CONTENTS

UNIT 01

Physical Quantities and Measurements

Q.1. Define Science. 09101001

Ans. *The field of observation and experimentation to understand the world around us is known as science.* Everything in our lives is closely linked to science and the discoveries made by scientists.

Q.2. Explain the difference between physical and non-physical quantities. Give examples. 09101002

Ans.

Physical Quantities	Non-Physical Quantities
Physical quantities can be measured directly or indirectly using tools and instruments.	Non-physical quantities cannot be measured using tools and instruments.
They are measurable and can be expressed in numerical terms.	They are abstract concepts and cannot be quantified.
Examples length, time, temperature, volume, density, etc.	**Examples** love, affection, fear, wisdom, beauty, etc.

Q.3. What is the difference between base quantities and derived quantities? Give examples of each. 09101003

Ans.

Base Quantities	Derived Quantities
Base quantities are fundamental physical quantities arbitrary selected by scientist to play a key role in measurements. They provide base for new quantities.	Derived quantities are those that can be described in terms of one or more base quantities.
Examples: Length, mass, time, temperature, electric current, amount of substance and intensity of light.	**Example:** Speed is a derived quantity that depends on distance and time, which are base quantities.

Q.4. What is meant by measurement? Explain. 09101004

Ans. *A **measurement** is a process of comparison of an unknown quantity with widely accepted standard quantity.* A measurement consists of two parts, a number and a unit. A measurement without unit is meaningless.

Challenges of Early Measurement Methods

In the early days, people used their hands, arms, feet, or steps to measure lengths. However, these methods were problematic because the size of hands, arms, and steps varied from person to person, leading to inconsistencies in measurements. This lack of uniformity created confusion when measurements needed to be compared or shared.

Need for Standardization in Measurements

To avoid confusion caused by personal differences, a standard unit of measurement was required. A standard ensures that any person performing a measurement would arrive at the same result. This idea of uniformity is crucial for accuracy and reliability in various fields, such as science, trade, and construction.

Q.5. What is the International System of Units (SI)? Explain. 09101005

Ans: i. International System of Units (SI):

Definition: *The International Committee on Weights and Measures in 1961 recommended the use of a system consisting of seven base units known as the* ***International System of Units (SI)***. This system is in use all over the world. The use of SI measurements helps all scientists to share and compare their observations and results easily. The seven base units are fixed with reference to international standards, ensuring consistency and universal understanding across different scientific fields.

ii. Base Units and Derived Units:

Base units cannot be derived from one another and cannot be resolved into anything more basic. However, the units of **derived quantities** such as speed, area, volume, force, pressure, and electric charge can be derived using the base units. These units are called **derived units**. For example:

- **Area** is derived as: Length × Breadth = meter × meter = square meter = m^2
- **Speed** is derived as: Distance / Time = meter / second = m/s

Thus, derived units can be expressed in terms of the base units, enabling scientists to measure a wide range of physical quantities.

Q.6. What are prefixes? What is their use in measurements? 09101006

Ans: The SI system is a decimal system, and **prefixes** are used to modify units by powers of 10. Writing large quantities, like 50,000,000 m, or small quantities, like 0.00004 m, is not convenient. Instead, prefixes make these quantities easier to express. For example:

- The quantity **50,000,000 m** can be written as 5×10^7 m **OR** $(50 \times 10^6 m \Rightarrow 50Mm$
- The quantity **0.00004 m** can be written as 4×10^{-5} m **OR**

$$(0.04 \times 10^3 m \Longrightarrow 0.04Km. (Mega = M = 10^6 : Kilo = K = 10^3)$$

Prefixes are the words or symbols added before S.I units such as **milli, centi, kilo, mega, and giga** are used to express quantities in a more manageable form. For example:

- One thousandth (1/1000) of a metre is a **millimetre (mm)**, useful for small measurements like the thickness of a thin wire.
- One thousand metres is a **kilometre (km)**, which is used to measure long distances.

These prefixes simplify the expression of both large and small quantities, making the system more practical and accessible for everyday use.

Q.7. What is scientific notation? Explain. 09101007

Ans: Scientific Notation

Definition: Scientific notation is a short way of representing very large or very small numbers. Writing such numbers otherwise takes up much space, making them difficult to read and compare. It also becomes hard to visualize their relative sizes and use them in calculations. These numbers are more conveniently expressed as powers of 10.

Simplification of Numbers

In scientific notation, the numerical part of the quantity is written as a number from 1 to 9, multiplied by whole number powers of 10. This simplification helps avoid writing long strings of numbers and makes calculations easier to perform.

Writing Numbers in Scientific Notation

To write numbers using scientific notation, you move the decimal point until only one non-zero digit remains on the left. Then, you count the number of places the decimal point is moved. This count becomes the power or exponent of 10. If the decimal is moved to the left, the exponent is positive. If it is moved to the right, the exponent is negative.

Examples of Scientific Notation

- The average distance from the Sun to the Earth is 138,000,000 km. In scientific notation, this distance would be written as $\mathbf{1.38 \times 10^8}$ **km**. The decimal point is moved 8 places to the left, so the exponent is positive.
- The diameter of a hydrogen atom is about 0.000000000052 m. In scientific notation, this would be written as $\mathbf{5.2 \times 10^{-11}}$ **m**. The decimal point is moved 11 places to the right, so the exponent is negative.

Thus, scientific notation is a helpful tool for expressing very large or very small numbers in a more compact and manageable form.

Q.8. Write a note on meter rule. 09101008

Ans: Measuring Length with a Meter Rule:

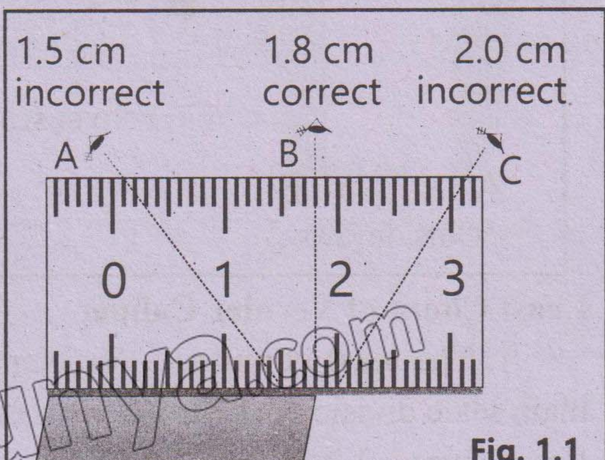


Fig. 1.1

Length is generally measured using a **meter rule** in the laboratory. The smallest division on a meter scale is **1 mm**, and the smallest measurement that can be taken with a meter rule is **1 mm**. This is known as the **least count** of the meter rule. The least count refers to the smallest measurement that can be accurately taken with an instrument.

Procedure for Measuring Length

To measure the length of an object, the meter rule is placed in such a way that its zero coincides with one edge of the object. Then, the reading in front of the other edge gives the **length of the object**.

Parallax Error

One common source of error when using a meter rule is the angle at which the instrument is read. The meter rule should either be tipped on its edge or read when the person's eye is directly above the ruler. If the meter rule is read from different angle, the object will appear to be of different lengths. This is known as **parallax error**, which occurs due to the distortion caused by the observer's perspective. This leads to inaccurate measurements and should be avoided to ensure precision.

Q.9. Describe construction and working of Vernier calipers in detail. 09101009

Ans: Vernier Caliper

*A **Vernier Caliper** is an instrument used to measure small lengths with high precision, down to **1/10th of a millimeter***. It is commonly used to measure the thickness, diameter, width, or depth of an object.

Construction:

The Vernier Caliper has two scales:

(a) **Main Scale**: This scale has markings of **1 mm** each.

(b) **Vernier (sliding) Scale**: The Vernier scale is **9 mm** long and divided into **10 equal parts**.

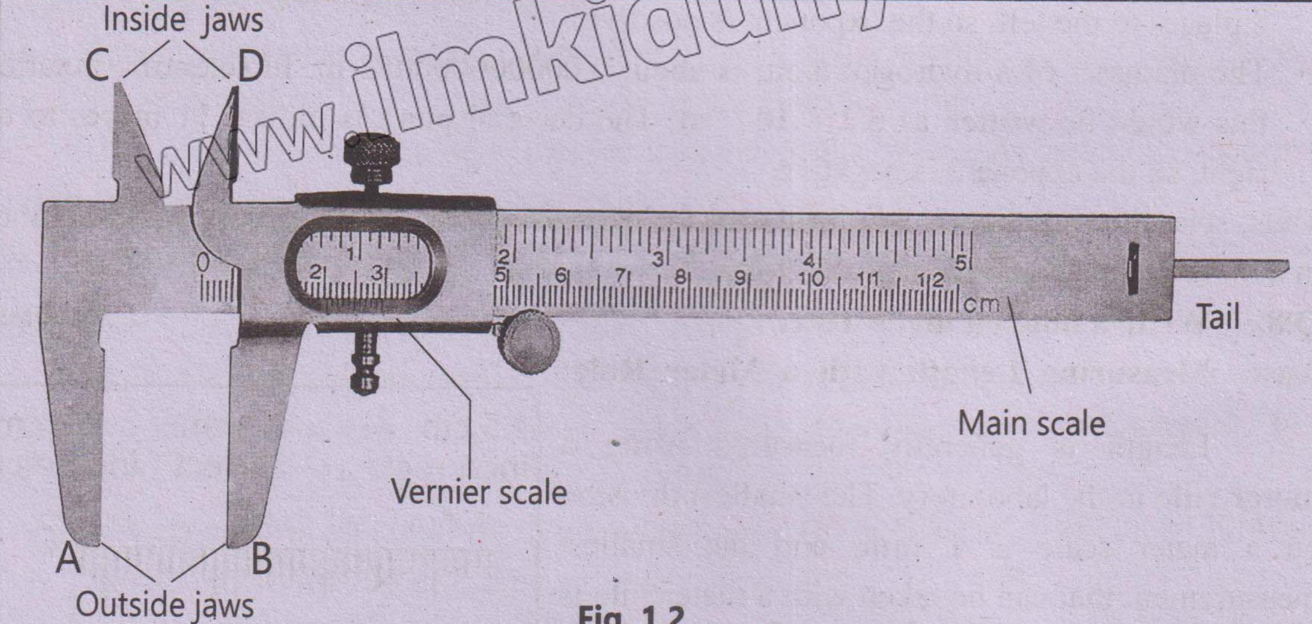


Fig. 1.2

Least Count of Vernier Caliper

The **least count** of a Vernier Caliper is the difference between the value of one main scale division (M.S) and one Vernier scale division (V.S).

