Chapter 1

Physical Quantities and Measurements

Define Physics ?

This field of observation and experimentation to understand about the world around us is known as science.

Differentiate between Physical and Non-Physical Quantities with Example?

Physical quantity :

All Measurable Quantity are called Physical quantity.

Exam : Such As length of an object using a ruler, time duration of an event using a clock, the temperature (the degree of hotness) of somebody using a thermometer. They are called physical quantities.

Non-physical quantities:

Non-physical quantities mostly help to understand and to analyse human behaviour, emotions and social interactions.

Exam : such as love, affection, fear, wisdom, and beauty cannot be measured using tools and instruments.

Differentiate Between Base and Derived Physical Quantities with Example.

Base quantities:

Base quantities are the quantities on the basis of which other quantities are expressed.

Exam : such as length, breadth, thickness, mass, volume, density, time, temperature, etc.

Derived physical quantities :

All the quantities which can be described in terms of one or more base quantities are called derived physical quantities.

For example:Speed is a derived quantity which depends on distance and time which are base quantities whereas density of a material is described in terms of mass and volume.

Speed=Distance/time

Density=Mass/Volume

How to Measurement of a Physical Quantity ?

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

What is Unit?

In the early days people used to measure length using hand or arm, foot or steps. This measurement may result in confusion as the measurement of different people may differ from each other because of different sizes of their hands, arms or steps. To avoid such confusion, there is a need of a standard so that measurement by any person may result the same. This standard of measurement is known as a unit.

Why unit are use?

Not very far in the past, every country in the world had its own units of measurements. However, problems were faced when people of different countries exchanged scientific information or traded with other countries using different units. Eventually, people got the idea of standardizing the units of measurements which could be used by all countries for efficient working and growth of mutual trade, business and share scientific information.

Define International System of Units?

The international committee on weights and measuresing 1961 recommended the use of a system consisted of seven base units known as international system of units, abbreviated as SI. This system is in use all over the world.

Differentiate between base and derived units ?

Base units :

Base units cannot be derived from one another and neither can they be resolved into anything more basic.

Derived units :

The units which can be expressed in terms of base units are called derived units.

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

1 C is the equivalent of 1 ampere-second,

$1\ C = 1\ A \cdot 1\ s$

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

Pascal is not the only unit of pressure. It is useful to understand some common conversions among these different units: 1 Pa = 0.00001 bar or 1 bar = 100,000 Pa. 1 Pa = 0.0000098692316931 atmosphere (standard) and 1 atm = 101.325 kPa.

Define SI Prefixes with example ?

The SI is a decimal system. Prefixes are used to write units by powers of 10. The big quantities like 50000000 m and small quantities like 0.00004 m are not convenient to write down. The use of prefixes makes them simple. The quantity 50000000 m can be written as 5×10^7 m. Similarly, the quantity 0.00004 m can be written as 4×10^{-5} m. Prefixes are the words or symbols added before SI unit such as milli, centi, kilo, mega, giga.

Convert into Prefixes Form.

(I) 5000 mm $= \frac{5000}{1000}$ m = 5 m

(ii) 50000 cm $= \frac{50000}{100}$ m = 500 m

(iii) 3000g $= \frac{3000}{1000}$ kg = 3 kg

(iv) 2000 μs = 2000×10^{-6} s= 2×10^{-3} s
= 2 ms

Define Scientific Notation ?

In scientific notation a number is expressed as some power of ten multiplied by a number between 1 and 10.The Moon is 384000000 metres away from the Earth. Distance of the moon from the Earth can also be expressed as 3.84 x10 m. This form of expressing a number is called the standard form or scientific notation.

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

Ans : yes

Define Metre Rule ?

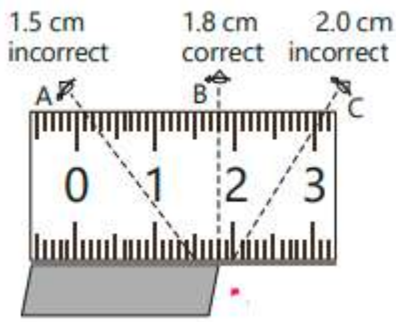
Metre Rule: Length is generally measured using a metre rule in the laboratory. The smallest division on a metre scale is 1 mm. The smallest measurement that can be taken with a metre rule is 1 mm. One millimetre is known as least count of the metre rule.

How to Measure Reading on Metre Rule?

