Unit 1 Physical Quantities and Measurements

1. What are physical and non-physical quantities?

Physical Quantities: *Physical quantities are quantities that can be measured directly or indirectly using tools and instruments, such as the length of an object using a ruler, the time duration of an event using a clock.*

They form the foundation of physics and are used to express its laws and principles.

Non-physical Quantities: *Quantities that cannot be measured using tools and instruments. They mostly help to understand and analyze human behavior, emotions, and social interactions.*

Examples include love, affection, fear, wisdom, and beauty, which often pertain to the perception or interpretation of the observer.

**** 2. Can a non-physical quantity be measured? If yes, then how?**

No, non-physical quantities (e.g., love, fear) cannot be measured using tools or instruments. They are subjective and lack numerical value or units.

3. Is a non-physical quantity has dimensions?

No, non-physical quantities do not have dimensions because they cannot be measured.

4. Complete the following table.

Feature	Physical Quantity	Non-Physical Quantity
1. Measurement	**Yes**	**No**
2. Instrument used	Yes (e.g., ruler, clock)	No
3. Numerical value and unit	Yes (e.g., meters, seconds)	No
4. Examples	1. Length 2. Temperature	1. Love 2. Fear

**** 5. What is difference between base quantities derived physical quantities?**

Base Quantities: *Quantities selected arbitrarily by scientists to play a key role in describing physical phenomena.*

Base quantities are length, mass, time, temperature, electric current, etc.

Derived Physical Quantities: *Quantities that can be described in terms of one or more base quantities.*

For example, speed is a derived quantity depending on distance and time, and density is a derived quantity described in terms of mass and volume.

**** 6. What is measurement? Name its two parts.**

Measurement is a process of comparison of an unknown quantity with a widely accepted standard quantity.

Its two parts are:

(i) A number (magnitude).

(ii) A unit (standard of measurement).

***7. What is a Unit?**

The standard amount of a physical quantity, which is used to compare larger or smaller amounts, is called the unit.

8. Which SI base unit has a prefix in its name?

The kilogram is the only base unit that has a prefix.

**** 9. Why do we need a standard unit for measurements?**

Standardized units of measurement are necessary to avoid confusion, enable efficient trade and business, and facilitate the exchange of scientific information among countries.

For example, different countries previously used their own units, which created problems in trade and scientific exchanges.

***10. What is the International System of Units (SI)? Also write its advantage.**

The International System of Units (SI) is a system of measurement consisting of seven base units, recommended by the international committee on weights and measures in 1961.

Advantage: The SI system is used all over the world, enabling scientists to share and compare their observations and results easily.

**** 11. What is difference between Base Units and Derived Units? OR Write the name of 3 base quantities and 3 derived quantities. OR Write the name and symbols of all SI base units. OR Give three examples of derived unit in SI. How are they derived from base units? Describe briefly.**

Base Units: *Base units cannot be derived from one another and cannot be resolved into anything more basic.*

No.	Physical quantity	Unit	Symbol
1.	Length	metre	m
2.	Mass	kilogram	kg
3.	Time	second	s
4.	Temperature	kelvin	K
5.	Electric current	ampere	A
6.	Intensity of light	candela	cd
7.	Amount of substance	mole	mol

Derived Units: *Derived units are the units of quantities that can be expressed in terms of base units.*

For example,

$$Area = length \times breadth$$
$$Area = metre \times metre$$
$$Area = metre^2$$
$$Area = m^2$$

$$Speed = \frac{distance}{time}$$
$$Speed = \frac{metre}{second}$$
$$Speed = \frac{m}{s}$$

$$Speed\ = ms^{-1}$$

$$Force = mass \times acceleration$$
$$Force = kg \times ms^{-1}$$
$$Force = N\ (newton)$$

No.	Physical quantity	Unit	Symbol
1.	Area	square metre	m^2
2.	Volume	cubic metre	m^3
3.	Speed	metre per second	ms^{-1}
4.	Force	newton	N
5.	Pressure	pascal	Pa
6.	Electric charge	coulomb	C
7.	Plane angle	radian	rad

$100\ kg$	$1\ quintal$
$10\ quintal\ or\ 1000\ kg$	$1\ tonne$
$1\ m$	$100\ cm$
$1\ cm$	$10\ mm$
$1\ km$	$1000\ m$
$1\ mm$	$10^{-3}\ m$
$1\ cm$	$10^{-2}\ m$
$1\ km$	$10^{3}\ m$

**** 12. Which SI unit will you use to express the height of your desk?**

Metre (m) or its sub-multiples e.g., centimetres, cm use to express the height of desk.