Least count = 1 M.S div - 1 V.S div

Least count = 1 mm - 0.9 mm = 0.1 mm

Alternatively, the least count can also be determined by dividing the length of one small division on the main scale by the total number of divisions on the Vernier scale:

Least count = 1 mm / 10 = 0.1 mm.

Jaws and Depth Gauge

The Vernier Caliper also has **two jaws** (A and B) to measure the **external dimensions** of an object. Jaws C and D are used to measure the **internal dimensions** of an object. Additionally, a narrow strip projecting from behind the main scale, known as the **tail or depth gauge**, is used to measure the **depths** of hollow objects.

Working:

Measurement Using Vernier Calipers

Suppose, an object is placed between the two jaws, the position of the Vernier scale on the main scale is shown in the Fig (1.2(a)).

i. Read the main scale marking just infront of zero of the Vernier scale. It shows 4.3 cm.

ii. Find the Vernier scale marking or division which is in line with any of the main scale marking. This shows:

length of object = Main scale reading + (Least count × Vernier scale reading).

$$= 4.3 + 0.01 \times 4 = 4.34 \text{ cm}$$

iii. Checking for zero error. Following are some important points to keep in mind before checking zero error:

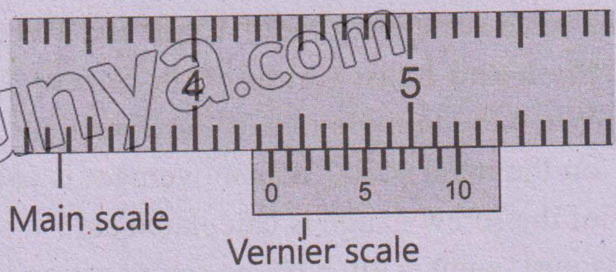


Fig. 1.2 (a)

a) If on joining the jaws A and B, the zeros of the main scale and Vernier scale do not exactly coincide with each other then there is an error in the instrument called **zero error.**

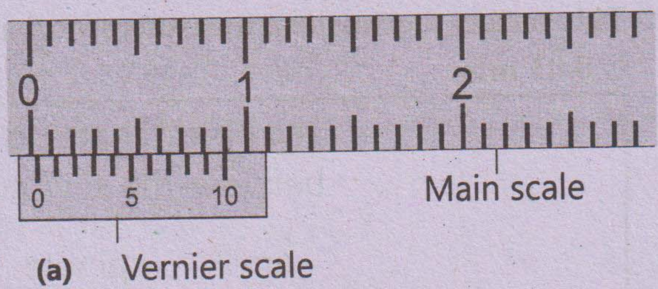


Fig. 1.2 (b)

b) If the zero of the Vernier scale is on the right side of the zero of the main scale (Fig.1.2(b)) then this instrument will show slightly more than the actual length. Hence, these zero errors are subtracted from the observed measurement.

To find the zero error, note the number of the division of the Vernier scale which is exactly in front of any division of the main scale. Multiply this number with the least count. The resultant number is the zero error of this instrument. The observed reading is corrected by subtracting the zero error from it.

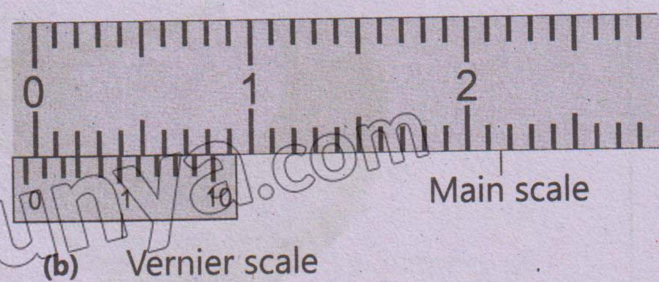


Fig. 1.2 (b)

c) If the zero of the Vernier scale is on the left side of the zero of the main scale (Fig. 1.2(c)), then instrument will show slightly less than the actual length.

Hence, the zero error is added in the observed measurement. For example, if 3 is the number of divisions coinciding with any main scale division then 3 is subtracted from 10 and the result is then multiplied with the least count. Therefore, the zero error in this case will be 0.7 mm. For correction, it is added in the observed reading.

Digital Vernier Caliper: Digital Vernier Calipers has greater precision than mechanical Vernier Calipers. Least count of Digital Vernier Calipers is 0.01 mm.

Q.10. What is screw gauge? What is its pitch and least count? How it is used to measure thickness of an object? OR What is screw gauge? Describe its construction and working. 09101010

Ans: Screw Gauge

A ***Screw Gauge*** *is an instrument used to measure very small lengths, such as the* ***diameter of a wire*** *or the* ***thickness of a metal sheet.***

Construction:

It consists of two scales:

(a) Main Scale on the sleeve, which has markings of **0.5 mm** each.

(b) Circular Scale on the thimble, which has **50 divisions**. Some screw gauges may have a main scale marking of **1 mm** and **100 divisions** on the thimble.

Pitch and Least Count of the Screw Gauge:

When the thimble makes one complete turn, the spindle moves **0.5 mm (1 scale division)** on the main scale. This movement is called the **pitch** of the screw gauge. The **least count** of the screw gauge is calculated as:

Least count = Pitch of the screw gauge / Number of divisions on the circular scale

Least count = 0.5 mm / 50 = 0.01 mm.

This means the smallest measurement that can be accurately taken using the screw gauge is **0.01 mm**.

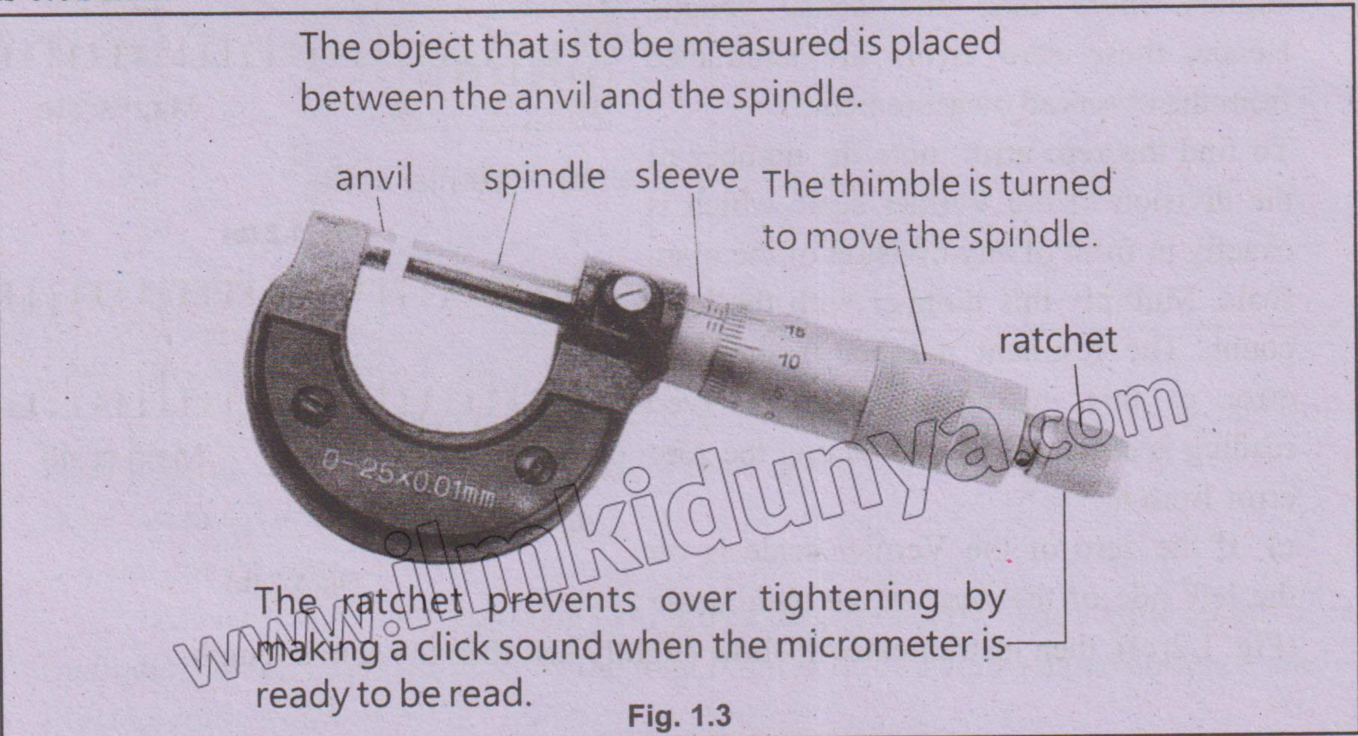


Fig. 1.3

Checking for Zero Error

Zero Error occurs when the zero of the circular scale does not coincide exactly with the horizontal line on the main scale. The following are the cases of zero error detection and correction:

- **No Zero Error**: If the zero of the circular scale coincides with the horizontal line (Fig. 1.4-a), there is **no zero error**.
- **Zero Error Below the Line**: If the zero of the circular scale is **below the horizontal line**, the screw gauge measures slightly more than the actual thickness. In this case, the **zero error** is **subtracted** from the observed measurement (Fig. 1.4-b).
- **Zero Error Above the Line**: If the zero of the circular scale is **above the horizontal line**, the screw gauge measures slightly less than the actual thickness. In this case, the **zero error** is **added** to the observed measurement (Fig. 1.4-c).