To measure the length of an object, the metre ruler is placed in such a way that its zero coincides one edge of the object and then the reading in front of the other edge is the length of the object. One common source of error comes from the angle at which an instrument is read. Metre ruler should either be tipped on its edge or read when the person's eye is directly above the ruler.

Define parallax error?

If the metre ruler is read from an angle, such as from point A or C, the object will appear to be of different length. This is known as parallax error.



Write a Short Note on Vernier Calipers ?

It is an instrument used to measure small lengths down to 1/10th of a millimetre. It can be used to measure the thickness, diameter, width or depth of an object. The two scales on it are:

(a) A main scale which has marking of 1mm each.

(b) A Vernier (sliding) scale of length 9 mm and it is divided into 10 equal parts.

Define Least Count Of Vernier calipers ?

Least count of a Vernier Callipers is the difference between one main scale division (M.S) and one Vernier scale (V.S) division.

Hence,

Least count = 1 M.S div – 1V.S div

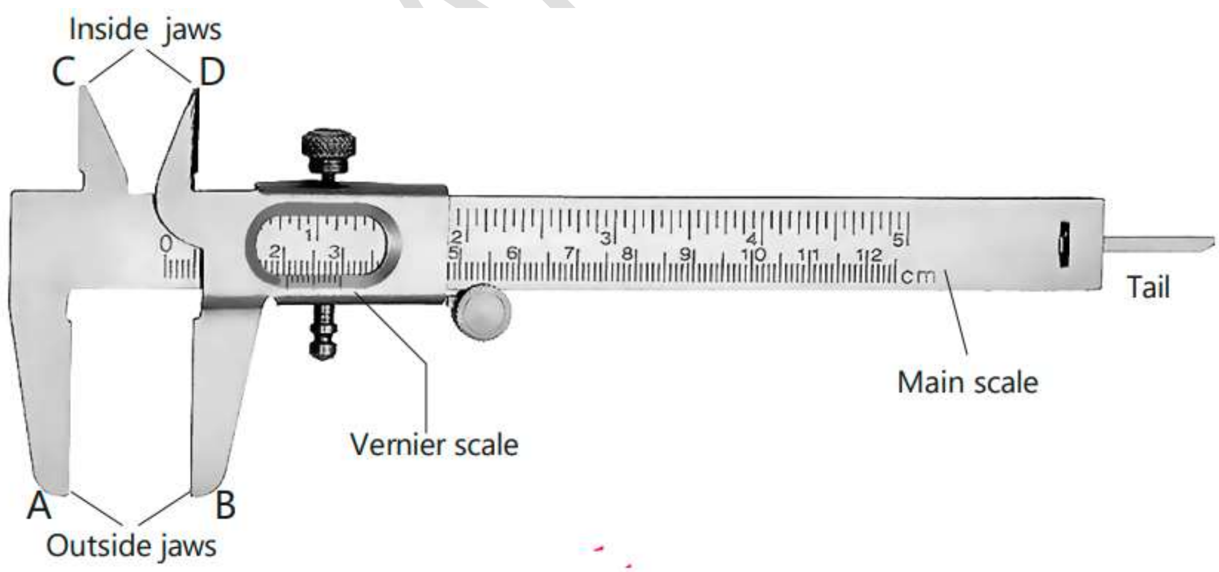
=1mm – 0.9 mm

=0.1 mm

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

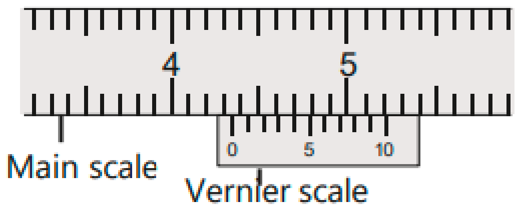
Explain structure of Vernier Calipers.

There are two Jaws A and B to measure external dimension of an object whereas jaws C and D are used to measure internal dimension of an object. A narrow strip that projects from behind the main scale known as tail or depth gauge is used to measure the depths of a hollow object.



How to Measurement Reading Using Vernier Callipers.

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



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

2. Find the Vernier scale marking or division which is in line with any of the main scale marking.

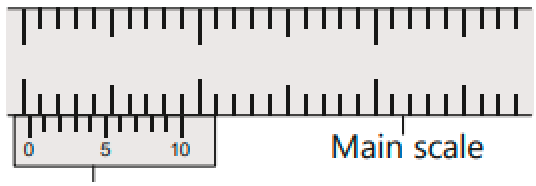
This shows: Length of object = Main scale reading + (Least count × Vernier scale reading).

