 14 x 21 = 6600cm^2

6600/1000 = 6.6litres

12. The figure below shows the change in volume of a liquid in a measuring cylinder when an irregular solid is immersed in it. Given that the mass of the solid is **75g**, determine the density of the solid in SI units.



Initial volume of water = 20cm^3

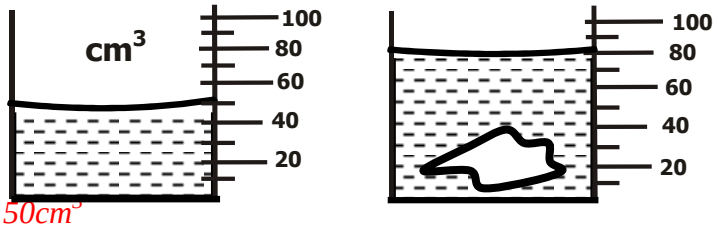
Final volume of water = 45cm^3

45 – 20 = 25cm^3

Mass of solid = 75g

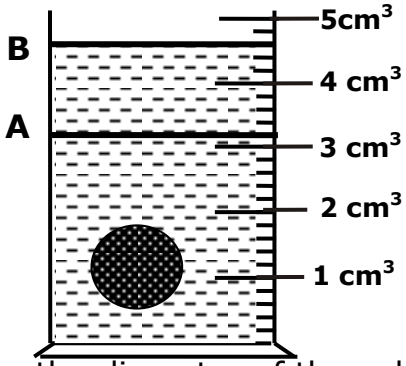
Density = mass/volume = 75/25 = 3g/cm^3 = 3000kgm^{-3}

13. The figure below shows the change in volume of a liquid in a measuring cylinder when an irregular solid is immersed in it. Given that the density of the solid is **4g/cm^3**, determine the mass of the solid in SI units. (4mk)



Initial volume of water = 50cm^3
Final volume of water = 80cm^3
80 – 50 = 30cm^3
Mass of solid = density x volume
Mass = 4x30 = 120g = 0.12kg

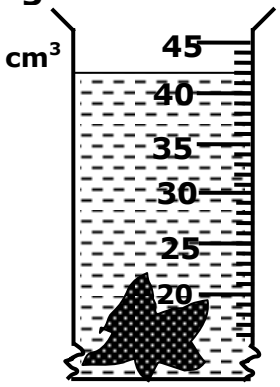
14. The figure below shows a measuring cylinder which contains water initially at a level **A**. A spherical solid of mass **11g** is immersed in the water, the level rises to **B**.



Determine the diameter of the spherical ball (2mk)

Initial volume of water = 3.2cm^3
Final volume of water = 4.6cm^3
Volume of spheres = 4.6 – 2.3 = 1.4cm^3
Mass of the spherical = 11g
Volume of sphere =4/3πr^3
1.4 = 4/3πr^3
1.4 = 88/21r^3
29.4 = 88r^3
R^3 = 0.3341
R = 0.6939
Diameter = 1.3878cm

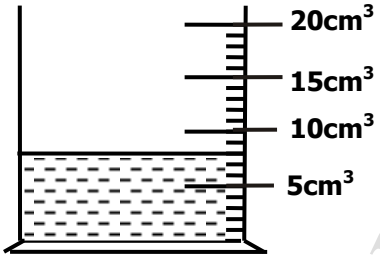
15. Fig shows a measuring cylinder into which an irregular stone of mass **60grams** has been immersed.



If the initial reading before immersing was **27cm^3**. Find the density of the stone. (2mk)

Initial reading = 27cm^3
Final reading = 42cm^3
Volume of the stone = 42 – 27
15cm^3
Mass of the stone = 60g
Density = mass/volume = 60/15 = 4g/cm^3

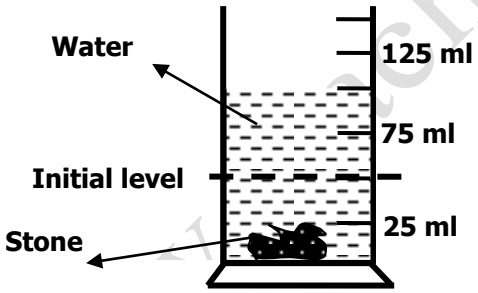
16. The figure below shows water placed in a measuring cylinder calibrated in **cm^3**?