By detecting and correcting the zero error, accurate measurements can be ensured using the screw gauge.

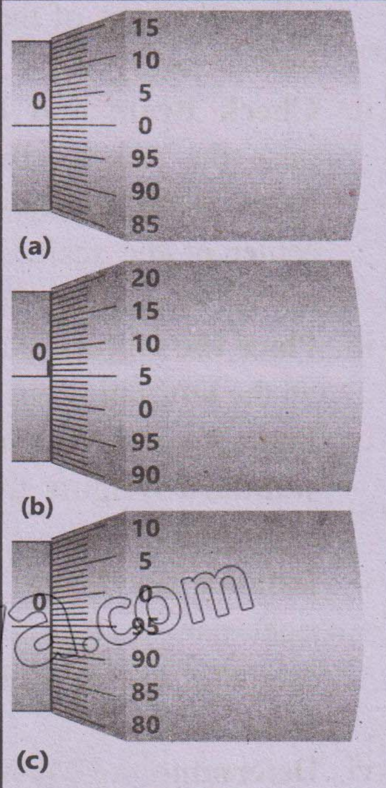


Fig. 1.6

Working:

Measurement Using Screw Gauge:

Suppose when a steel sheet is placed in between the anvil and spindle, the position of circular scale is shown in Fig. 1.4 (b).

(a) Read the marking on the sleeve just before the thimble. It shows 6.5 mm.

(b) Read the circular scale marking which is in line with the main scale. This shows 25. Hence,

$$\text{Thickness} = \text{main scale reading} + (\text{circular scale reading} \times \text{L.C.})$$
$$= 6.5\ \text{mm} + 25 \times 0.01\ \text{mm}$$
$$= 6.5\ \text{mm} + 0.25\text{mm} = 6.75\ \text{mm}$$

Q.11. Write a brief note on physical balance. **09101011**

Ans: Physical Balance

Definition: *A **Physical Balance** is used for measuring the **mass** of an object, and it is based on the principle of levers.* In daily life, we often use the term **weight** to refer to mass, but in **Physics**, mass and weight are distinct concepts. **Mass** refers to the quantity of matter in a body, while **weight** is the force by which the object is attracted to the Earth. The **weight** of an object can be measured using a **spring balance**, whereas the **mass** is determined by comparing the object with known standard masses. This process is known as **weighing**.

Steps for Using a Physical Balance

To weigh an object accurately using a physical balance, follow these steps:

i. **Level the Base**: First, use the levelling screws to adjust the base of the balance so that the **plumb line** is exactly above the pointed mark.

ii. **Check Beam and Pointer**: Turn the knob to raise the pans of the balance. Ensure that the beam is **horizontal** and the **pointer** is at the center of the scale. If not, adjust the balancing screws on the beam to make it horizontal.

iii. **Place the Object**: Place the object to be weighed on the **left pan** of the balance.

iv. **Place Known Weights**: Using **forceps**, place the **standard weights** from the weight box into the **right pan**.

v. **Balance the Beam**: Adjust the weights on the right pan so that the pointer stays at **zero** or oscillates evenly on both sides of the zero of the scale.

vi. **Determine the Mass**: The total of the **standard masses** placed on the right pan gives the **mass** of the object in the left pan.

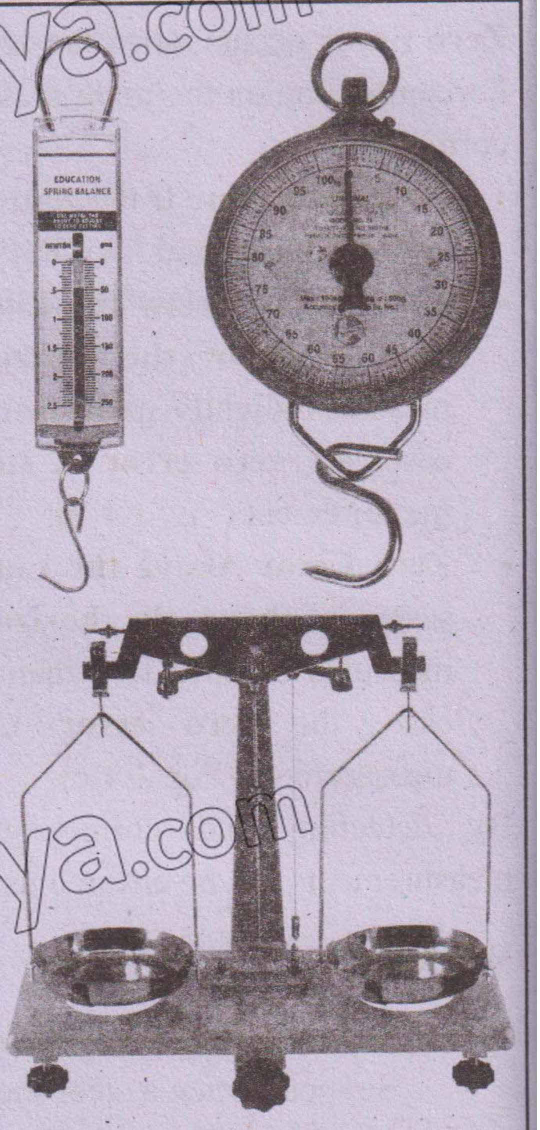


Fig. 1.5

Q.12. Write a brief note on stopwatch.

09101012

Ans: Stopwatch

A ***stopwatch*** *is an instrument used to measure the* ***duration of time*** *of an event.* It contains two needles: one for **seconds** and another for **minutes**. The dial of the stopwatch is usually divided into **30 big divisions**, with each of these divisions being further divided into **10 small divisions**. Each **small division** represents **one tenth (1/10) of a second**. Therefore, **one tenth of a second** is the **least count** of the stopwatch.

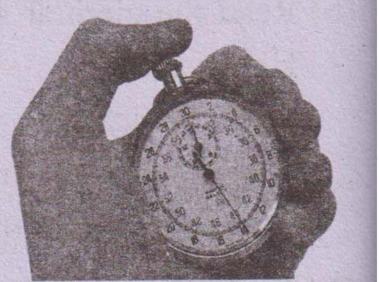


Fig. 1.6 Mechanical Stopwatch

Using the Stopwatch

To use the stopwatch, the following steps should be followed:

i. Press the **knob** present on the top of the device to start the stopwatch.

ii. Press the same **knob** again to stop it after the event is measured.

iii. Once the reading is noted, press the **knob** once more to reset the needles back to the **zero position**.

Fig. 1.7 Digital Stopwatch

Modern Digital Stopwatches

In modern times, **electronic/digital watches** are available, which can measure time more accurately, down to **one hundredth** of a second. These digital stopwatches offer a higher level of precision compared to traditional mechanical stopwatches.

Q.13. Write a brief note on measuring cylinder. 09101013

Ans: Measuring Cylinder

A **measuring cylinder** is a cylindrical container made of **glass** or **transparent plastic**. It is marked with a scale divided into **cubic centimeters (cm or cc)** or **milliliters (mL)**. The measuring cylinder is primarily used to find the **volume of liquids** and **non-dissolvable solids**.

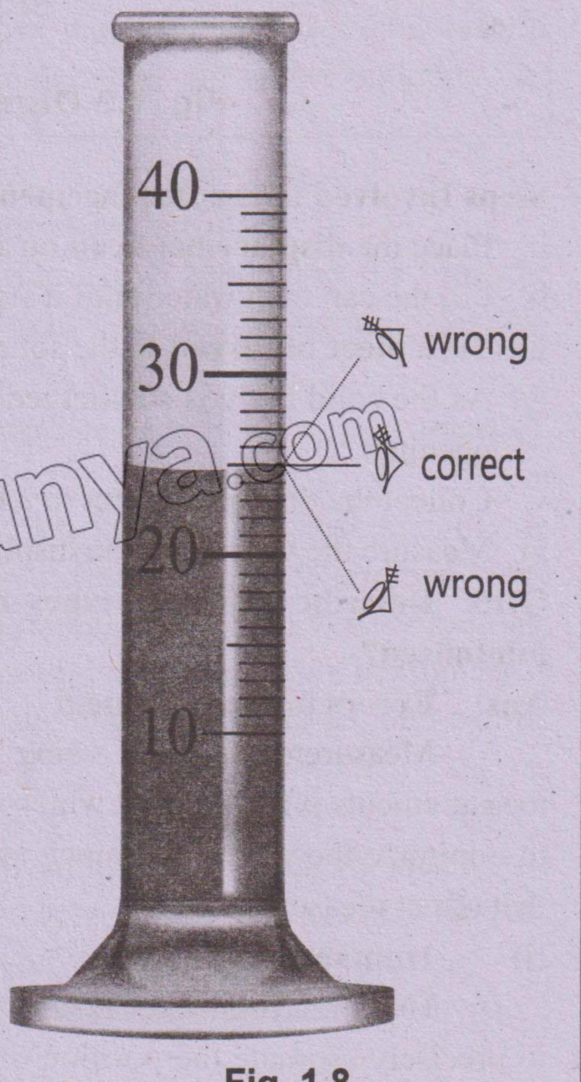


Fig. 1.8
Measuring cylinder

Measuring the Volume of Liquids

To measure the volume of a liquid, the liquid is poured into the measuring cylinder, and the level of the liquid marks the volume. To read the volume accurately, the cylinder must be placed on a **horizontal surface**, and the **eye must be level with the meniscus** of the liquid surface. The **meniscus** is the curve at the top of the liquid surface. For **water**, the meniscus forms a **concave surface**, and the reading is taken at the **bottom edge** of the concave surface.