$=4.3+0.01 \times 4=4.34$ cm

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

(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.**

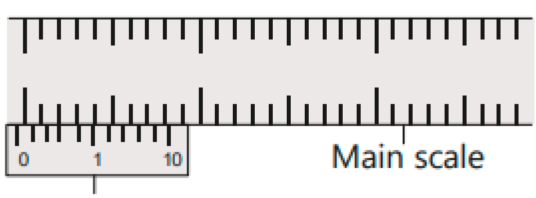
(b) If the zero of the Vernier scale is on the right side of the zero of the main scale (Fig.



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.

(c) If the zero of the Vernier scale is on the left side of the zero of the main scale (Fig.



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.

What is Micrometer Screw Gauge.

It is used to measure very small lengths such as diameter of a wire or thickness of a metal sheet. It has two scales: **(a)** The main scale on the sleeve which has markings of 0.5 mm each.

(b) The circular scale on the thimble which has 50 divisions. Some instruments may have main scale marking of 1 mm and 100 divisions on the thimble.

Define pitch of the screw gauge

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

Thus, its least count is:

Least count = Pitch of the screw gauge / No. of divisions on the circular scale

=0.5 mm/ 50

=1.12m

How to Checking for Zero Error.

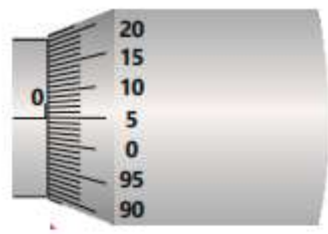
No zero error:

If the zero of the circular scale coincides with horizontal line, there is no zero error.

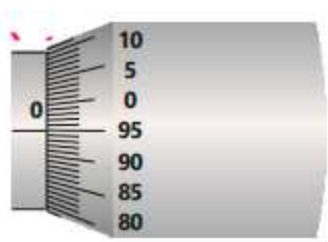
Zero error:

If it is not exactly in front of the horizontal line of the main scale on joining the anvil and spindle then there is a zero error in the screw gauge (Fig.

If zero of the circular scale is below the horizontal line then it will measure slightly more than the actual thickness and hence, **zero error will be subtracted** from the observed measurement.

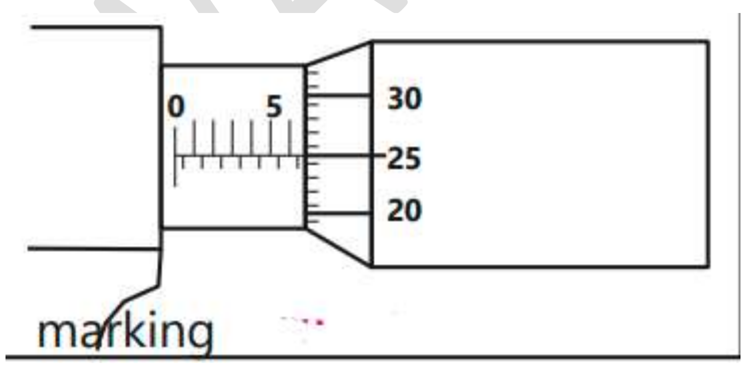


If the zero of the circular scale is above the horizontal line (Fig. , then it will show slightly less than the actual thickness and hence, the **zero error will be added** to the observed measurement.



How to Measurement Reading 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.



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

(b) Read the circular scale which is in line with the main scale. This shows 25. Hence, Thickness = main scale reading + (circular scale reading × L.C.)

$=6.5\text{ mm} + 25 \times 0.01\text{ mm}$

$=6.5\text{ mm} + 0.25\text{ mm}$

$=6.75\text{ mm}$

Difference between Weight and Mass?

Mass	weight
Mass is the measure of quantity of matter in a body	the weight is the force by which the body is attracted towards the Earth.
The mass of an object is found by comparing it with known standard masses.	Weight can be measured using spring balance

Write the process of measurement reading in Physical balance.

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

2. Turn the knob so that the pans of the balance are raised up. Is the beam horizontal and pointer at the centre of the scale? If not, turn the balancing screws on the beam so that it becomes horizontal.

3. Place the objectto be weighed on the left pan.

4. Place the known weight from the weight box in the right pan using forceps.

5. Adjust the weight so that pointer remains on zero or oscillates equally on both sides of the zero of the scale.

6. The total of standard masses (weights) is a measure of the mass of the object in the left pan.

Write the Uses of mechanical Stopwatch.