**** 13. Why prefix is used? Name three sub-multiples and three multiple prefixes with their symbols.**

Prefixes are words or symbols added before SI units to express quantities as multiples or sub-multiples of base units using powers of 10.

Prefixes helps simplify large or small quantities for convenience.

For example, $50{,}000{,}000\ m$ can be written as $5 \times 10^7\ m$, and $0.00004\ m$ can be written as $4 \times\ 10^{-5}\ m$.

Type	Prefix	Symbol	Powers of Ten
Sub-multiples	atto	a	10^{-18}
	femto	F	10^{-15}
	pico	p	10^{-12}
	nano	n	10^{-9}
	micro	M	10^{-6}
	milli	m	10^{-3}
	centi	c	10^{-2}
	deci	d	10^{-1}
Multiples	kilo	k	10^{3}
	mega	M	10^{6}
	giga	G	10^{9}
	tera	T	10^{12}
	peta	P	10^{15}
	exa	E	10^{18}

14. How are prefixes used with SI base units.

Prefixes such as milli (m), centi (c), kilo (k), mega (M), and giga (G) are added to the seven base units of the SI system to represent multiples or sub-multiples.

Some examples of prefixes in the SI system include:

- Length (metre, m): Millimetre (mm), Centimetre (cm), Kilometre (km)
- Mass (kilogram, kg): Milligram (mg), Gram (g), Kilogram (kg)

These prefixes represent multiples or sub-multiples of the base units.

**** 15. What is meant by: (a) 5 pm (b) 15 ns (c) 6 μm (d) 5 fs**

(a) $5\ picometres\ = 5\ \times\ 10^{-12}\ m$

(b) $15\ nanoseconds\ = 15\ \times\ 10^{-9}\ s$

(c) $6\ micrometres\ = 6\ \times 10^{-6}\ m$

(d) $5\ femtoseconds\ = 5\ \times\ 10^{-15}\ s$

***16. What is scientific notation?**

Scientific notation is a method of representing very large or very small numbers in a compact form. It expresses numbers as a product of a number between 1 and 10, multiplied by a power of 10.

This makes the numbers easier to read, compare, and use in calculations.

17. Why is scientific notation used?

Scientific notation is used to simplify the representation of very large or very small numbers. Without scientific notation, these numbers would take up much space, be difficult to read, and be challenging to work with in calculations. Scientific notation makes it easier to understand and manipulate these numbers.

***18. How do you write a number in scientific notation?**

To write a number in scientific notation:

(i) Move the decimal point until only one non-zero digit remains on the left.

(ii) Count how many places the decimal point has been moved.

(iii) The number of places moved becomes the 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.

19. Can you provide examples of large and small numbers in scientific notation?

(i) The average distance from the Sun to the Earth is$138{,}000{,}000\ km$ is written as $1.38 \times 10^8\ km$.

(ii) The diameter of a hydrogen atom is $0.000{,}000{,}000{,}052\ m$ is written as $5.2 \times 10^{-11}\ m$.

***20. What is a metre rule, and how is it used to measure length? Also define least count.**

A metre rule is commonly used in laboratories to measure length. The smallest division on a metre rule is 1 mm, which is known as the least count of the metre rule.

To measure the length of an object, place the zero of the metre rule at one edge of the object and read the measurement at the other edge.

***Least count:** The **least count** is the smallest measurement that can be accurately taken with an instrument.*

***21. What is parallax error?**

Parallax error occurs due to the incorrect position of the eye when taking measurements. This results in inaccurate readings.

It can be avoided by keeping the eye perpendicular to the scale reading to ensure an accurate measurement.

***22. What is a measuring tape, and what is its least count?**

A measuring tape is used to measure lengths ranging from $1\ mm$ to several metres. Its least count is $1\ mm$.

A measuring tape is primarily used to measure longer distances, typically over several metres.