An object of mass **50.1g** and density **16.7g/cm^3** is lowered gently into the water. Indicate on the diagram the new level. (2mk)

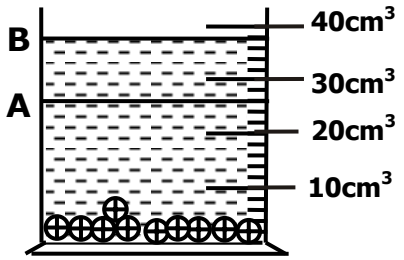
Density = mass/volume
16.7 = 60/v
V= 3cm^3

17. The figure below shows the level of water in a measuring cylinder after a stone of mass **100 g** is immersed in the water. The initial level of the water is shown with a dotted line. Determine the density of the stone. (3mk)



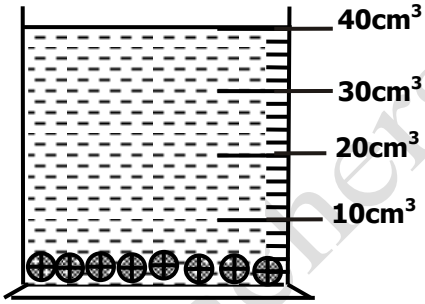
Initial reading = 50cm^3
Final reading = 100cm^3
Volume of the stone = 100 – 50
50cm^3
Density = mass/volume = 100/50 = 2g/cm^3

18. Ten glass marbles, each of mass 6.0 g, were gently lowered into a measuring cylinder containing water to the level marked **A**. The water level rose to the level marked **B** as shown in Fig below. Determine the density of the glass. (3mk)



Initial reading = 26cm^3
Final reading = 38cm^3
Volume of ten glass marble = 38 – 26
12cm^3
Volume of each glass marble = 12/10 = 1.2cm^3
Density = mass/volume = 6/1.2 = 5g/cm^3

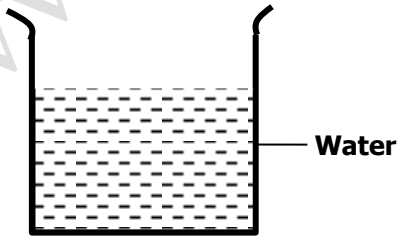
19. The figure below shows a cylinder with water and **8** lead pellets each of volume **1.5cm^3**.



Indicate on the diagram the level of water if the pellets are removed. (2 mk)

Volume of 1 pellet= 1.5cm^3
Volume of 8 pellet = 1.5 x 8cm^3 = 12cm^3
Final volume = 40
Initial volume = final volume - Volume of 8 pellet = 40 – 12 = 28cm^3

20. Figure Shows a glass beaker of cross sectional area 10.5cm^2



When a metal block of mass **250 g** is immersed into the water, the level of water rises by **3.5 cm**. determine the density of the metal block. Express your answer in S.I unit (3mk)

Volume = A x h
10.5 x 35 = 36.75cm^3
Mass of the metal block = 250g
Density = mass/volume
250/36.75 = 6.8g/cm^3
1g/cm^3 = 100kg/m^3
6.8g/cm^3 = ?
6.8 x 1000 = 6800kg/m^3

BURETTE

1. **1600 cm^3** of fresh water of density **1 g/cm^3** are mixed with **1400cm^3** of seawater of density **1.25g/cm^3**. Determine the density of the mixture.

Density of the mixture = total mass of the mixture/total volume of mixture
Mass of fresh water = density x volume
1g x 1600cm^3 = 1600g
Mass of salt water = density x volume
1.25g x 1400cm^3 = 11750g
Density = $\frac{1600+1750}{1600+1400}$ = 3350/3000 = 0.1117g/cm^3

1. The water level in a burette is **27cm^3**. If **88** drops of water fall from the burette and the average volume of one drop is **0.25cm^3** what is the final water level in the burette?

Initial level of water in burette =27cm^3
No of drops added = 88
Volume of each drop = 0.25cm^3
Total volume added = 88x0.25 =22cm^3
Final burette reading = 27 -22 = 5cm^3

2. The initial level of water in a burette was **32cm^3.** Some **20** drops of water each of volume **0.4cm^3** are **added**. Find its final reading.

Initial level of water in burette =32cm^3
No of drops added = 20
Volume of each drop = 0.4cm^3
Total volume added = 20x0.4 =8cm^3
Final burette reading = 32 -8 = 24cm^3

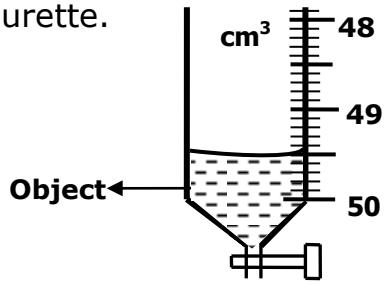
2. **1600 cm^3** of fresh water of density **1 g/cm^3** are mixed with **1400cm^3** of seawater of density **1.25g/cm^3**. Determine the density of the mixture.

Density of the mixture = total mass of the mixture/total volume of mixture
Mass of fresh water = density x volume
1g x 1600cm^3 = 1600g
Mass of salt water = density x volume
1.25g x 1400cm^3 = 11750g
Density = $\frac{1600+1750}{1600+1400}$ = 3350/3000 = 0.1117g/cm^3

3. The initial level of water in a burette was **26cm^3.** Some **10** drops of water each of volume **0.5cm^3** are allowed to **drop out**. Find its final reading.