The duration of time of an event is measured by a stopwatch as shown in Fig. 1.10. It contains two needles, one for seconds and other for minutes. The dial is divided usually into 30 big divisions each being further divided into 10 small divisions. Each small division represents one tenth (1/10) of a second. Thus, one tenth of a second is the least count of this stopwatch. While using, a knob present on the top of the device is pressed. This results in the starting of the watch. The same knob is again pushed to stop it. After noting the reading, the same knob is again pressed to bring back the needles to the zero position.

Fig. 1.10 Mechanical Stopwatch

Write the Use of Digital Stopwatch.

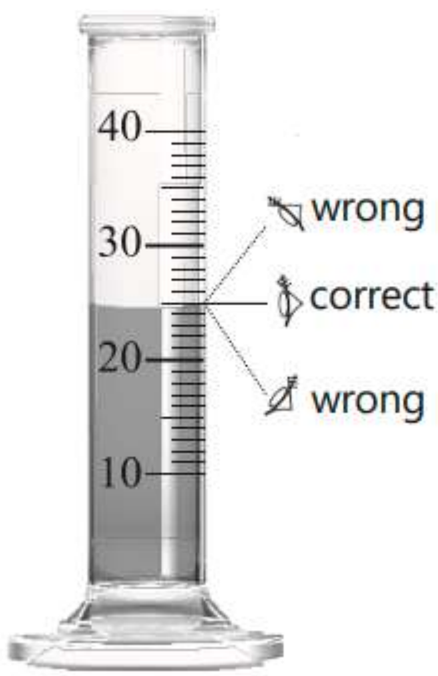
The digital stopwatch starts to indicate the time lapsed as the start/stop button is pressed. As soon as start/stop button is pressed again, it stops and indicates the time interval recorded by it between start and stop of an event. A reset button restores its initial zero setting.

Define Measuring Cylinder ?

It is a cylinder made of glass or transparent plastic with a scale divided in cubic centimetres (cm^3 or cc) or millilitres (mL) marked on it. It is used to find the volume of liquids and non-dissolvable solids.

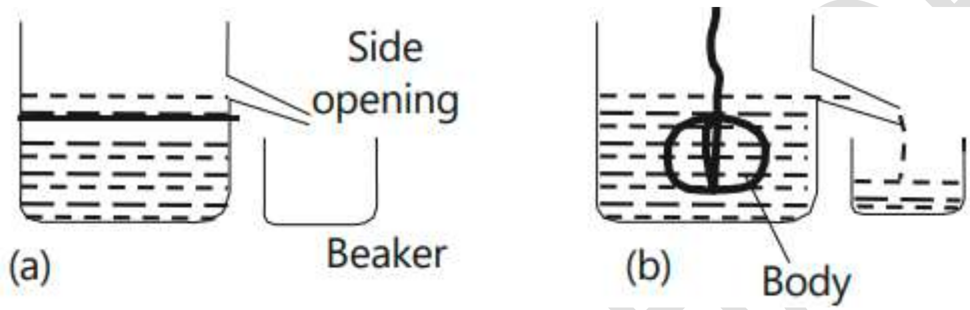
How to measure reading on Measuring Cylinder.

In order to read the volume correctly, the cylinder must be placed on a horizontal surface and the eye shall be kept in level with meniscus of water surface as shown in Fig. 1.12. The meniscus is the top level of the liquid surface. **Water in the cylinder curves downward and its surface is called concave surface**. The reading is taken corresponding to the bottom edge of the surface. **The mercury in the cylinder curves upward. Its surface is convex** and the reading is taken corresponding to the top edge. The cylinder can be used to find the volume of solids.



Write the Displacement Can or Overflow Can Method.

If the body does not fit into the measuring cylinder, then an overflow can or displacement can of wide opening is used as shown in Fig. Place the displacement can on the horizontal table. Pour water in it until it starts overflowing through its opening. Now tie a piece of thread to the solid body and



lower it gently into the displacement can. The body displaces water which overflows through the side opening. The water or liquid is collected in a beaker and its volume is measured by the measuring cylinder. This is equal to the volume of solid body.

How many type of errors?

there are three types of experimental errors affecting the measurements.