**** 23. For what purpose, a Vernier Callipers is used?**

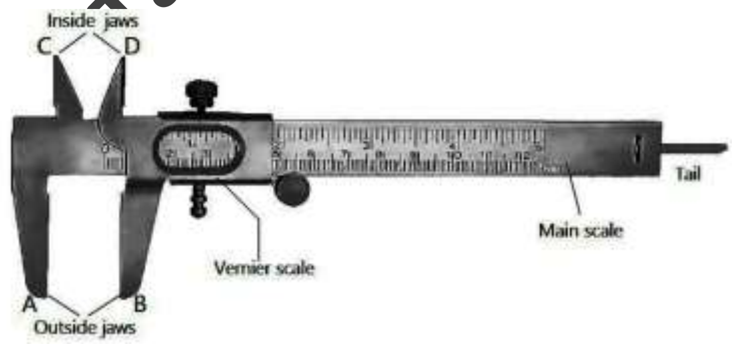
The Vernier Calliper is an instrument used to measure small lengths with high precision, down to $\frac{1}{10}$th of a millimetre.

It can measure the thickness, diameter, width, or depth of an object.

**** 24. What are the parts of the Vernier Calliper, and what are they used for?**

The Vernier Calliper has two jaws:

- **Jaws $(\boldsymbol{external})$:** Jaws A and B are used to measure the external dimensions of an object.
- **Jaws $(\boldsymbol{internal})$:** Jaws C and D are used to measure the internal dimensions of an object.
- Additionally, a narrow strip called the **tail or depth gauge** is used to measure the depth of a hollow object.



**** 25. How is the least count of a Vernier Calliper determined?**

The least count of a Vernier Calliper is the difference between one main scale division $(1\ mm)$ and one Vernier scale division $(0.9\ mm)$.

Hence,

$$\begin{aligned} least\ count &= 1\ M.S\ div\ -\ 1V.S\ div \\ &= 1\ mm\ -\ 0.9\ mm \\ &= 0.1\ mm \end{aligned}$$

The least count is usually found by dividing the length of one small division on the main scale by the total number of divisions on the Vernier scale. For example,

$$L.C = \frac{Smallest\ reading\ on\ main\ scale}{Total\ no.of\ divisions\ on\ vernier\ scale}$$

$$L.C = \frac{1\ mm}{10}$$

$$L.C = 0.1\ mm$$

$$L.C = 0.01\ cm$$

26. How is the length of an object measured using Vernier Callipers?

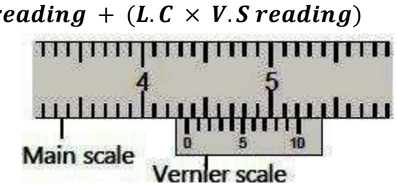
Suppose an object is placed between the two jaws, the position of the Vernier scale on the main scale is observed.

1. Read the main scale marking just in front of zero of the Vernier scale.
2. Find the Vernier scale marking or division which is in line with any of the main scale markings.

27. What is the formula to calculate the length of an object using Vernier Callipers? Explain with an example.

The formula to calculate the length of an object is:

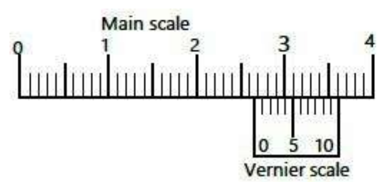
$$\boldsymbol{Length\ of\ object\ =\ M.S\ reading\ +\ (L.C\ \times\ V.S\ reading)}$$



For example, if the main scale reading before the zero of the Vernier scale is $4.3\ cm$ and the Vernier scale reading is 4 as shown in figure , then length of the object is:

$$\begin{aligned} Length &= \boldsymbol{M.S\ reading\ +\ (L.C\ \times\ V.S\ reading)} \\ &= 4.3\ +\ (0.01\ \times\ 4) \\ &= 4.34\ cm \end{aligned}$$

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



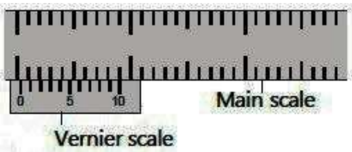
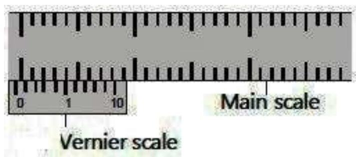
The least count of Vernier Callipers is $0.01\ cm$**.** The main scale reading before the zero of the Vernier scale is $2.6\ cm$ and the Vernier scale reading is 4 as shown in figure, then length of the object is:

$$\begin{aligned} Length &= \boldsymbol{M.S\ reading\ +\ (L.C\ \times\ V.S\ reading)} \\ &= 2.6\ +\ (0.01\ \times\ 4) \\ &= 2.64\ cm \end{aligned}$$

**** 29. What is zero error in Vernier Callipers, and when does it occur?**

Zero error occurs if, on joining the jaws of Vernier Callipers, the zeros of the main scale and Vernier scale do not exactly coincide with each other. This error in the instrument is called zero error.