Reading the Meniscus of Mercury

When measuring **mercury**, the liquid forms a **convex surface**, which curves **upward**. In this case, the reading is taken from the **top edge** of the convex surface.

Measuring the Volume of Solids

The measuring cylinder can also be used to measure the **volume of solids** by observing the displacement of the liquid when the solid is added.

Q.14. Describe displacement can method for finding volume of a solid. 09101014

Ans: Displacement Can Method

The **displacement can method** is used when the solid body cannot fit into the measuring cylinder. Instead, a **displacement can** with a wide opening is used to measure the volume of the solid.

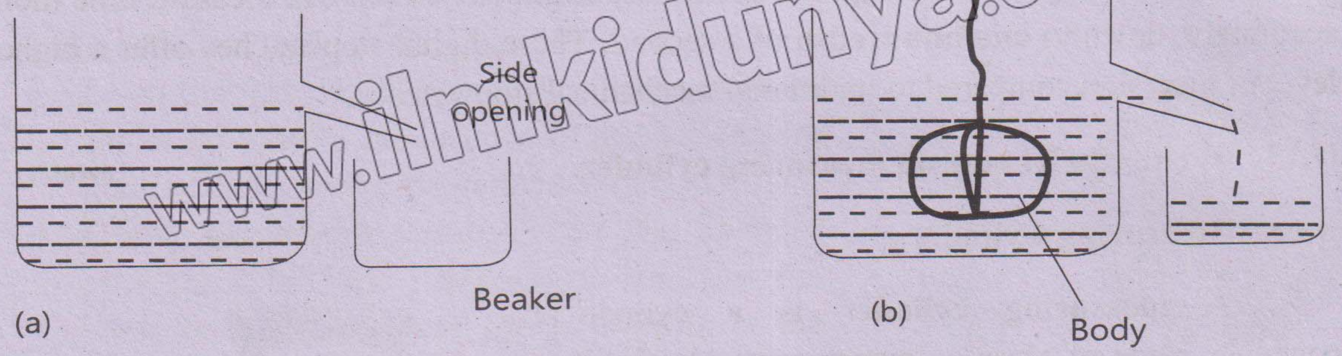


Fig. 1.9 Displacement can or Overflow can

Steps Involved in the Displacement Can Method

i. Place the **displacement can** on a **horizontal table**.
ii. Fill the can with water until it starts **overflowing** through its opening.
iii. Tie a **piece of thread** to the solid body and gently lower it into the displacement can.
iv. As the solid body is submerged, it **displaces water**, which flows out through the side opening.
v. Collect the displaced water in a **beaker**.
vi. Measure the volume of the displaced water using a **measuring cylinder**.

Q.15. Describe different types of errors in measurement and how can they be minimized? 09101015

Ans: Errors in Measurement

Measurements made using tools and instruments are not always perfect. These measurements inherit errors, which cause them to differ from their true values. The goal is to minimize these errors as much as possible. There are three types of experimental errors that affect measurements:

(i) Human Errors

Human errors occur due to personal performance limitations, such as the inability to precisely estimate the position of a pointer on a scale. These errors can also arise from faulty procedures, like improper reading of the scale. **In timing experiments**, human reaction time in starting or stopping the clock also affects the measurement.

Minimizing Human Errors:

- Ensuring proper **training**, techniques, and procedures to handle instruments.
- Avoiding **environmental distractions** to maintain focus.
- Using **automated or digital instruments** can significantly reduce human error.

(ii) Systematic Errors

Systematic errors refer to errors that influence all measurements of a particular type in the same way, resulting in consistent differences in readings. These errors may arise from factors such as **zero error**, poor calibration of instruments, or incorrect markings on the scale.

Minimizing Systematic Errors:

- Comparing the instrument with another one known to be more accurate.
- Applying a **correction factor** to adjust the measurements.

(iii) Random Errors

Random errors occur when repeated measurements of the same quantity produce different results under the same conditions. These errors are caused by unpredictable factors, and the experimenter has little or no control over them. They may arise due to fluctuations in **environmental conditions**, such as changes in temperature, pressure, humidity, or voltage.

Minimizing Random Errors:

- Taking multiple readings and calculating the **average** or **mean** value.
- For example, when measuring the time of oscillations of a pendulum, the time for several oscillations (e.g., 30 oscillations) is measured, and the average time for one oscillation is then calculated.

Q.16. Describe concept of uncertainty in measurement. **09101016**

Ans: Uncertainty in Measurements

There is no such thing as a perfect measurement. Whenever a physical quantity is measured, except for counting, there is always some uncertainty in the determined value due to the limitations of the instrument used. This uncertainty arises from various reasons, with one key factor being the type of instrument employed. Every measuring instrument is calibrated to a certain smallest division, which limits the degree of accuracy that can be achieved when using it.

Instrument Limitations and Uncertainty

Consider the example of measuring the length of a straight line using a meter rule calibrated in millimeters. If the endpoint of the line lies between the 10.3 cm and 10.4 cm marks, the reading is taken according to the following convention:

- If the endpoint of the line does not touch or cross the midpoint of the smallest division, the reading is confined to the previous division.
- If the endpoint touches or crosses the midpoint, the reading is extended to the next division.

In this example, the maximum uncertainty is **± 0.05 cm**, which is equivalent to **± 0.1 cm**, representing half of the least count of the instrument, divided into two parts—half above and half below the recorded reading.

Significant Figures and Uncertainty

The uncertainty or accuracy of the measured value can be conveniently indicated using **significant figures**. This method expresses the uncertainty in the measurement by indicating the degree of precision in the recorded value. Significant figures help to convey the limits of accuracy in the measurement, providing a clear understanding of the measurement's reliability.

Q.17. What are significant figures? Explain general rules for written significant figure with the help of examples. 09101017

Ans: Significant Figures

"In any measurement, the accurately known digits and the first doubtful digit are known as significant figures."

Explanation:

Significant figures are used to reflect the degree of uncertainty in a measurement, which occurs due to limitations in the measuring instrument. While we can count objects like candies in a jar exactly, we cannot measure certain physical quantities, such as the height of a jar, with perfect accuracy. Every measurement includes some level of uncertainty, and significant figures help convey this uncertainty by recording all the reliably known digits along with the first doubtful or uncertain digit.

For example, when measuring the length of a rod between 4.6 cm and 4.7 cm, the first student might estimate it to be 4.6 cm, and the second student might estimate it as 4.7 cm. Both students agree on the first digit (4), but the second digit is uncertain and was estimated, making it a "doubtful digit." In this case, the significant figures would include both the accurately known digit and the first doubtful digit.

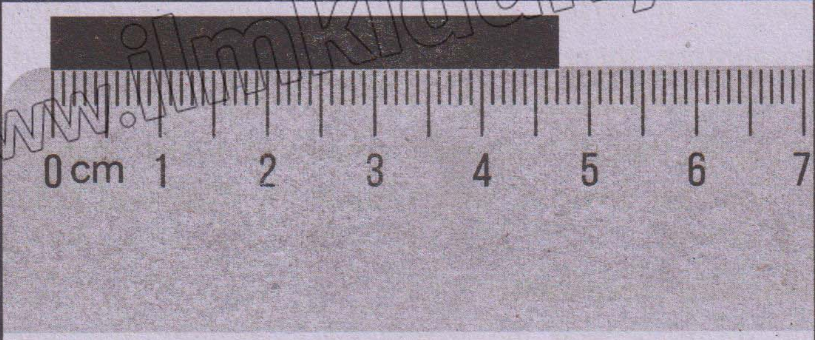


Fig. 1.10

Rules for Determining Significant Figures:

The following rules help to determine the number of significant figures in a measurement:

i. **All digits from 1 to 9 are always significant**.
For example, in the measurement 5.06 m, all digits (5, 0, and 6) are significant, so it has 3 significant figures.

ii. **Zeros between non-zero digits are considered significant**.
For instance, in 5.06 m, the zero between 5 and 6 is significant, so it has 3 significant figures.

iii. **Leading zeros (zeros before the first non-zero digit) are not significant**.
For example, in 0.0034 m, the zeros before 3 are not significant, so it has 2 significant figures.

iv. **Zeros to the right of a decimal point are considered significant**.
For example, in 2.40 mm, the zero after the decimal point counts as significant, so it has 3 significant figures.

v. **In scientific notation, all digits before the exponent are significant.**
For example, in 3.50×10^{-4} m, the significant figures are 3 (3, 5, and 0), as all digits before the exponent are considered significant.

Q.18. Differentiate between precision and accuracy in physical measurement. 09101018

Ans: Precision and Accuracy

In physical measurements, precision and accuracy are two distinct concepts that must be clearly understood.