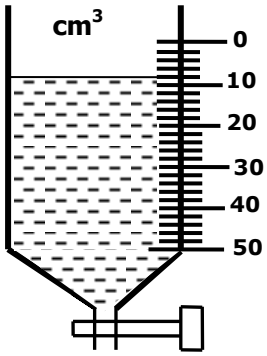
Initial level of water in burette =26cm^3
No of drops added = 10
Volume of each drop = 0.5cm^3
Total volume added = 10x0.5 =5cm^3
Final burette reading = 26 +5 = 31cm^3

4. A ball bearing of volume **1.8cm^3** was dropped into water contained in the burette shown in figure below. Determine the final reading of water in the burette. (2mks)



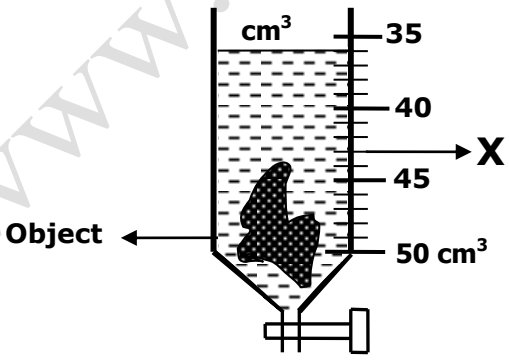
Volume of the ball bearing = 1.8cm^3
Initial reading = 49.5cm^3
Final reading =49.5 – 1.8 = 47.7cm^3

5. The figure below shows the reading on a burette after 55 drops of a liquid have been used.



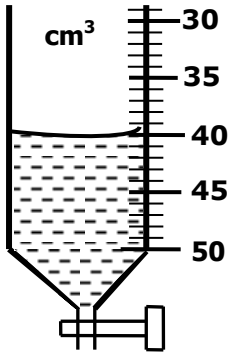
If the initial reading was at **0cm** mark, determine the volume of one drop.
Burette reading = 8cm^3
Initial burette reading = 0cm^3
Volume of water added = 8 – 0 = 8cm^3
Total volume of 55drops = 8cm^3
Volume of 1 drop = 8/55 = 0.145cm^3

6. The figure below shows a burette initially filled with water to the level marked **X**. An object of density **1.5gcm^{-3}** is immersed into it and the level rose as shown**.** Determine the mass of the object (3mk)



Initial reading at x = 43 cm^3
Final reading = 36 cm^3
Volume of the object = 43- 36 = 7 cm^3
Density of the object = 1.5g/ cm^3
Mass = density x volume = 1.5 x 7 = 10.5g

7. The figure below shows a section of a measuring instrument.



(i) Name the measuring instrument shown above **(1mk)**

Burette

(ii) What is the volume of water in it? **(1mk)**

Initial volume = 40 cm^3

Final volume = 50 cm^3

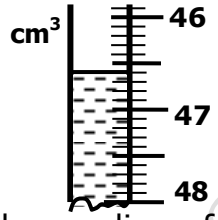
Volume of water in the burette = 50 – 40 = 40 cm^3

(iii) Some **24** drops of water each of volume **0.5cm³** are **added** to the instrument above. Find the final reading of the instrument.

Total volume of drops added = 24 x 0.5 = 12 cm^3

Final reading = 40 -12 = 28 cm^3

8. In an experiment to measure the density of a liquid, a student filled a burette with a liquid to the 0cm^3 mark. The figure below shows as section of the burette showing the level of the liquid after 93.2g of the liquid had been run out.



(i) Take the reading of the burette *46.6 cm^3* (1mk)

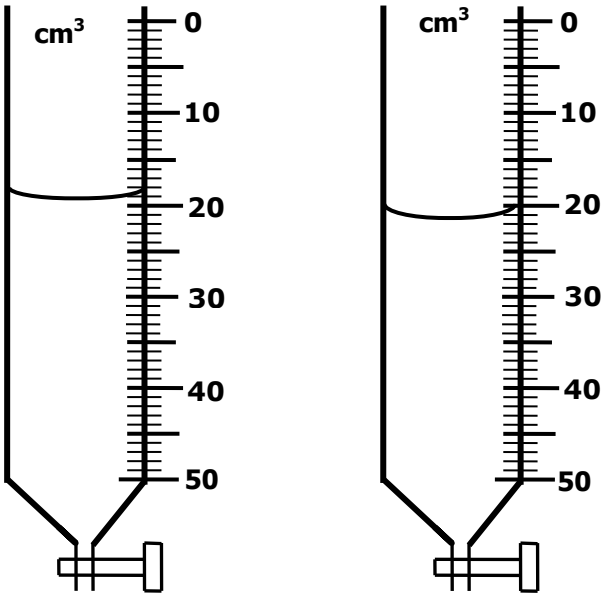
(ii) Determine the density of the liquid. (3mk)