***30. Difference Between Positive and Negative Zero Errors in Vernier Callipers.**

Positive Zero Error	Negative Zero Error
The zero of the Vernier scale is on the **right side** of the main scale zero. 	The zero of the Vernier scale is on the **left side** of the main scale zero. 
The instrument shows a length slightly **more** than the actual length.	The instrument shows a length slightly **less** than the actual length.
Note the Vernier scale division coinciding with any main scale division and multiply it by the least count.	Subtract the coinciding Vernier scale division from 10 and multiply the result by the least count.
The zero error is **subtracted** from the observed measurement.	The zero error is **added** to the observed measurement.
If 3 Vernier scale divisions coincide, the zero error is **0.3 mm** and subtracted.	If 3 Vernier scale divisions coincide, the zero error is **0.7 mm** and added.

***31. What is a Screw Gauge, and how is it used to measure small lengths?**

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.

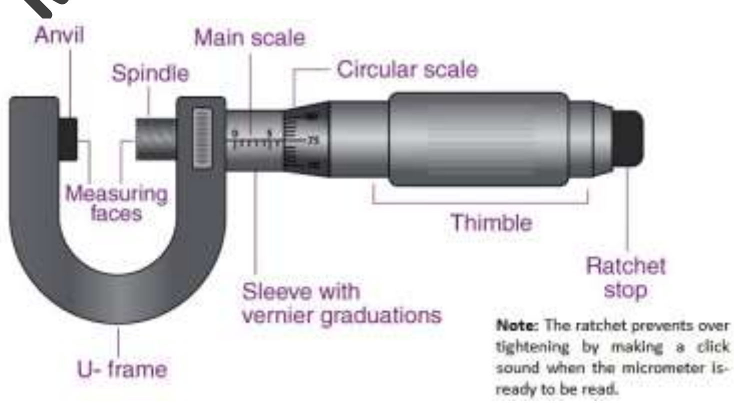
OR

Screw guage is an instrument which can measure length correct up to $0.01\ mm$.

It has two scales:

- **Main Scale:** Located on the sleeve, it has markings of 0.5 mm each.
- **Circular Scale:** Located on the thimble, it has 50 divisions. Some instruments may have main scale markings of 1 mm and 100 divisions on the thimble.

The main parts of screw gauge are shown in figure.



***32. What is the pitch of a screw gauge?**

The pitch of the screw gauge is the distance the spindle moves along the main scale when the thimble completes one full rotation.

For example, if the spindle moves 0.5 mm in one complete turn, the pitch is 0.5 mm.

33. Define least count of screw gauge.

The least count of a screw gauge is calculated using the formula

$$Least\ Count = \frac{Pitch\ of\ the\ Screw\ Gauge}{Number\ of\ Divisions\ on\ the\ Circular\ Scale}$$

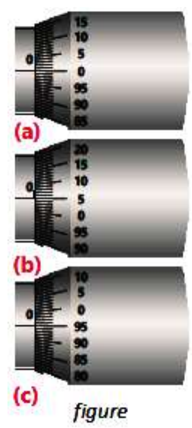
$$Least\ Count = \frac{0.5mm}{50}$$

$$Least\ Count = 0.01\ mm\ \ or\ 0.001\ cm$$

34. What is zero error in a screw gauge?

Zero error in a screw gauge occurs when the zero of the circular scale does not coincide with the horizontal line of the main scale when the anvil and spindle are fully closed (see figure).

35. How can zero error in a screw gauge be identified and corrected?

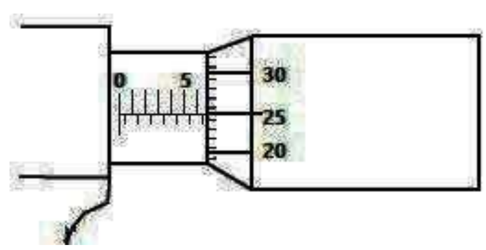


(a) If the zero of the circular scale **coincides** with the horizontal line, there is **no zero error** (see figure a).

(b) If the zero of the circular scale is **below** the horizontal line, the screw gauge will measure **slightly more** than the actual thickness. In this case, the zero error is **subtracted** from the observed measurement (see figure b).