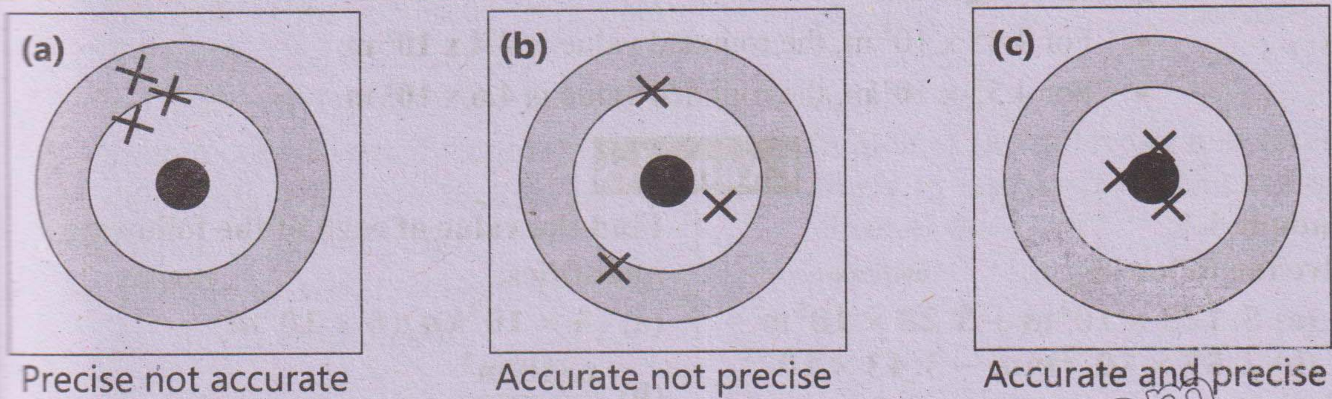


Fig. 1.11

i. **Precision** refers to how close together a group of measurements are to each other. It shows the consistency or repeatability of the measurements. For example, if arrows are shot at a target and hit near each other (Fig. 1.16 a), the measurements are considered precise, regardless of whether they are near the bullseye or not.

ii. **Accuracy**, however, refers to how close the measured value is to the accepted or true value. In the example of a target (Fig. 1.16 b), if the arrows hit near the bullseye, then the measurements are considered accurate because they reflect the true value of the measurement.

Explanation:

In conclusion, precision is about the closeness of repeated measurements to each other, while accuracy is about how close those measurements are to the true value, with both being influenced by the type of instrument used and the number of significant figures recorded.

Q.19. Explain rounding off number in scientific measurement. 09101019

Ans: Rounding Numbers to Significant Figures

When rounding numbers to a specified number of significant figures, the following rules should be applied:

i. **If the last digit is greater than 5**, increase the retained digit by one.

ii. **If the last digit is less than 5**, retain the retained digit as it is.

iii. **If the last digit is exactly 5**, apply the following:

- **If the digit before the 5 is odd**, increase the last retained digit by one.

- **If the digit before the 5 is even**, leave the last retained digit unchanged.

These rules ensure that the rounded value reflects the correct level of precision.

Examples of Rounding to Significant Figures

- **Rounding to 2 significant figures**:
- For 2.512×10^3 m, the rounded value is **2.5×10^3 m**
- For 3.4567×10^4 kg, the rounded value is **3.46×10^4 kg**

Examples of Rounding with the Digit 5

- **To 2 significant figures**:
  - For 4.45×10^2 m, the rounded value is **4.4×10^2 m**
  - For 4.55×10^2 m, the rounded value is **4.6×10^2 m**

Examples

Example 1.1:

Solve the following: **09101020**

(a) $5.123 \times 10^4 m + 3.28 \times 10^5 m$

(b) $2.57 \times 10^{-2} mm - 3.43 \times 10^{-3}$

Solution:

(a) $5.123 \times 10^4 m + 3.28 \times 10^5 m$

$= 5.123 \times 10^4 m + 32.8 \times 10^4 m$

$= (5.123 + 32.8)10^4 m$

$= 37.923 \times 10^4 m$

$= 3.7923 \times 10^5 m$

(b) $2.57 \times 10^{-2} mm - 3.43 \times 10^{-3} mm$

$= 2.57 \times 10^{-2} mm - 0.343 \times 10^{-2} mm$

$= (2.57 - 0.343)10^{-2} mm$

$= 2.227 \times 10^{-2} mm$

$= 2.227 \times 10^{-2} \times 10^{-3} m$

$= 2.227 \times 10^{-5} m$

Example 1.2:

Find the value of each of the following quantities: **09101021**

(a) $(4 \times 10^3 kg)(6 \times 10^6 m)$

(b) $\frac{6\times10^6 m^3}{2\times10^{-2} m^2}$

Solution:

(a) $(4 \times 10^3 kg)(6 \times 10^6 m) = (4 \times 6) \times 10^{3+6} kg\ m$

$= 24 \times 10^9 kg\ m$

$= 2.4 \times 10^{10} kg\ m$

(b) $\frac{6\times10^6 m^3}{2\times10^{-2} m^2} = \frac{6}{2}\times10^{6-(-2)} m^{3-2}$

$= 3 \times 10^8 m$

Exercise

(A) Multiple Choice Questions (Exercise)

1. **The instrument that is most suitable for measuring the thickness of a few sheets on cardboard is a:** **09101022**
   (a) metre rule
   (b) measuring tape
   (c) vernier calipers
   (d) micrometer screw guage

2. **One femtometre is equal to:** **09101023**
   (a) 10^{-9}m (b) 10^{-15}m
   (c) 10^9m (d) 10^{15}m

3. **A light year is a unit of:** **09101024**
   (a) light (b) time
   (c) distance (d) speed

4. **Which one is a non-physical quantity?** 09101025

(a) distance (b) density
(c) colour (d) temperature

5. **When using a measuring cylinder, one precaution to take is to:** 09101026

(a) check for the zero error
(b) look at the meniscus from below the level of the water surface
(c) take several readings by looking from more than one direction
(d) position the eye in line with the bottom of the meniscus

6. **Volume of water consumed by you per day is estimated in:** 09101027

(a) millilitre
(b) litre
(c) kilogram
(d) cubic metre

7. **A displacement can is used to measure:** 09101028

(a) mass of liquid
(b) mass of solid
(c) volume of a liquid
(d) volume of a solid

8. **Two rods with lengths 12.321 cm and 10.3 cm are placed side by side, the difference is their lengths is:** 09101029

(a) 2.02 cm
(b) 2.0 cm
(c) 2 cm
(d) 2.021 cm

9. **Four students measure the diameter of a cylinder with Vernier Calipers. Which of the following readings is correct?** 09101030

(a) 3.4 cm (b) 3.475 cm
(c) 3.47 cm (d) 3.5 cm

10. **Which of the following measures are likely to represent the thickness of a sheet of this book?** 09101031

(a) 6×10^{-25}m
(b) 1×10^{-4}m
(c) 1.2×10^{-15}m
(d) 4×10^{-2}m

11. **In a Vernier Calipers ten smallest divisions of the Vernier scale are equal to nine smallest divisions of the main scale. If the smallest division of the main scale is half millimeter, the Vernier constant is equal to:** 09101032

(a) 0.5 mm
(b) 0.1 mm
(c) 0.05 mm
(d) 0.001 mm

Answer Key

1.	(d)	2.	(b)	3.	(c)	4.	(c)	5.	(d)	6.	(b)
7.	(d)	8.	(b)	9.	(c)	10.	(b)	11.	(c)		

SLO based Additional MCQs

Units

1. **Which one of the following unit is not a derived unit?** 09101033

(a) Pascal (b) kilogram
(c) newton (d) watt

2. **Amount of a substance in terms of numbers is measured in:** 09101034

(a) gram (b) kilogram
(c) newton (d) mole

3. **Which of the following is a base unit?** 09101035
(a) Pascal
(b) coulomb
(c) meter per second
(d) mole

4. **0.2 mm in units of meters is:** 09101036
(a) 0.0002 m (b) 2×10^4 m
(c) both (a) and (b) (d) none

Significant Figures

5. **The number of significant figures in 0.00650s are:** 09101037
(a) 2 (b) 3
(c) 5 (d) 6

6. **Which of the following numbers show 4 significant digits?** 09101038
(a) 9000.8 (b) 4
(c) 5174.00 (d) 0.001248

7. **The numbers having one significant digit is:** 09101039
(a) 1.1 (b) 6.0
(c) 7.1 (d) 6×10^2

Prefixes

8. **Which of following prefix represents largest value?** 09101040
(a) mega (b) pico
(c) peta (d) kilo

9. **Ratio of millimeter to micrometer is:** 09101041
(a) 1000 m
(b) 0.001 mete
(c) 1000
(d) 0.001

Screw Gauge

10. **Micro meter can be used to measure:** 09101042
(a) current (b) force
(c) length (d) mass

11. **Least count of screw gauge is 0.01 mm. If main scale reading of screw gauge is zero and third line of its circular scale coincides with datum line then the measurement on the screw gauge is:** 09101043
(a) 0 mm (b) 3 mm
(c) 0.03 mm (d) 0.3 mm

Measuring Instruments

12. **The instrument best measures the internal diameter of a pipe is:** 09101044
(a) screw gauge
(b) vernier caliper
(c) metre rule
(d) measuring tape

Scientific Notation

13. **9.483 x10^3 m is the standard form of** 09101045
(a) 94.83 m
(b) 9.483 m
(c) 948.3 m
(d) 9483 m

Answer Key

1	(b)	2	(d)	3	(d)	4	(a)	5	(b)
6	(d)	7	(d)	8	(c)	9	(c)	10	(c)
11	(c)	12	(b)	13	(d)				

(B) Short Questions (Exercise)

1.1 Can a non-physical quantity be measured? If yes, then how? 09101046

Ans: Non-physical quantities, such as emotions, intelligence, or satisfaction, cannot be directly measured using traditional instruments. However, they can be assessed indirectly through metrics, scales, or standardized tests. For example:

i. **Intelligence** is measured using **IQ tests**.
ii. **Customer satisfaction** can be quantified through **surveys** or **rating scales**.