Mass of the liquid 93 .2g

Volume of the liquid = 46.6 – 0 = 46.6 cm^3

Density = mass/volume = 93.2/46.6 = 2g/ cm^3

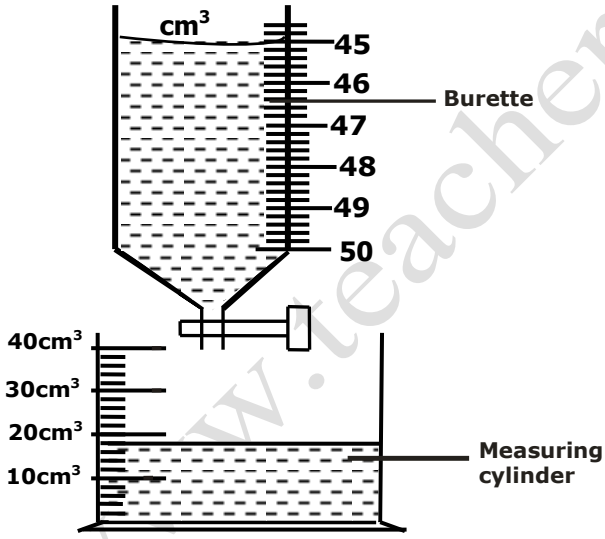
9. The figure (a) below shows the initial reading of a burette used to measure the volume of oil. After 50 drops of oil were run out, the final reading was as shown in (b). Determine the volume of one drop of oil (2mk)



Initial volume = 19 cm^3
Final volume = 21 cm^3
Volume of oil = 21 -19 = 2 cm^3
Volume of 1 drops = 2/50 = 0.04 cm^3

(3mk)

10. Figure below shows a measuring cylinder containing some water.

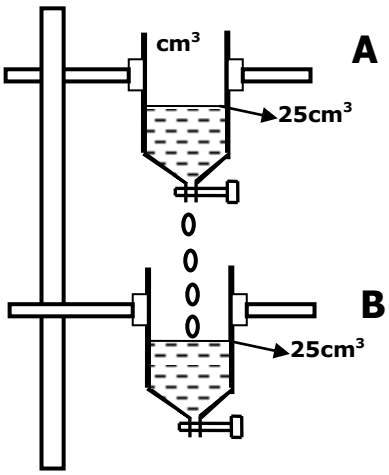


(i) New reading *5 cm^3* (1 mk)

(ii) New reading *19 + 3 = 21 cm^3* (1mk)

Another **3cm³** of water was added to the cylinder from a burette delivering volume from **0cm³** to **50cm³**. Record in the spaces provided the new reading indicated on each vessel.

11. Two burettes **A** and **B** were arranged as shown below. Burette **A** leaked into **B** at the rate of **10** drops per minute. If the initial reading on both burettes was **25cm^3**. What would be their reading at the end of one hour if **B** does not leak? Volume of one drop of water is **2.0 x 10^{-8}m^3**. (3mks)

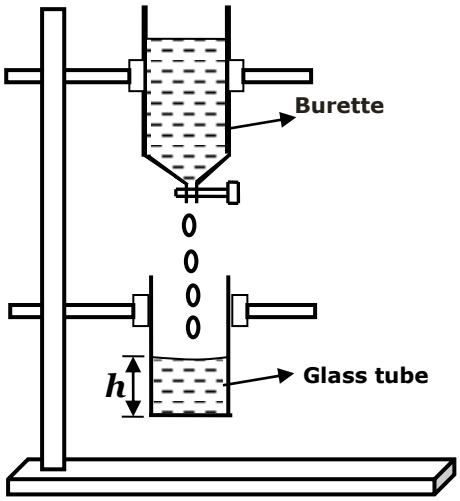


A leak to B at the rate of 10drops
1min = 10drops
No of drops in 1hour
60x10 = 600drops
V0lume of all drops = 600 x 2.0 x 10^{-5}m^3 = 1.2 x 10^{-5}m^3 = 12cm^3
Final reading in A = 25 + 12 = 37cm^3
*Final reading in **B** = 13cm^3*

12. In an experiment to measure the radius of a wire a student cut the wire into **100** identical pieces of length **7mm** and dipped the pieces completely into a burette with initial level of liquid at **49.5cm^3** mark. If the final level was at **0cm^3**. Determine the radius of the wire giving your answer to two decimal places (3mks)