(c) If the zero of the circular scale is **above** the horizontal line, the screw gauge will measure **slightly less** than the actual thickness. In this case, the zero error is **added** to the observed measurement (see figure c).

36. How can the thickness of a steel sheet be measured using a screw gauge?



Suppose a steel sheet is placed between the anvil and spindle, and the position of the circular scale is as shown in **figure.**

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

(ii) Read the circular scale marking that aligns with the main scale. This shows **25**.

The thickness of the steel sheet is calculated as:

$$\begin{aligned} Thickness &= M.S.R + (C.S.R \times Least\ Count) \\ &= 6.5\ mm + (25 \times 0.01\ mm) \\ &= 6.5\ mm + 0.25\ mm \\ &= 6.75\ mm. \end{aligned}$$

37. Which balance is the most precise for measuring mass, and what is its precision?

The most precise balance is the **digital electronic balance**, which can measure mass with a precision of $\mathbf{0.1\ mg}$.

38. Differentiate between mass and weight.

Mass	Weight
Mass is the measure of the **quantity of matter** in a body.	Weight is the **force by which a body is attracted toward the Earth**.
Measured in kilograms **(kg)** or **grams (g)**.	Measured in **Newtons (N)**.

39. How is mass measured using a physical balance?

The **mass** of an object is determined by comparing it with known standard masses, a process called **weighing**. In laboratories, a **physical balance** is used, which works on the **principle of levers**. The process of measurement is as follows:

(i) Level the base of the balance using levelling screws until the plumb line is exactly above the pointed mark.

(ii) Turn the knob to raise the pans of the balance. Check if the beam is horizontal and the pointer is at the centre of the scale. If not, adjust the balancing screws on the beam until it becomes horizontal.

(iii) Place the object to be weighed on the left pan.

(iv) Using forceps, place known weights from the weight box onto the right pan.

(v) Adjust the weights until the pointer remains on zero or oscillates equally on both sides of zero.

(vi) The total of standard masses (weights) in the right pan gives the mass of the object in the left pan.

40. How is the duration of an event measured using a stopwatch?

The duration of an event is measured by a stopwatch, which contains two needles: one for seconds and one for minutes.

The dial is divided into 30 big divisions, each further divided into 10 small divisions. Each small division represents one-tenth $\left(\frac{1}{10}\right)$ of a **second**, making $\frac{1}{10}$ of a second the least count of the **stopwatch**.

41. How is the stopwatch operated?

The stopwatch is operated by pressing a knob on the top to start the watch. Pressing the knob again stops it. After noting the reading, the knob is pressed again to reset the needles to zero.

42. Are there other types of stopwatches available?

Yes, modern electronic or **digital stopwatches** are available that can measure up to one-hundredth $\left(\frac{1}{100}\right)$ of a second.

43. What is a measuring cylinder and what is it used for?

A measuring cylinder is a cylinder made of glass or transparent plastic, with a scale marked in cubic centimeters (cm^3 or cc) or milliliters (mL).

It is used to find the **volume** of **liquids** and **non-dissolvable solids**.

44. How is the volume of liquid measured in a cylinder?

To measure the **volume** of a **liquid**, the level of the **liquid** in the **cylinder** is marked. The **cylinder** must be placed on a **horizontal surface**, and the eye should be at the same level as the **meniscus** of the **liquid's** surface.

The meniscus is the curved surface of the liquid;

For **water**, the surface curves downward, and the reading is taken at the bottom edge of the **meniscus**.

For **mercury**, which curves upward, the reading is taken at the top edge of the **meniscus**.

45. How is the volume of the solid body determined using a displacement can?

If the body does not fit into the measuring cylinder, an overflow can or displacement can with a wide opening is used. Place the displacement can on a horizontal table and pour water in it until it starts overflowing through its opening.

"Tie a piece of thread to the solid body and lower it gently into the **displacement can**. The body displaces water, causing it to overflow through the side opening. The displaced water is collected in a **beaker**, and its **volume** is measured using the **measuring cylinder**. This volume is equal to the volume of the solid body."

**** 46. Identify and explain the reasons for human errors, random errors and systematic errors in experiments.**

Measurements using tools and instruments are never perfect. They inherit some errors and differ from their true values. There are three types of experimental errors:

(i) Human Errors:

- These occur due to personal performance.
- Caused by limitation of human perception, such as the inability to perfectly estimate the position of the pointer on a scale.
- Can also arise due to faulty procedure to read the scale.
- Correct measurement needs to line up the eye right in front of the level.
- In timing experiments, the reaction time to start or stop the clock also affects the measured value.