These methods convert abstract concepts into numerical values that allow for comparison and analysis.

1.2 What is measurement? Name its two parts. 09101047

Ans: A measurement is a process of comparison of an unknown quantity with widely accepted standard quantity. A measurement consists of two parts, a number and a unit. A measurement without unit is meaningless.

1.3 Why do we need a standard unit for measurements? 09101048

Ans: A standard unit ensures consistent and accurate measurements. It allows everyone to understand and compare results, which is important for science, trade, and construction.

1.4 Write the name of 3 base quantities and 3 derived quantities. 09101049

Ans: Base Quantities: Fundamental physical quantities from which other quantities are derived:

i. **Length:** Measured in meters (m).
ii. **Mass:** Measured in kilograms (kg).
iii. **Time:** Measured in seconds (s).

Derived Quantities: Formed by combining base quantities:

i. **Speed:** Defined as distance/time (m/s).
ii. **Area:** Defined as length × width (m^2).
iii. **Density:** Defined as mass/volume (kg/m^3).

1.5 Which SI unit will you use to express the height of your desk? 09101050

Ans: The height of a desk is typically expressed in centimeters (cm) or meters (m) for accurate and consistent measurement.

1.6 Write the name and symbols of all SI base units. 09101051

Ans: There are **seven SI base units**:

i. **Length:** Meter (**m**)
ii. **Mass:** Kilogram (**kg**)
iii. **Time:** Second (**s**)
iv. **Electric current:** Ampere (**A**)
v. **Temperature:** Kelvin (**K**)
vi. **Amount of substance:** Mole (**mol**)
vii. **Intensity of light:** Candela (**cd**)

1.7 Why is a prefix used? Name three sub-multiples and three multiples prefixes with their symbols. 09101052

Ans: Prefixes simplify the expression of very large or very small numbers by scaling the base unit. They make communication more efficient and measurements easier to read.

- **Sub-multiples:**

i. **Milli (m):** 10^{-3} (e.g., 1 mm = 10^{-3} m)

ii. **Micro (μ):** 10^{-6} (e.g., 1 μm = 10^{-6} m)

iii. **Nano (n):** 10^{-9} (e.g., 1 ns = 10^{-9} s)

- **Multiples:**

i. **Kilo (k):** 10^3 (e.g., 1 km = 10^3 m)

ii. **Mega (M):** 10^6 (e.g., 1 MJ = 10^6 J)

iii. **Giga (G):** 10^9 (e.g., 1 GHz = 10^9 Hz)

1.8 What is meant by: **09101053**

(a) 5 pm (b) 15 ns (c) 6 μm (d) 5 fs

Ans: (a) 5 pm = 5×10^{-12}m

(b) 15 ns = 15×10^{-9}s

(c) 6 μm = 6×10^{-6}m

(d) 5 fs = 5×10^{-15}m

1.9 (a) For what purpose a Vernier Calipers is used? **09101054**

(b) Name its two main parts.

(c) How is least count found?

(d) What is meant by zero error?

Ans: (a) A Vernier Caliper is an instrument used to measure small lengths with high precision, down to 1/10th of a millimeter. It is commonly used to measure the thickness, diameter, width, or depth of an object.

(b) The Vernier Caliper has two parts:

i. **Main Scale**: This scale has markings of **1 mm** each.

ii. **Vernier (sliding) Scale**:. The Vernier scale is **9 mm** long and divided into **10 equal parts**.

(c) The **least count** of a Vernier Caliper is the difference between the value of one main scale division (M.S) and one Vernier scale division (V.S).

Least count = 1 M.S div - 1 V.S div

Least count = 1 mm - 0.9 mm = 0.1 mm

Alternatively, the least count can also be determined by dividing the length of one small division on the main scale by the total number of divisions on the Vernier scale:

Least count = 1 mm / 10 = 0.1 mm.

(d) Zero error will exist if zero of vernier scale is not coinciding with zero of the vernier scale. There are two types of errors:

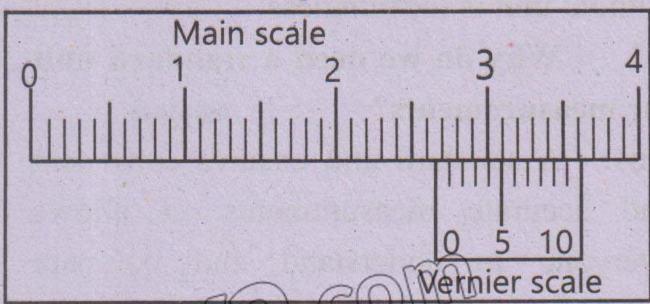
i. Positive zero error

Zero error will be positive if zero of vernier scale is on the right side of the zero of the main scale.

ii. Negative zero error

Zero error will be positive if zero of vernier scale is on the left side of the zero of the main scale.

1.10 State least count and Vernier scale reading as shown in figure and hence, find the length. **09101055**



Ans: Least Count

The least count of a vernier calipers is the value of the smallest measurement that can be taken using the vernier calipers.

To calculate the least count, we use the formula:

$$\text{Least count} = \frac{\text{One small division on main scale}}{\text{No.of division on vernier scale}}$$

$$\text{Least count} = \frac{1mm}{10} = 0.1\text{mm or } 0.01\text{cm}$$

Length

In the given figure

- The main scale reading is **2.6 cm**.
- The Vernier scale division is **5th division**.

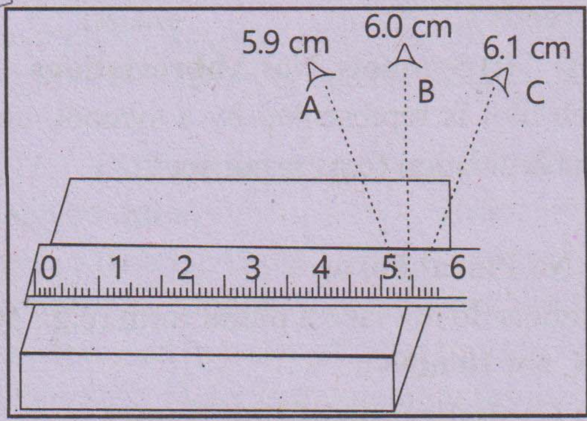
Therefore, the total length is:

Length = Main scale reading + Vernier scale reading × L.C

Length = 2.6cm + 5 × 0.01cm =2 .65cm

Thus, the length measured is **2.65 cm**.

1.11 Which reading out of A, B, and C shows the correct length and why? 09101056



Ans: The correct reading is **B** because figure shows that the eye is exactly above the reading point.

SLO based Additional Short Questions

Physical Quantities

Q1. Is a non-physical quantity has dimensions? 09101057

Ans: No, a non-physical quantity does not have dimensions because it is not related to fundamental physical units and is not measurable in physical terms.

International System of Units

Q2. Write the unit of charge in terms of base unit ampere and second. 09101058

Ans: The unit of charge in terms of base units is **ampere-second (A·s)**, derived from the relationship **Q=I.t**

Q3. Express the unit of pressure "pascal" in some other units. 09101059

Ans: The unit of pressure, **pascal (Pa)**, can be expressed as $1Pa = 1N/m^2$

Q4. Which SI base unit is the only one that uses a prefix in its standard form? 09101060

Ans: The kilogram is the only base unit that has prefix.

Scientific Notation

Q5. Express the following into scientific notation. 09101061

Ans:

(a) 0.00534m
5.34×10^{-3}m

(b) 2574.32 kg
2.57432×10^{3}kg

(c) 0.45m
4.5×10^{-1}m

(d) 0.004 kg
4.0×10^{-3}kg

(e) 186000 s
1.86×10^{5} s

Prefixes

Q6. What are the key rules for writing SI unit symbols and prefixes correctly? 09101062

Ans: (i) Symbols, Not Abbreviations

Each unit is represented by a symbol, not an abbreviation (e.g., **s**, not **sec**).

(ii) No Plural Form

Symbols do not take a plural form (e.g., **10 mN**, not **10 mNs**).

(iii) Capitalization of Unit Names

Full unit names are written in lowercase, except **Celsius**. (e.g., metre, second, newton)

(iv) Uppercase for Certain Symbols

Symbols appear in lowercase, except **L** for liter and symbols named after scientists (e.g., **N** for newton).

(v) Prefix Placement

Prefixes are written directly before the unit (e.g., **ms**, not **m, s**).

(vi) Spacing Between Units

Units are written with one space apart (e.g., **N m**, not **Nm**).

(vii). No Compound Prefixes

Compound prefixes are not allowed (e.g., **7 ps**, not **7 μμs**).

Measurements

Q7. Why must numbers have the same exponent for addition or subtraction, and how can you make the exponents equal? 09101063

Ans: Numbers must have the same exponent for addition or subtraction because the operation can only be performed on like terms. If the exponents are different, adjust the decimal point to make the exponents equal before performing the operation.

Q8. What are the essential laboratory safety rules to follow during experiments? 09101064

Ans:

(i) Handle all apparatus and chemicals carefully and correctly.

(ii) Always check the label on the container before using the substance it contains.

(iii) Do not taste any chemical unless otherwise instructed by the teacher.

(iv) Do not eat, drink, or play in the laboratory.

(v) Do not tamper with the electrical mains and other fittings in the laboratory.

(vi) Never work with electricity near water.

(vii) Don't place flammable substances near naked flames.

(viii) Wash your hands after all laboratory work.

Q9. Define unit. Write down two types of unit. 09101065

Ans. The standard measurement of any quantity if called its units.

There are two types of units:

(i) Base units

(ii) Derived units

Q10. Define least count of measuring instrument. Give examples. 09101066

Ans. Least count is the smallest measurement that can be taken accurately with an instrument.