- **(i)** Human Errors
- **(ii)** Systematic Errors
- **(iii)** Random Errors

(i) Human Errors

They occur due to personal performance. The limitation of the human perception such as the inability to perfectly estimate the position of the pointer on a scale. Personal errors can also arise due to faulty procedure to read the scale. The correct measurement needs to line up your eye right in front of the level. In timing experiments, the reaction time of an individual to start or stop clock also affects the measured value.

Human error can be reduced:

Human error can be reduced by ensuring proper training, techniques and procedure to handle the instruments and avoiding environmental distraction or disturbance for proper focusing.

Best Way to reduce Human error:

The best way is to use automated or digital instruments to reduce the impact of human errors.

(ii) Systematic Errors :

They refer to an effect that influences all measurements of particular measurements equally. It produces a consistence difference in reading. It occurs due to some definite rule. It may occur due to zero error of instrument, poor calibration of instrument or incorrect marking.

How to reduce Systematic errors:

Error can be reduced by comparing the instrument with another which is known to be more accurate.

Random Errors:

It is said to occur when repeated measurements of a quantity give different values under the same conditions. It is due to some unknown causes which are unpredictable. The experimenter have a little or no control over it. Random error arise due to sudden fluctuation or variation in the environmental conditions. **For example**:changes in temperature, pressure, humidity, voltage, etc.

Reduce Random errors:

Random errors can be reduced using several or multiple readings and then taking their average or mean value.

Define Uncertainity in a Measurement with example?

There is no such thing as a perfect measurement. Whenever a physical quantity is measured except counting, there is inevitably some uncertainty about its determined value due to some instrument. This uncertainty may be due to use of a number of reasons. One reason is the type of instrument being used. We know that every measuring instrument is calibrated to a certain smallest division and this fact puts a limit to the degree of accuracy which can be achieved while measuring with it.

Suppose that we want to measure the length of a straight line with the help of a metre rule calibrated in millimetres. Let the end point of the line lies between 10.3 cm and 10.4 cm marks. By convention, if the end of the line does not touch or cross the midpoint of the smallest division, the reading is confined to the previous division. In case the end of the line seems to be touching or have crossed the midpoint, the reading is extended to the next division. Thus, in this example, the maximum uncertainty is $\pm$ 0.05 cm. It is, infact, equivalent to an uncertainty of 0.1 cm equal to the least count of the instrument divided into two parts, half above and half below the recorded reading.

Reduce uncertainty in small length :

The uncertainty in small length such as diameter of a wire and short interval of time can be reduced further by taking multiple readings and then finding average value. For example, the average time of one oscillation of a simple pendulum is usually found by measuring the time for thirty oscillations.

Define Significant Figures and write its rules.

The significant figures or digits are the digits of a measurement which are reliably known.

(a) A zero between two digits is considered significant. For example in 5.06m, the number of significant figures is 3.

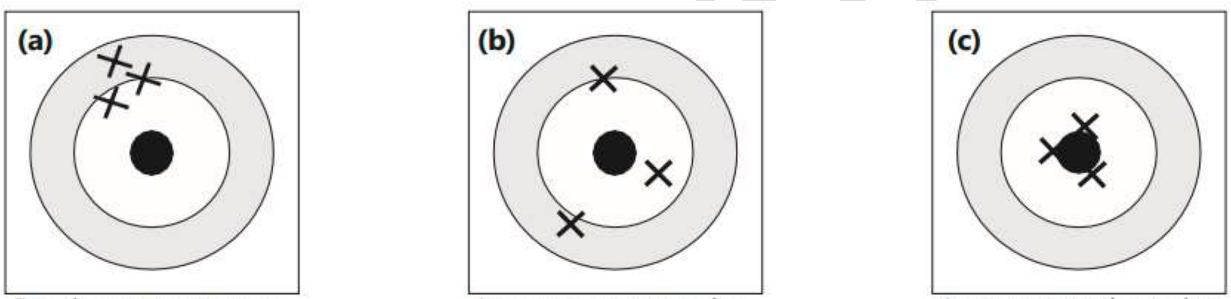
(b) Zeros on the left side of the measured value are not significant. For example, in 0.0034 m, the number of significant figures is 2.

(c) Zeros on the right side of a decimal are considered significant. For example, in 2.40 mm the significant digits are 3.

(d) If numbers are recorded in scientific notation, then all the digits before the exponent are significant. For example, in 3.50 × 104 m, the significant figures are 3.

Define Precision and Accuracy with example?