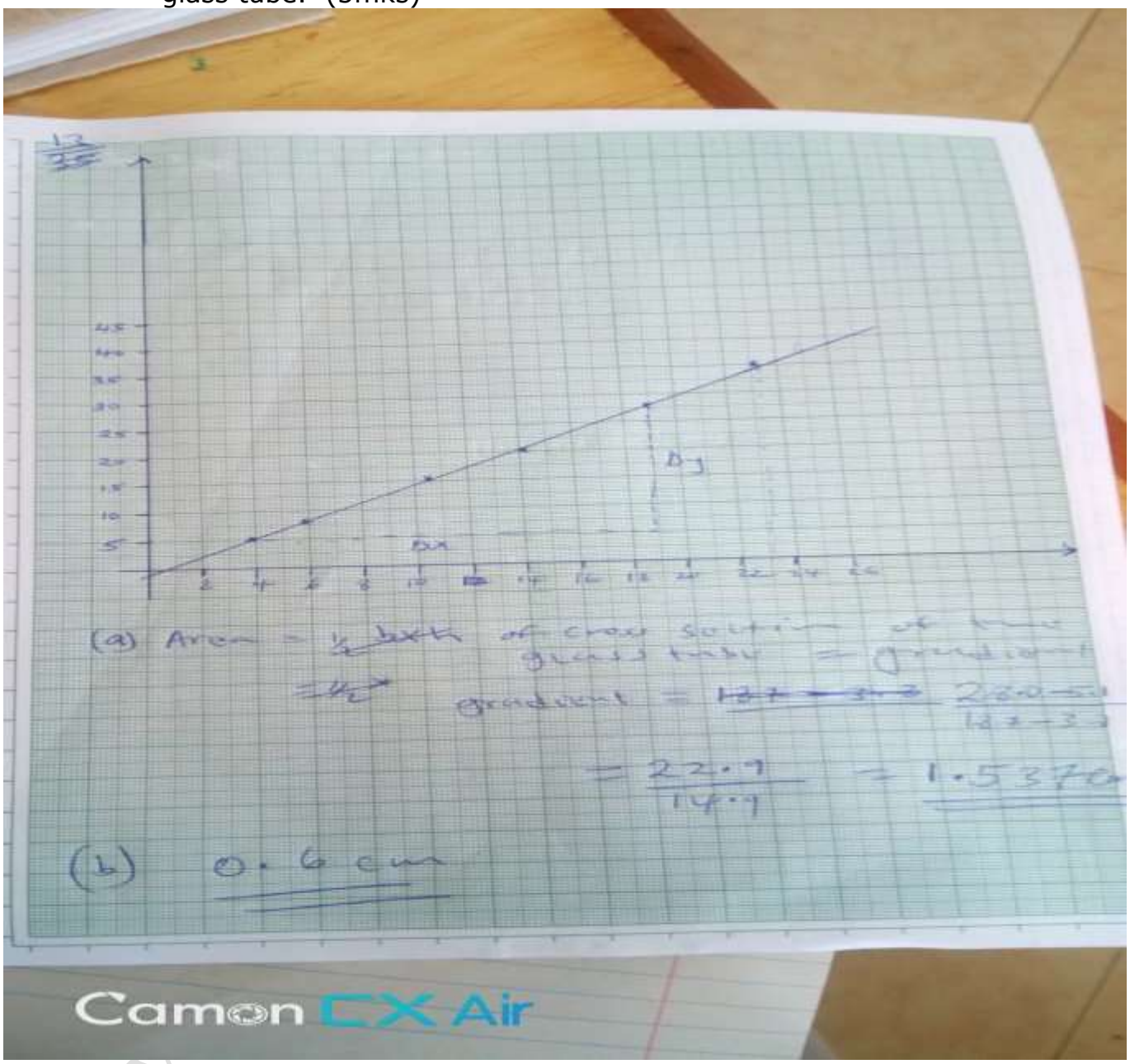
Initial reading = 49.5
Final reading = 0cm^3
Volume of 100 pieces of wire = 49.5
Volume of 1 piece 49.5/100 = 0.495cm^3
R^2 = 0.495 x 7/22 x 10/7 = 0.225. r = $\sqrt{0.225}$ = 0.474cm

13. The diagram fig below shows an arrangement that a certain student set up in a physics lab without the consent of the teacher. He allowed some volume of water into the glass tube and measured the corresponding height h of water in the tube using a ruler. He tabulated his data as below.



Burette reading cm^3	5.1	8.2	15.4	21.5	28.0	35.6
Height h, cm	3.8	5.8	10.5	14.5	18.7	23.2

(a) Draw a graph of the burette reading against height h of the water in the glass tube. (5mks)



(ii) Use your graph above to determine the area of cross section of the glass tube. (3mks)

(iii) Use your graph to determine how far the zero mark of the ruler is from the end placed on the base of the stand. (2mks)

DENSITY

3. Define density and give its **SI** units.

Density is defined as mass per unit volume.

SI units kilograms per cubic metre(kg/m^3)

4. The density of concentrated Sulphuric acid is **$1.8gcm^{-3}$**. Calculate the volume of **3.6kg** of the acid.

Volume = mass/ density = 3.6 x 1000^3/1.8 = 2000g 0r 2kg

5. A block of metal of mass **72g** measures **2cm x 4cm x 6 cm**, calculate the density of the metal in **SI** unit.

Density = mass/volume = (2x4x6)/48 = 1.5g/cm^3 x 1000 = 1500kg/m^3

6. Determine the density in **SI units** of a solid whose mass is **40g** and whose dimensions in cm are **30 x 4 x 3** **(2mk)**

Volume = 30x4x3 = 360cm^3
Mass = 40g
Density = 40/360 = 0.1111g/cm^3 = 111.1kg/m^3

7. A cuboid has dimensions **12cm** by **10cm** by **15cm**. its weight is **72N**. Determine the density of the material the cuboid is made of. **(3mks)**