Instrument	Range	Least count
Measuring tape	1 cm to several metres	1 mm
Metre rule	1 mm to 1 m	1 mm
Vernier Callipers	0.1 mm to 15 cm	0.1 mm
Micrometer Screw Gauge	0.01 mm to 2.5 cm	0.01 mm

Q11. Define zero error of an instrument. **09101067**

Ans. Zero error of an instrument: A systematic error that occurs when the instrument reads a value other than zero when the true value is zero.

Q12. Write down formula for calculating least count of (a) Screw gauge (b) Vernier Callipers. **09101068**

Ans. (a) Least count of screw gauge is calculated by formula:

$$\text{Least count} = \frac{\text{Pitch of screw guage}}{\text{No.of divisoon on circular scale}}$$

(b) Least count of Vernier calipers:

Usually, the least count is found by dividing the length of one small division of main scale by the total number of divisions on the Vernier scale which is again $1\text{ mm}/10 = 0.1\text{mm}$.

Alternatively, the least count can also be determined by dividing the length of one small division on the main scale by the total number of divisions on the Vernier scale:

Least count = 1 mm / 10 = 0.1 mm.

Q13. Define pitch of screw gauge. **09101069**

Ans. When the thimble makes one complete turn, the spindle moves **0.5 mm (1 scale division)** on the main scale. This movement is called the **pitch** of the screw gauge.

Q14. Why area is derived quantity? Explain. **09101070**

Ans. Area is a derived quantity because it is calculated by multiplying two base quantities, length and width. It is expressed in terms of square units, such as m^2.

Q15. Differentiate between base and derived units. **09101071**

Ans. (i) Base Units

Definition: Fundamental units that cannot be expressed in terms of other units.

Examples: Meter (m), kilogram (kg), second (s), Kelvin (K), etc.

(ii) Derived Units

Definition: Units that can be expressed in terms of base units.

Examples: Speed (m/s), force ($N = kg\,m/s^2$), energy ($J = kg\,m^2/s^2$), etc.

Q16. Name some repetitive processes occurring in nature that could serve as a reasonable time standard. **09101072**

Ans:

(i) The rotation of the Earth on its axis.

(ii) The revolution of the Earth around the Sun.

(iii) The vibration of a cesium-133 atom.

(iv) The oscillation of a pendulum.

Errors in measurements

Q17. Identify Personal, Systematic, and Random Errors: **09101073**

(i) Your eye level may move a bit while reading the meniscus.
Personal Error

(ii) Air current may cause the balance to fluctuate.
Random Error

(iii) The balance may not be properly calibrated.
Systematic Error

(iv) **Some of the liquid may have evaporated while it is being measured.**

Random Error

Significant figures

Q18. How many significant figures are there in each of the following? 09101074

(i) **1.25×10^2**

3 significant figures

(ii) **12.5 cm**

3 significant figures

(iii) **0.125 m**

3 significant figures

(iv) **0.000125 km**

3 significant figures

Q19. Differentiate between systematic and random errors. 09101075

Ans. Difference between systematic and random errors:

Systematic Errors	Random error
Systematic errors refer to errors that influence all measurements of a particular type in the same way, resulting in consistent differences in readings.	Random errors occur when repeated measurements of the same quantity produce different results under the same conditions.
These errors may arise from factors such as zero error, poor calibration of instruments, or incorrect markings on the scale.	These errors are caused by unpredictable factors, and the experimenter has little or no control over them. They may arise due to fluctuations in environmental conditions, such as changes in temperature, pressure, humidity, or voltage.
Minimizing Systematic Errors: Comparing the instrument with another one known to be more accurate or applying a correction factor to adjust the measurements.	**Minimizing Random Errors:** Taking multiple readings and calculating the average or mean value. For example, when measuring the time of oscillations of a pendulum, the time for several oscillations (e.g., 30 oscillations) is measured, and the average time for one oscillation is then calculated.

(C) Constructed Response Questions

1.1 In what unit will you express each of the following? 09101076

a) **Thickness of a five-rupee coin:** Millimeter (mm)

b) **Length of a book:** Centimeter (cm) or millimeter (mm)

c) **Length of football field:** Meters (m) or yards (yd)

d) **The distance between two cities:** Kilometer (km)

e) **Mass of five-rupee coin:** Gram (g)

f) **Mass of your school bag:** Gram (g) or kilogram (kg)

g) **Duration of your class period:** Minutes or hours

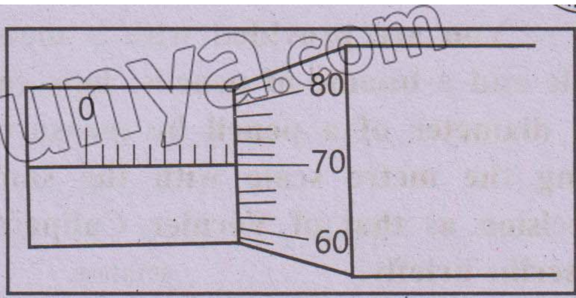
h) **Volume of petrol filled in the tank of a car:** Litre

i) **Time to boil one litre milk:** Minutes

1:2 Why might a standard system of measurement be helpful to a tailor? 09101077

Ans: A standard system of measurement is essential for a tailor because it ensures uniformity and consistency in the garments being made. With standardized units such as centimeters or inches, a tailor can accurately measure fabric, seams, and clothing sizes to produce well-fitting garments. This prevents errors and misunderstandings when dealing with customers, suppliers, and manufacturers, ensuring that all parties are using the same measurement units.

1.3 The minimum main scale reading of a micrometer screw gauge is 1 mm and there are 100 divisions on the circular scale. When the thimble is rotated once, 1 mm is its measurement on the main scale. What is the least count of the instrument? The reading for the thickness of a steel rod as shown in the figure. What is the thickness of the rod? 09101078



Ans: Least count

The least count of a micrometer screw gauge is the value of the smallest measurement that can be taken using the instrument.

Least count= $\frac{\text{Pitch of screw guage}}{\text{No.of divison on circular scale}}$

Least count= $\frac{1mm}{100}$

Least count= 0.01mm or 0.001cm

Thickness

Main scale reading shown in figure=9+0.5mm=9.5mm

Circular scale reading shown in figure=70

Thickness= Main scale reading + Circular scale reading × L.C

Thickness= 9.5mm+70 × 0.01mm

Thickness=9.7mm

1.4 State the similarities and differences between Vernier Calipers and micrometer screw gauge. 09101079

Ans: Similarities:

- Both are precision measuring instruments used to measure the length, diameter, and thickness of small objects.
- Both use a scale (main scale and secondary scale) to measure.
- Both are widely used in mechanical workshops and laboratories to measure precise dimensions.

Differences:

#	Vernier Calipers	Micrometer Screw Gauge
i.	Measures internal/external dimensions, and depth.	Measures the external dimensions of small objects (like thickness of rods).
ii.	Least count is 0.1 mm or 0.01cm.	Least count is 0.01 mm or 0.001cm.
iii.	Less precise than a micrometer screw gauge.	More precise for smaller measurements.
iv.	Larger range (from a few millimeters to several centimeters).	Smaller range (typically up to 25 mm).
v.	Versatile for different dimensions.	Specifically for measuring thickness or diameter of small objects.

1.5 You are provided with a metre scale and a bundle of pencils; how can the diameter of a pencil be measured using the metre scale with the same precision as that of Vernier Calipers? Describe briefly. 09101080

Ans: To measure the diameter of a pencil using a metre scale with precision comparable to Vernier Calipers, you can follow these simple steps

i. Arrange the Pencils:

Take a number of pencils (say 10 or more) and place them tightly together in a row so that they are in contact with each other and aligned side-by-side.

ii. Measure the Length:

Use the metre scale to measure the total width of the bundle of pencils. Let's denote this measurement as **L**.

iii. Count the Number of Pencils:

Count the total number of pencils in the row. Denote this number as **n**.

iv. Calculate the Diameter:

The diameter of one pencil can be calculated by dividing the total width of the bundle by the number of pencils:

$$\text{Diameter of one pencil} = \frac{L}{n}$$

1.6 The end of a metre scale is worn out. Where will you place a pencil to find the length? 09101081

Ans: If the end of a metre scale is worn out, you should place the pencil at the **beginning** of the scale (where the zero mark is still clearly visible) to ensure that you are measuring from the accurate starting point. The worn end can lead to incorrect readings, so avoiding it is essential for accurate measurements.

1.7 Why is it better to place the object close to the metre scale? 09101082

Ans: It is better to place the object close to the metre scale to minimize errors caused by parallax and the possibility of the object being misaligned. Placing the object too far from the scale may also cause inaccuracies due to the length and alignment of the measuring instrument, which could lead to a greater chance of human error in reading the measurement.

1.8 Why is a standard unit needed to measure a quantity correctly? 09101083

Ans: A standard unit is necessary to measure a quantity correctly because it ensures consistency, accuracy, and comparability of measurements. Without standardized units, different people or countries could use different measurement systems, leading to confusion and inconsistency in data. A standard unit allows for universal understanding and accurate communication of measurement results.

1.9 Suggest some natural phenomena that could serve as a reasonably accurate time standard. 09101084

Ans: Some natural phenomena that could serve as reasonably accurate time standards include:

i. Earth's Rotation: The rotation of the Earth, which defines the day, can be used as a time standard.

ii. Pendulum Oscillations: The oscillation of a pendulum with a consistent period is used in clocks to measure time.

iii. Atomic Clock: The vibrations of atoms, such as cesium, can be used as an accurate timekeeping standard (used in atomic clocks).