Precision of a measurement refers to how close together a group of measurements actually are to each other. Accuracy of a measurement refers how close the measured value is to some accepted or true value.



Precise not accurate | Accurate not precise | Accurate and precise

A classic illustration is helpful to distinguish the two concepts. Consider a target or bullseye hit by arrows in Fig. To be precise, arrows must hit near each other (Fig.a) and to be accurate, arrows must hit near the bullseye (Fig.b). Consistently hitting near the centre of bullseye indicates both precision and accuracy (Fig.c).

Define Rounding off the digits with example.

When rounding off numbers to a certain number of significant figures, do so to the nearest value. If the last digit is more than 5, the retained digit is increased by one and if it is less than 5, it is retained as such.

For example:

(i) Round to 2 significant figures: 2.512×10^3 m.

Answer: 2.5×10^3 m

Define Rounding off the digits with arbitrary rule:

If the number before the 5 is odd, one is added to the last digitretained. If the number before the 5 is even, it remains the same:

For example:

(i) Round to 2 significantfigures: 4.45×10^2 m.

Answer: 4.4×10^2 m

(iii) Round to 2 significantfigures: 4.55×10^2 m.

Answer: 4.6×10^2 m

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Book Short Answer Questions

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

Anwer:

Yes, a non- physical quantity like temperature can be measured indirectly using instruments such as thermometers, which quantity the effect of tempure on a material.

1.2 What is measurement? Name its two parts.

Answer:

Measurement is the proces of obtaining a numerical value for a physical quantity. Its two parts are:

(i) Numerical value

(ii) Unite of measurement

1.3 Why do we need a standard unit for mesurements?

Answer:

A standard unit ensures uniformity and consistency across measurements, making it possible to compare results globally and accurately.

1.4 Write the name of 3 base quantities and 3 drived quantities.

Answer:

1. **Base Quantities:**

(i)Length (ii)Mass (iii)Time

2. **Derived Quantities:**

(i)Speed (ii)Area (iii)Voulme

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

Answer:

The SI units for height id meter (m).

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

Answer:

i. Length - meter (m)
ii. Mass - Kilogram(kg)
iii. Time - second (s)
iv. Electric current – ampere (A)
v. Temperature – kelvin (K)
vi. Luminous intensity – candela (cd)
vii. Amount of substance – mole (mol)

1.7 Why prefix is used? Name three sub-mutiples and three multiple prefixes with their symbols.

Answer:

Prefixes are used to represent very large or very small numbers in a more convenient way.

Sub-multiples:

(i) Milli (m) = 10^{-3}

(ii) Micro (μ) = 10^{-6}

(iii) Nano (n) = 10^{-9}

Multiples:

(i) Kilo (k) = 10^{3}

(ii) Mega (M) = 10^{6}

(iii) Giga (G) = 10^{9}

1.8 What is ment by:

(a) 5pm

= 5 picometers = $5 * 10^{-12}$ meters

(b) 15 ns

= 15 nanoseconds = $15 * 10^{-9}$ second

(c) 6 μm

= 6 micrometers = $6 * 10^{-6}$ meters

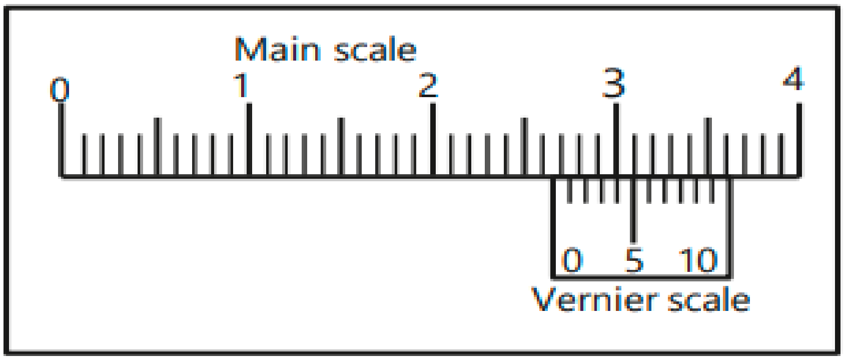
(d) 5 fs

= 5 femtoseconds = $5 * 10^{-15}$ second

1.9 (a) For what purpose, a Vernier Callipers is used ?

Answer:

Vernier Callipers are used to measure lenghts with high precision, typically up to 0.1 mm.



(b) Name its two main parts.

(i) Main Scale

(ii) Vernier Scale

(c) How is least count found?