Volume = 12 x 10 x 15 = 180 cm^3
W =mg
Mass = 72/10 = 7.2kg
Density = mass/volume = 7200/180 = 4g/ cm^3 = 4000kg/m^3

8. The mass of an empty density bottle is **20g**. When the bottle is full of paraffin it weighs **60g** and when full of water weighs **70g**. Calculate the density of paraffin in SI units. **(4mk)**

Mass of paraffin =60 – 20 = 40g
Mass of water 70 – 20 = 50g
Volume of water = 50/1g/cm^3 = 50 cm^3
Volume of water = volume of paraffin = 50 cm^3
Density of paraffin =m/v= 40/50 = 0.8g/cm^3 = 800kg/m^3

9. An empty density bottle has a mass of **50g**. Its mass is **100g** when filled with water and **120g** when filled with liquid **K**. Calculate the density of liquid **K** in **SI** units.

Mass of water =100 – 50 = 50g
Mass of water 120 – 50 = 70g
Volume of water = 50/1g/cm^3 = 50 cm^3(density of water = 1g/cm^3)
Volume of density bottle = volume of liquid K = 50 cm^3
Density of liquid K = m/v= 70/50 = 1.4g/cm^3 = 1400kg/m^3

10. The mass of a density bottle is **20g** when empty, **70g** when full of water and **50g** when full of ethanol. Calculate the density of ethanol in **SI** units.

Mass of water =70 – 20 = 50g
Mass of ethanol 50 – 20 = 30g
Volume of water = 50/1g/cm^3 = 50 cm^3(density of water = 1g/cm^3)
Density of liquid ethanol =m/v = 30/50 = 0.6g/cm^3 = 600kg/m^3

11. A density bottle has a mass of **45g** when full of paraffin and a mass of **50g** when full of water if the empty bottle weighs **25g**, calculate the relative density of paraffin.

Mass of paraffin =45 – 25 = 20g
Mass of water 50 – 25 = 25g
Volume of water = 25/1g/cm^3 = 25 cm^3
Volume of water = volume of paraffin = 50 cm^3
Density of paraffin =m/v= 20/25 = 0.8g/cm^3 = 800kg/m^3

12. The mass of an empty density bottle is **20g**. When the bottle is full of paraffin it weighs **60g** and when full of water weighs **70g**. Calculate the density of paraffin in **SI** units.

Mass of paraffin =60 – 20 = 40g
Mass of water 70 – 20 = 50g
Volume of water = 50/1g/cm^3 = 50 cm^3
Volume of water = volume of paraffin = 50 cm^3
Density of paraffin =m/v= 40/50 = 0.8g/cm^3 = 800kg/m^3

13. The mass of a density bottle is **20g** when empty **70g** when full of water and **695g** when full of another liquid. Calculate the

(i) density of the other liquid (take density of water as **1g/cm^3**

Mass of water =70 – 20 = 50g
Mass of liquid 695 – 20 = 675g
Volume of water = 50/1g/cm^3 = 50 cm^3
Volume of water = volume of liquid = 50 cm^3
Density of liquid =m/v= 675/50 = 13.5g/cm^3 = 13500kg/m^3

(ii) Mass o**f 20cm^3** of the liquid **(2mk)**

Mass = density x volume
13.5 x 20 = 270g

14. The mass of a density bottle of volume 50cm^3 is 10.0g when empty. Aluminium turnings are poured into the bottle and the total mass is 60.0g. Water is then added into the turnings till the bottle is full. If the total mass of the bottle and its contents is 90.0g, calculate the density of the aluminium turnings. (3mk)

Mass of aluminium turnings =60 – 20 = 50g
Mass of liquid 90 – 60 = 30g
Volume of water = 30/1g/cm^3 = 30 cm^3
Volume of aluminium turnings = 50 -30 = 20cm^3
Density =m/v= 50/20 = 2.5g/cm^3 = 2500kg/m^3

15. An empty density bottle has a mass of **23g**. When completely filled with water its mass is **39.0g**. What will be its mass if it is completely filled with an acid of relative density **1.25**? (Take the density of water as **1.0gcm^{-3}**)

Mass of water =39 – 23 = 16g
Density of acid = 1.25g/cm^3
Volume of water = mass/volume = 16/1g/cm^3 = 16cm^3
Mass of acid = 1.25 x 16 = 20cm^3

16. An empty density bottle has a mass of **30g**. When completely filled with water its mass is **70g**. What will be its mass if it is completely filled with an acid of relative density **1.6**?

Mass of water =70 – 30 = 40g
Volume of water = m/d =40/1 = 40cm^3
Volume of water = volume of acid
Mass of acid = 1.6 x 40 = 64cm^3

17. **200cm^3** of water of density **1g/cm^3** is mixed with **300cm^3** of milk of density **2g/cm^3**. Calculate

(i) The total volume of the mixture

200 + 300 = 500 cm^3

(ii) The total mass of the mixture

Mass of water = density x volume
1g/ cm^3 x200 cm^3 = 200g
Mass of milk = density x volume
2g/ cm^3 x300 cm^3 = 600g
Total mass of mixture = 200g+600g = 800g

(iii) The density of the mixture in **SI** units.