Can be reduced by:

(i) Proper training, techniques and procedures

(ii) Avoiding distractions

(iii) Using **automated or digital instruments**

(ii) Systematic Errors

- Refer to effects that influence all measurements equally, causing a consistent difference in readings.
- Occur due to a definite rule, such as:
  - **(i)** Zero error of instrument
  - **(ii)** Incorrect marking

Can be reduced by:

- **(i)** Comparing with a more accurate instrument
- **(ii)** Applying a correction factor

(iii) Random Errors

- Occur when repeated measurements give different values under the same conditions.
- Caused by unknown or unpredictable factors such as sudden fluctuation in:
  - **(i)** Temperature
  - **(ii)** Pressure
  - **(iii)** Humidity
  - **(iv)** Voltage, etc.
- The experimenter has little or no control over it.

Can be reduced by:

- **(i)** Taking several readings and finding the average (mean) value
- **(ii)** For example, in pendulum experiments, the time for 30 oscillations is measured, then the average time of one oscillation is calculated.

47. What is uncertainty in measurement? State its cause, give an example, and expl how it can be reduced.

Uncertainty is the range of possible error in a measurement, showing how much the measured value may differ from the true value due to limitations of instruments or methods.

Cause of Uncertainty

- One reason is the type of instrument being used.
- Every measuring instrument is calibrated to a certain smallest division, which limits the degree of accuracy.

Example of Uncertainty

- Suppose we measure a length using a metre rule calibrated in millimetres.
- If the endpoint lies between 10.3 cm and 10.4 cm, and:
  - **(i)** It does not cross the midpoint → reading is 10.3 cm
  - **(ii)** It crosses or touches the midpoint → reading is 10.4 cm
- Thus, maximum uncertainty is ± 0.05 cm, which equals half the least count of the instrument (0.1 cm ÷ 2).

Reducing Uncertainty

- Small lengths (e.g., diameter of a wire) and short time intervals can have uncertainty reduced by:
  - **(i)** Taking multiple readings
  - **(ii)** Finding the average value

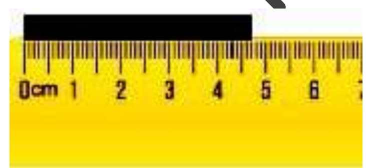
Example:

- Average time of one pendulum oscillation is found by timing 30 oscillations and dividing by 30.

****48. What are significant figures and how do they relate to measurement uncertainty?**

***Significant figures** (or **digits**) are the digits of a measurement that are reliably known. They include all the **accurately known digits** and the **first doubtful digit**, which is determined by estimation and has a probability of error.*

For example, when measuring the **length of a rod** with a ruler and the reading is between $4.6\ cm$ and $4.7\ cm$, the first student might estimate it as $4.6\ cm$, while the second estimates it as $4.7\ cm$. The accurately known digits are 4 and the doubtful digit is 6 or 7.



***49. What are the rules for determining the number of significant figures in a measurement?**

The following rules help determine the **significant figures** in a measurement:

(a) All digits from 1 to 9 are significant.
Example: 345 **m** has 3 significant figures.

(b) Zeros may or may not be significant:

- **(i)** Zero between digits is significant.
  Example: In $5.06\ m$, the zero between 5 and 6 is significant, so the number has 3 significant figures.
- **(ii)** Zeros on the left side of a measured value are not significant.
  Example: In $0.0034\ m$, the zeros before 3 and 4 are not significant, so the number has 2 significant figures.
- **(iii)** Zeros to the right of a decimal are significant.
  Example: In $2.40\ mm$, the zero after 4 is significant, so the number has 3 significant figures.
- **(iv)** In scientific notation, all digits before the exponent are significant.
  Example: In $3.50 \times 10^4\ m$, all digits (3, 5, and 0) are significant, so the number has 3 significant figures.

50. What is the difference between precision and accuracy in physical measurements?

***Precision** of a measurement refers to how **close together** a group of measurements are to each other.*

***Accuracy** of a measurement refers to how **close** the measured value is to some **accepted or true value**.*

**** 51. Differentiate between precision and accuracy of a measurement with examples.**

Precision refers to how close together a group of measurements are.

Accuracy refers to how close the measured value is to the true value.