Answer:

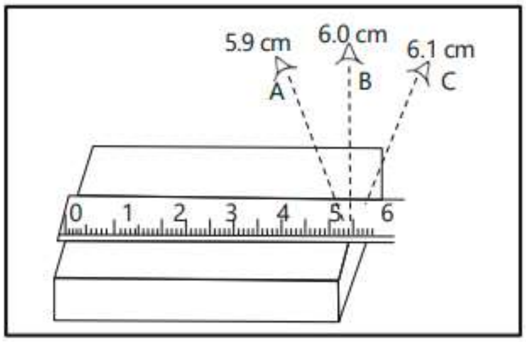
Least count is found by subtracting the value of one main dvision from one Vernier scale division.

(d) What is meant by zero error?

Answer:

Zero error refers to a mistake in measurement when the measurement does not read zero when the object being measured is absent.

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



Answer:

Answer should be depend on the provided figure for precise calculation. The least count is typically determined by the difference in values between the Vernier and main scale readings.

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

Answer:

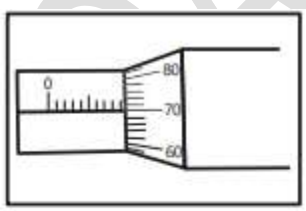
This would require specific figure for A,B and C to compare the readings and determine which one is most accurate based on the instrument used and the least count.

Constructed Response Questions

1.1 why might a standard system of measurement be helpful to a tailor?

Answer: A standard system of measurements allows the tailor to accurately measure fabric and ensure proper fitting for customers, avoiding confusion and inconsistency in clothing sizes.

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



Answer: Least count: 1 mm 100/ frac {1/, /text {mm}} {100} 1001mm =0.01mm.

The thickness of road depends on the reading from the circular scale, which isn't provided here, so this can't be determine without the figure.

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

Answer: To measure the diameter of a pencil using the scale with the same precisions you can place the pencil on the scale and measure the distance between the edges using the scale's smallest division. By taking multiple reading and average them, Precision can be improved.

1.4 The end of the meter scale is worth out. Where will you place a pencil to find the length?

Answer: To measure accurately place the pencil near the undamaged end of the scale and ensure the measurement start from the zero point of the scale.

1.5 Why is it's better to place the object close to the meter scale?

Answer: Placing the object close to the meter scale reduce the chances of parallax error and ensure a more accurate reading.

1.6 Why a standard unit is needed 1 meter a quantity correctly?

Answer: A standard unit ensure consistently and universal understanding, allowing measurements to be universally accepted and compared accurately.

1.7 Suggest some natural phenomena that could serve as a reasonable accurate time standard.

Answer: Some natural phenomena that serve as time standard include the rotation of the Earth (a day), the Earth's orbit around the Sun (a year), or the oscillation of atoms in atomic clocks (cesium or rubidium frequency).

1.8 Which instrument can be used to measure:

(i) Internal diameter of test tube.

Vernier calipers or micrometer screw gauge.

(ii) Depth of a beaker.

Screw gauge or depth gauge.

Numerical Problems

Chapter # 1

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

Solution :

(a). Day

1 day = 24 hours

1 Hour = 60 Min

1 Min = 60 Sec

Now

1 day = $24 \times 60 \times 60$

1 day = 86400 Sec

86400 in Prefixes = $86400 \div 1000$ (1000=1K)

86400 in Prefixes = 86.4 Ks

b. Week

1 week = 7 day

1 day = 24 hours

1 Hour = 60 Min

1 Min = 60 Sec

Now

1 week = 7×24×60×60

1 week = 604800 Sec

1 week = 604800 ÷ 1000

1 week = 604.8 Ks

c. Month

Assuming a Month has 30 days:

1 Month = 30 days

1 day = 24 hours

1 Hour = 60 Min

1 Min = 60 Sec

Now

1 Month = 30×24×60×60

1 Month = 2592000 Sec

1 Month = 2592000 ÷ 1000000 (1000000=1mega (M))

1 Month = 2.592 Ms

1.2 State the answers of problem 1.1 in scientific notation.

Solution :

(a). Day

1 day = 24 hours

1 Hour = 60 Min

1 Min = 60 Sec

Now

1 day = $24 \times 60 \times 60$

1 day = 86400 Sec

86400 in Prefixes = 86400

86400 in Scientific Notation = 8.64×10^{4} Sec

b. Week

1 week = 7 day

1 day = 24 hours

1 Hour = 60 Min

1 Min = 60 Sec

Now

1 week = 7×24×60×60

1 week = 604800 Sec

1 week = 6.048×10^5 Sec

c. Month

Assuming a Month has 30 days:

1 Month = 30 days

1 day = 24 hours

1 Hour = 60 Min

1 Min = 60 Sec

Now

1 Month = 30×24×60×60

1 Month = 2592000 Sec

1 Month = 2592000

1 Month in Scientific Notation= 2.592×10^6Sec

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

Solution :

(a) 4×10^{-4} kg+3×10^{-5} kg

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

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

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

(b) 5.4×10^{-6} m – 3.2×10^{-5} m

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

$= 10^{-5} (0.54 - 3.2)$ m

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

Solve the following multiplication or division. State your answers in scientific notation.

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

Solution :

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

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

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

$=15 \times 10^2$m

b) 6×10^8 kg / 3×10^4 m^3

$= 2 \times 10^8 \times 10^{-4}$ Kg m^{-3}

$= 2 \times 10^{8-4}$ Kg m^{-3}

$= 2 \times 10^4$ Kg m $^{-3}$

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

$(3 \times 10^2$ kg$) \times (4.0$ Km$) / 5 \times 10^2$ s^2

Solution :

$= (3 \times 4.0) \times 10^2$ Kg Km $/ 5 \times 10^2$ s^2

$= 12 \times 10^2 \times 10^{-2}$ Kg Km S $^{-2}$ /5

$= 2.4 \times 10^{2-2}$ Kg Km S $^{-2}$ (1000=1k)

$= 2.4$ Kg 10^3 m S $^{-2}$

$=2.4 \times 10^3$ Kg m S $^{-2}$

1.6 State the number of significant digits in each measurement.

(a) 0.0045 m (b) 2.047 m (c) 3.40 m (d) 3.420 × 104 m

Solution :

(a) 0.0045 m

0.0045 has significant digit = 2

(b) 2.047 m

2.047 has significant digit = 4

(c) 3.40 m

3.40 has significant digit = 3

(d) 3.420×10^4 m

3.420×10^4 has significant digit = 4

Write in scientific notation:

(a) 0.0035 m (b) 206.4×10^2 m

Solution :

0.0035 m

0.0035 has scientific notation = 3.5×10^{-3} m

206.4×10^2 m

206.4×10^2 has scientific notation= 2.064×10^4 m

1.8 Write using correct prefixes:

(a) 5.0×10^4 cm (b) 580×10^2 g (c) 45×10^{-4} s

Solution :

5.0×10^4 cm

$= 5.0 \times 10^4 \times 10^{-2}$ m ($1\text{cm}=10^{-2}$)

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

$=5.0 \times 10^2$m

$=0.5 \times 10^3 m$

$= 0.5$ Km

(b) 580×10^2 g

$= 58 \times 10^1 \times 10^2$ g

$= 58 \times 10^3$g

= 58 kg

(c) 45×10^{-4} s

$=45 \times 10^{-1} \times 10^{-3}$ s

$=45 \times 10^{-1}$ ms (10^{-3}=1m)

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 m s^{-1}, calculate the distance.

Solution :

Distance = ?

Speed of light = 3.0×10^8 m s^{-1}

Distance = Speed × Time

1 year has = 365 days

1 day = 24 haour

1 hour = 60 Min

1 Min = 60 sec

Total number of year in sec = 365 × 24 × 60 × 60

Total number of year in sec = 31536000 sec / year

Total number of year in sec = 3.1536×10^{7}

Distance = Speed × Time

Distance = $(3.0 \times 10^{8}\ m\ s^{-1})(3.1536 \times 10^{7}\ sec / year)$

Distance = $(3.0 \times 3.1536)(10^{8+7})\ m\ s^{-1+1}$

Distance = 9.46×10^{15} m

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

Solution :

Density of mercury = 13.6 g cm^{-3}

1 g = 10^{-3} kg

1 cm = 10^{-2} m

Density of mercury = 13.6×10^{-3} kg 10^{6} m^{-3}

Density of mercury = $13.6 \times 10^{-3+6}$ kg m^{-3}

Density of mercury = 13.6×10^{3} kg m^{-3}

Density of mercury = $1.36 \times 10^{1} \times 10^{3}$ kg m^{-3}

Density of mercury = 1.36×10^{4} kg m^{-3}