Density of mixture = total mass mixture/total volume of mixture
800/500 = 1.6g/cm^3 = 1600kg/m^3

18. **1000cm^3** of water density **1g/cm^3** mixed with **2000cm^3** of saturated salt solution of density **1.3g/cm^3**. Calculate

(i) The total volume of the mixture

1000 + 2000 = 3000cm^3

(ii) The total mass of the mixture

Mass of water = density x volume

1g/ cm^3 x1000 cm^3 = 1000g

Mass of saturated salt = density x volume

1.3g/ cm^3 x2000 cm^3 = 2600g

Total mass of mixture = 1000g+2600g = 3600g

(iii) The density of the mixture in SI units.

Density of mixture = total mass mixture/total volume of mixture

3600/3000 = 1.2g/cm^3 = 1200kg/m^3

19. An alloy is made by mixing **80cm^3** of copper of density **9g/cm^3** with **120cm^3** of alluminium of density **3g/cm^3**. Determine the

(i) Total volume of the alloy.

80 + 120 = 200cm^3

(ii) Total mass of the alloy

Mass of copper = density x volume

9g/ cm^3 x80 cm^3 = 720g

Mass of alluminium= density x volume

3g/ cm^3 x120 cm^3 = 360g

Total mass of mixture = 720g+360g = 1080g

(iii) Density of the alloy in **SI** units.

Density of alloy = total mass mixture/total volume of mixture

1080/2000 = 5.4g/cm^3 = 5400kg/m^3

20. **100cm^3** of water of density **1g/cm^3** is mixed with **400cm^3** of ethanol of density **800kg/m^3**. Calculate

(i) The total volume of the mixture

100 + 400 = 500cm^3

(ii) The total mass of the mixture

Mass of water = density x volume

1g/ cm^3 x100 cm^3 = 100g

Mass of ethanol= density x volume

0.8g/ cm^3 x400 cm^3 = 320g

Total mass of mixture = 100g+320g = 420g

(iii) The density of the mixture in **SI** units.

Density of mixture = total mass mixture/total volume of mixture

420/500 =0.84g/cm^3 = 840kg/m^3

21. **400cm^3** of alcohol of density **800kg/m^3** is mixed with **600cm^3** of water of density **1000kg/m^3**. Calculate the density if the mixture in **SI** units.

Density of mixture = total mass of mixture/total volume of mixture

$= \frac{(400\ x\ 0.8)+(600x1)}{400+600}$ *=920/1000 = 0.92g/cm^3= 920kg/m^3*

22. An alloy is made by mixing **180cm^3** iron metal of density **2000kg/m^3** with **120cm^3** of lead meal of density **4g/cm^3**. Calculate the density of the alloy.

Density of mixture = total mass of mixture/total volume of mixture

$= \frac{(180\ x\ 2)+(120+4)}{180+120}$ *=840/300 = 2.8g/cm^3= 2800kg/m^3*

23. **400cm^3** of alcohol of density **800kg/m^3** is mixed with **600cm^3** of water of density **1g/m^3**. Calculate the density if the mixture in **SI** units.

Density of mixture = total mass of mixture/total volume of mixture

$= \frac{(400\ x\ 0.8)+(600x1)}{400+600}$ *=920/1000 = 0.92g/cm^3= 920kg/m^3*

24. **1600 cm^3** of fresh water of density **1 g/cm^3** are mixed with **1400cm^3** of seawater of density **1.25g/cm^3**. Determine the density of the mixture.

Density of mixture = total mass of mixture/total volume of mixture

$= \frac{(1600\ x\ 1)+(1400x1.25)}{1600+1400}$ *=3350/3000 = 1.117g/cm^3= 1117kg/m^3*

25. A liquid of density **800kg/m^3** has a mass of **3.2g**. Calculate its volume in **SI** unit.

Volume = mass/density = 3.25/0.8 = 4cm^3

26. **100cm^3** of water of density **1g/cm^3** is mixed with **200cm^3** of ethanol of density **0.79g/cm^3**. Calculate the density of the mixture in SI units.

Density of mixture = total mass of mixture/total volume of mixture

$= \frac{(100\ x\ 1)+(200x0.79)}{100+200}$ *=258/300 = 0.86g/cm^3= 860kg/m^3*

27. **500cm^3** of fresh water of density **1000 kg/m^3** mixed with **1000cm^3** of sea water density **1020kg/m^3**. Calculate the density of the mixture in SI units.

Density of mixture = total mass of mixture/total volume of mixture

$= \frac{(500\ x\ 1)+(1000x1.02)}{500+1000}$ *=1520/1500 = 1.013g/cm^3= 1013kg/m^3*

28. An alloy is made by mixing **80 cm** of copper of density **8.9g/cm^3** with **120cm^3** of alluminium of density **2.7g/cm^3**. Determine the density of the alloy in SI units.