1.10 It is difficult to locate the meniscus in a wider vessel. Why?

09101085

Ans: It is difficult to locate the meniscus in a wider vessel because the curvature of the meniscus becomes less pronounced as the diameter of the vessel increases. In smaller vessels, the meniscus is more visible due to the surface tension of the liquid, but in wider vessels, the liquid's surface is flatter and harder to observe, making it difficult to determine the exact level of the liquid.

1.11 Which instrument can be used to measure: **09101086**

i. Internal diameter of a test tube.

ii. Depth of a beaker.

Ans: (i) Vernier Calipers can be used to measure the internal diameter of a test tube. It can measure both internal and external dimensions by using the appropriate jaws.

(ii) Vernier Calipers can be used to measure the depth of a beaker. A **measuring tape** can also be used for larger beakers.

(D) Comprehensive Questions

1.1 What is meant by base and derived quantities? Give the names and symbol of SI base units.

09101087

Answer: See Question number Q.3

1.2 Give three examples of derived unit in SI. How are they derived from base units? Describe briefly.

09101088

Ans:

i. Newton (N) (Unit of Force)

Derived from: Kilogram (kg), meter (m), and second (s)

Relationship:

Force is defined by Newton's second law as **F=ma**, where F is force, m is mass, and a is acceleration.

Acceleration (a) is the rate of change of velocity (m/s):

$$a = \frac{m/s}{s} = m/s^2$$

Therefore, the unit of force is:

$$\text{Newton} = kg.\ m/s^2$$

Thus, 1 Newton is the force needed to accelerate 1 kilogram of mass at 1 meter per second squared.

ii. Joule (J)(Unit of work)

Derived from: Kilogram (kg), meter (m), and second (s)

Relationship:

Work is the product of force and displacement:

$$\mathbf{W=F\times d}$$

We know that force (F) has the unit kg. m/s^2 and displacement (d) has the unit m.

Therefore, the unit of work is:

$$\text{Joul(J)} = kg.\ m^2/s^2$$

Hence, 1 Joule is the work done when a force of 1 Newton moves an object 1 meter in the direction of the force.

iii. Pascal (Pa) (Unit of Pressure)

Derived from: Kilogram (kg), meter (m), and second (s)

Relationship:

Pressure is defined as force per unit area:

$$P=\frac{F}{A}$$

The unit of force (F) is Newton=kg. m/s^2 and area (A) is measured in square meters (m^2)

Therefore, the unit of pressure is:

$$\text{Pascal(pa)} = \frac{N}{m^2} = \frac{kg.m/s^2}{m^2} = kg\ m^{-1}s^{-2}$$

Thus, 1 Pascal is the pressure exerted when 1 Newton of force is applied uniformly over an area of 1 square meter.

1.3 Identity and explain the reason for human errors, random errors and systematic errors in experiments. 09101089

Ans: See Question number Q.15

1.4 Differentiate between precision and accuracy of a measurement with examples. 09101090

Ans: See Question number Q.18

(E) Numerical Problems

1.1 Calculate the number of second in a (a) day (b) week (c) month and state your answer using SI prefixes. 09101091

Solution:

a) Day

1 day = 24 hours, 1 hour = 60 minutes,

1 minutes = 60 seconds

Number of seconds in a day

$= 24 \times 60 \times 60 = 86400$

Or

$=86.4 \times 10^3 s$

Or

=86.4ks

b) Week

1 week = 7 days, 1 day = 86400 s

So,

Numbers of seconds in a week $= 7 \times 86400$

$= 604800$ seconds

Or

$= 604.8 \times 10^3$ seconds

Or

= 604.8 ks

c) Month

Assuming a month has approximated 30 days.

1 month = 30 days, 1 day = 86400 seconds

So,

Number of seconds in a month is:

$= 30 \times 86400$

= 2592000 seconds

Or

$= 2.592 \times 10^6$ seconds

Or

= 2.592 Ms

1.2 State the answer of problem 1.1 in scientific notation. 09101092

Solution:

a) Day

1 day = 86400s

In scientific notation, the number of seconds in a day is $= 8.64 \times 10^4 s$

b) Week

1 week = 604800 seconds

In scientific notation, the number of seconds in a week is $= 6.04 \times 10^5 s$

c) Month

1 month = 2592000 seconds

In scientific notation, the number of seconds in a week is $= 2.592 \times 10^6 s$

1.3 Solve the following addition or subtraction. State your answers in scientific notation. 09101093

a) $\mathbf{4 \times 10^{-4} + 3 \times 10^{-5} kg}$

b) $\mathbf{5.4 \times 10^{-6} - 3.2 \times 10^{-5}}$

Solution:

a) $\mathbf{4 \times 10^{-4} + 3 \times 10^{-5} kg}$

To add, express the numbers with the same exponent

$= 4 \times 10^{-4} + 0.3 \times 10^{-4}$

$= 4.3 \times 10^{-4}$kg

b) $5.4 \times 10^{-6} - 3.2 \times 10^{-5}$

To subtract, express the numbers with the same exponent

$= 0.54 \times 10^{-5} - 3.2 \times 10^{-5}$

$= -2.66 \times 10^{-5}$m

1.4 Solve the following addition or subtraction. State your answer in scientific notation. **09101094**

a) $(5 \times 10^4\text{m}) \times (3 \times 10^{-2}\text{m})$

b) $\frac{6\times10^8\text{kg}}{3\times10^4\text{m}^3}$

(a) $15 \times 10^{4-2}$ m^2 **(B)** 1.5×10^3m^2

Solution:

a) $(5 \times 10^4\text{m}) \times (3 \times 10^{-2}\text{m})$

$(5 \times 3) \times (10^4 \times 10^{-2})(m \times m)$

$= 15 \times 10^{4-2}$ m^2

$= 15 \times 10^2$m^2

Or

$= 1.5 \times 10^{2+1}$ m^2

$= 1.5 \times 10^3$m^2

$= 15 \times 10^2$m^2

b) $\frac{6\times10^8\text{kg}}{3\times10^4\text{m}^3}$

$= \frac{6}{3}\times\frac{10^8}{10^4}\times\frac{\text{kg}}{\text{m}^3}$

$=2\times10^{8-4}$ kgm^{-3}

$=2\times10^4$ kgm^{-3}

1.5 Calculate the following and state your answer in scientific notation.

09101095

$\frac{(3\times10^2\text{kg})\times(4.0\text{kg})}{5\times10^2\text{s}^2}$

Solution:

$\frac{(3\times10^2\text{kg})\times(4.0\text{km})}{5\times10^2\text{s}^2}$

$=\frac{(3\times10^2\text{kg})\times(4.0\times10^3\text{m})}{5\times10^2\text{s}^2}$

$=\frac{(3\times4.0)}{5}\times10^2\times10^3\times10^{-2}$kgms^{-2}

$=\frac{12}{5}\times10^{2+3-2}$kgms^{-2}

$=2.4\times10^3$kgms^{-2}

1.6 State the number of significant digits in each measurement. **09101096**

a) 0.0045m b) 2.047m c) 3.40m

d) 3.420×10^4m

Solution:

a) 0.0045m

There are 2 significant figure in 0.0045 because zeros on left side of first significant figure are not significant.

b) 2.047 m

There are 4 significant figures because all accurately known digits are significant, also the zero between two significant figure is significant.

c) 3.40m

There are 3 significant figures because all accurately known digits are significant, also final and ending zero is significant.

d) 3.420×10^4m

There are 4 significant figures because all the digits before the exponent are significant.

1.7 Write in scientific notation:

a) 0.0035m b) 206.4×10^2m

Solution: **09101097**

a) 0.0035m

$= 3.5 \times 10^{-3}$m

b) 206.4×10^2m

$= 2.064 \times 10^4$m

1.8 Write using correct prefixes:

a) 5.0×10^4cm b) 580×10^2g

c) 45×10^{-4}s **09101098**

Solution:

a) 5.0×10^4cm

Centi = c = 10^{-2}

So,

$= 5.0\times10^4\times10^{-2}$m

$= 5.0 \times 10^{4-2}$m

$= 5.0 \times 10^{2}$m

$= 0.5 \times 10^{2+1}$m

$= 0.5 \times 10^{3}$m

So, kilo = K=10^3

= 0.5 km

b) 580×10^2g

$=58.0 \times 10^{2+1}$g

$=58.0 \times 10^{3}$g ∴ kilo=k=10^3

So, =58kg

c) 45×10^{-4}s

$= 4.5 \times 10^{-3}$s

= 4.5 ms

1.9 Light year is a unit of distance used in Astronomy. It is the distance covered by light in one year. Taking the speed of light as 3.0 10^8 ms^{-1}, calculate the distance. 09101099

Solution:

Given data

Speed of light = c= $3 \times 10^8 ms^{-1}$

Time=t= 1 year= $1 \times 365 \times 24 \times 60 \times 60$

Time = t = 3.15×10^7s

To find

Distance covered by light = S = ?

Distance = speed of light × time

$= 3 \times 10^8 \times 3.15 \times 10^7$

$=9.45 \times 10^{15}$m

Result

Hence the distance travelled by the light in one year is 9.45×10^{15}m.

1.10 Express the density of mercury given as 13.6 g cm^{-3} in kg m^{-3}. 09101100

Solution:

Given data

Density of mercury = $13.6 \frac{g}{cm^3}$

To find

Density of mercury in $\frac{kg}{m^3}$= ?

$1 \frac{g}{cm^3} = 1000 \frac{kg}{m^3}$

So,

Density of mercury in kgm^{-3} is = 13.6 ×1000 kgm^{-3}

$= 1.36 \times 10^4 kgm^{-3}$

Result

Hence the density of mercury is

$1.36 \times 10^4 kgm^{-3}$