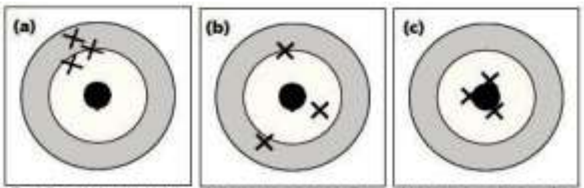
To explain this with a **target example**:

(i) **Precise but not accurate**: The arrows hit near each other but not near the bullseye. (Fig. a)

(ii) **Accurate but not precise**: The arrows hit near the bullseye but are spread out. (Fig. b)

(iii) **Accurate and precise**: The arrows hit near the center of the bullseye, indicating both precision and accuracy. (Fig. c)

This illustrates how precision and accuracy are related and can be visualized through the behavior of arrows on a target.



Precise not accurate Accurate not precise Accurate and precise

***52. How do you round off numbers to a specific number of significant figures?**

When rounding numbers to a certain number of significant figures, round to the nearest value. If the last digit is more than 5, increase the retained digit by one. If the last digit is less than 5, retain it as it is.

Examples:

(i) Round to 2 significant figures: $2.512 \times 10^3\ m$

Answer: $\mathbf{2.5 \times 10^3\ m}$

(ii) Round to 3 significant figures: 3.4567×10^4 kg

Answer: $\mathbf{3.46 \times 10^4\ kg}$

53. What is the rule when rounding numbers that end in 5?

If the number ends in 5:

(i) If the number before the 5 is **odd**, add 1 to the last digit.

(ii) If the number before the 5 is **even**, retain the last digit.

Examples:

(i) Round to 2 significant figures: $4.45 \times 10^2\ m$

Answer: $\mathbf{4.4 \times 10^2\ m}$

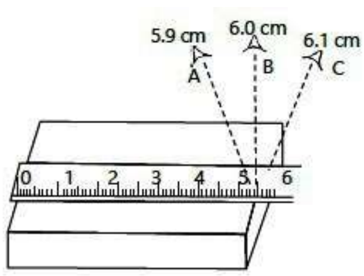
(ii) Round to 2 significant figures: $4.55 \times 10^2\ m$

Answer: $\mathbf{4.6 \times 10^2\ m}$

54. How can logic be applied while rounding numbers?

Logic is sometimes applied to determine the final value. For example, when rounding $4.452 \times 10^2\ m$ to 2 significant figures, the answer should be $\mathbf{4.5 \times 10^2\ m}$, as it is closer to $\mathbf{4.5 \times 10^2\ m}$ than to $\mathbf{4.4 \times 10^2\ m}$.

**** 55. Which reading out of A, B and C shows the correct length and why?**



- The correct reading should be the one where the ruler aligns properly with the object's length.
- Looking at the image, B (6.0 cm) appears to be the correct reading because it aligns well with the edge of the object.

Thus, B is the correct reading because it minimizes parallax error and aligns accurately with the scale.

**** 56. State the similarities and differences between Vernier Callipers and micrometer screw gauge.**

Similarities:

(i) Both are used to **measure small lengths with high precision**.

(ii) Both instruments have **two scales**.

(iii) Both have a **least count**.

(iv) Both can have **zero error**, and **zero correction method** can be applied.

(v) Both can measure length in **same units** (millimetres or centimetres).

Differences:

(i) Both have **different shapes**.

(ii) **Screw gauge** is used for **very small thickness** of wires or sheets.

(iii) **Vernier calliper** can measure **internal diameter, external diameter, and depth**, while screw gauge measures only **external dimensions**.

(iv) Both have **different measuring ranges**:
Vernier Calliper: **0.1 cm**
Screw Gauge: **0.01 mm to 2.5 cm**

(v) Both have **different least counts**:
Vernier Calliper: **0.1 mm**
Screw Gauge: **0.01 mm**

(vi) **Screw gauge gives more precision** as compared to Vernier Calliper.

57. What safety precautions should be followed in the laboratory?

1. Handle all apparatus and chemicals carefully and correctly.
2. Always check the label on the container before using the substance it contains.
3. Do not taste any chemical unless otherwise instructed by the teacher.
4. Do not eat, drink or play in the laboratory.
5. Do not tamper with the electrical mains and other fittings in the laboratory.
6. Never work with electricity near water.
7. Don't place flammable substance near naked flames.
8. Wash your hands after all laboratory work.