Density of mixture = total mass of mixture/total volume of mixture

$= \frac{(80\ x\ 8.9)+(120x2.7)}{80+120}$ *=1036/200 = 5.18g/cm^3= 5180kg/m^3*

29. An alloy is made by mixing **180cm^3** iron metal of density **2000kg/m^3** with **120cm^3** of lead meal of density **4g/cm^3**. Calculate the density of the alloy.

Density of alloy = total mass of mixture/total volume of mixture

$= \frac{(180\ x\ 2)+(120x4)}{180+120}$ *=840/300 =2.8g/cm^3= 2800kg/m^3*

30. **400cm^3** of alcohol of density **800kg/m^3** is mixed with **600cm^3** of water of density **1g/m^3**. Calculate the density if the mixture in **SI** units.

Density of mixture = total mass of mixture/total volume of mixture

$= \frac{(400\ x\ 0.8)+(600x1)}{400+600}$ *=920/1000 = 0.92g/cm^3= 920kg/m^3*

31. **100cm^3** of sea water of density **1150kg/m^3** is mixed with **100cm^3** of fresh water of density **1000kg/m^3**. Determine density of the mixture.

Density of mixture = total mass of mixture/total volume of mixture

$= \frac{(100\ x\ 1.15)+(100x1)}{100+100}$ *=215/200 = 1.075g/cm^3= 1075kg/m^3*

32. **1600 cm^3** of fresh water of density **1g/cm^3** are mixed with **1400cm^3** of seawater of density**1.25g/cm^3**. Determine the density of the mixture.

Density of mixture = total mass of mixture/total volume of mixture

$= \frac{(1600\ x\ 1)+(1400x1.25)}{1600+1400}$ *=3350/3000 = 1.117g/cm^3= 1117kg/m^3*

33. An alloy contains **40%** by mass of lead and **60%** by mass of tin. Determine the density of the alloy in kgm^3. (density of lead = **1.4g/cm^3** and density of tin = **7.3g/cm^3)** 3mks)

34. **X**cm^3 of substance **A** which has a density of **800kg/m^3** is mixed with**100cm^3** of water with a density of **1000 kg/m^3**. The density of the mixture is **960kg/m^3**. Determine the value of **X**.

Density of mixture = total mass of mixture/total volume of mixture

$0.96 = \frac{(y \times 0.8)+(100x1)}{y+100}$

$0.96 = \frac{0.8y+100}{y+100}$

$0.96(y + 100) = 0.8y+100$

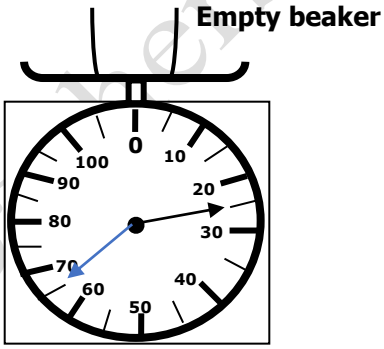
$Y = 25cm^3$

MASS

35. A butcher has a beam balance and masses **0.5 kg** and **2 kg**. How would he measure **1.5 kg** of meat on the balance at once?

Place a mass of 2kg on one side and 0.5kg mass on the other side . place a piece of meat which have a mass relatively greater than 1.5kg on the same side as 0.5kg mass. Reduce the meat bit by bit until the beam balances and end up with 1.5kg mass meat.

36. The figure below shows an empty beaker placed on the top of a pan calibrated in grammes. **50ml** of alcohol of density **0.8g/cm^3** was added to the beaker. Show on the diagram the new pointer position. (3mk)



1l = 1000ml

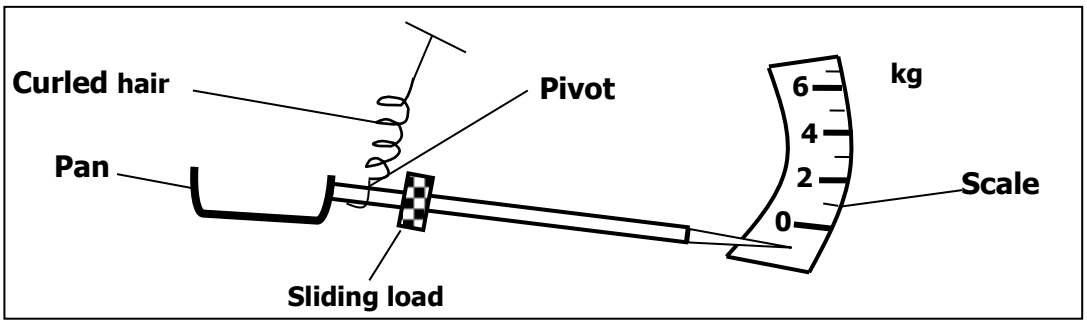
? = 50ml

0.05ml

Mass = density x volume = 0.8 x 50 = 40g

New reading 25g + 40g = 65g

37. Figure below shows the arrangement of a sensitive spring balance.



How would you adjust the position of the sliding load to reset its reading to zero? (1 mk)

Moving the sliding load towards the pan.