CHAPTER- 1 S.I Units & MEASUREMENT

Short Questions (2 marks)

1. **Define the least count and write the formula for the least count of the micrometer screw gauge.**

   For a Vernier scale,

   The smallest possible measurement of a physical quantity by a given instrument is called the least count of that instrument.

   $$\text{L.C.} = \frac{\text{smallest division on main scale}}{\text{total number of divisions on the Vernier scale}}$$

   L.C. (of a micrometer screw)

   $$= \frac{\text{pitch}}{\text{number of divisions on the circular scale(N)}}$$

2. **Define percentage error.**

   Relative error measured in percentage is called percentage error.

   $$\therefore \text{Percentage Error (પ્રતિશત ત્રુટિ) } (\delta a) = \delta a \times 100\%$$

   $$= \frac{\Delta \bar{a}}{\bar{a}} \times 100\%$$

3. **Write the formula to find out the least count measurement of Vernier Calipers.**

   $$\text{L.C.} = \frac{\text{smallest division on main scale}}{\text{total number of divisions on the Vernier scale}}$$

4. **Write S.I. unit of Force, velocity, Power, acceleration.**

   Force - Newton

   Power - Watt

   Velocity - meter/second (m/s)

   Acceleration - meter/second^2 (m/s^2)

5. **Write two applications of Vernier calipers.**

   - Using Vernier calipers one can measure diameter of solid cylinder, internal and external diameter of a hollow cylinder.
   - Using Vernier calipers one can measure thickness of a thin plate of glass of any material.
   - Using Vernier calipers one can measure depth of liquid in a small vessel

6. **State dimensional formula for Force, mass, length, density, Velocity, acceleration**

   Force – $M^1L^1T^{-2}$

   Mass – M^1

   Length – L^1

   Density – $M^1L^{-3}T^0$

   Velocity – $M^0L^1T^{-1}$

   Acceleration – $M^0L^1T^{-2}$

7. **State the significant digit of following: (1) 16723 (2) 0.123 (3) 0.00872 (4) 0.0016300 (5) 11.09230 (6) 7009800 (7) 6.67×10^{-11}**

1) 16723=5
2) 0.123=3
3) 0.00872=3
4) 0.0016300=5
5) 11.09230=7
6) 7009800=7
7) 6.67×10^{-11} =3

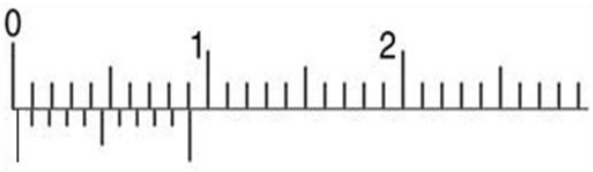
Answer in Detail (3,4 Marks)

1. Write the names of basic quantities with its S.I. Unit which are belong to S.I. Unit method.

Name	Name	Symbol
time	second	s
length	metre	m
mass	kilogram	kg
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd

2. **What are the positive error and negative errors of Vernier Calipers? Explain it with a neat sketch.**

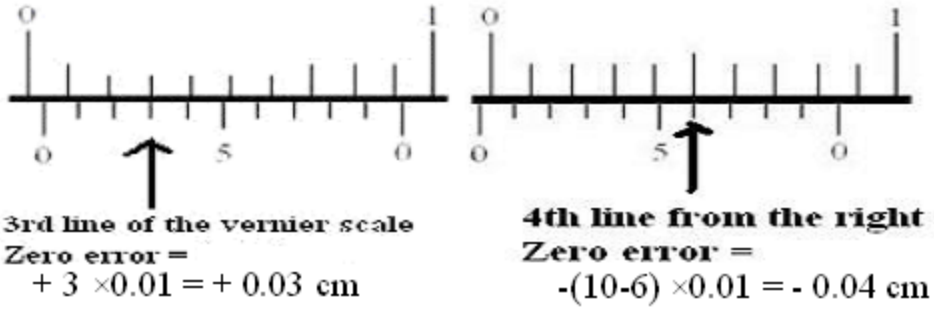
- If zero of the Vernier scale falls left of the zero of the main scale, there exists a negative error.



- If zero of the Vernier scale falls right of the zero of the main scale, there exists a positive error.

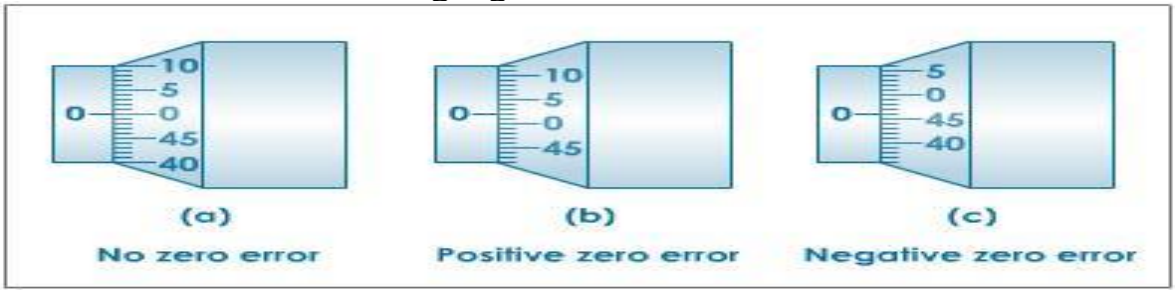
If there is an error in the instrument either positive or negative, it can be calculate as shown in figure below with its sign i.e., + for positive error and – for negative error
Formula to find out error in the instrument,

$$\pm error = no.of\ the\ division\ of\ v.s\ exactly\ match\ with\ division\ of\ m.s \times L.C.$$



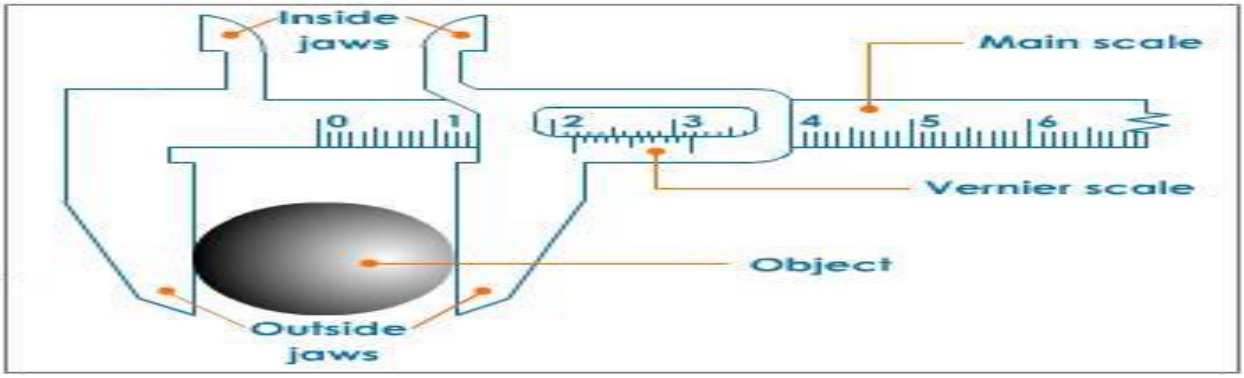
3. **What are positive error and negative error of micrometer screw gauge? Explain it with neat sketch.**

Error in Micrometre screw gauge:

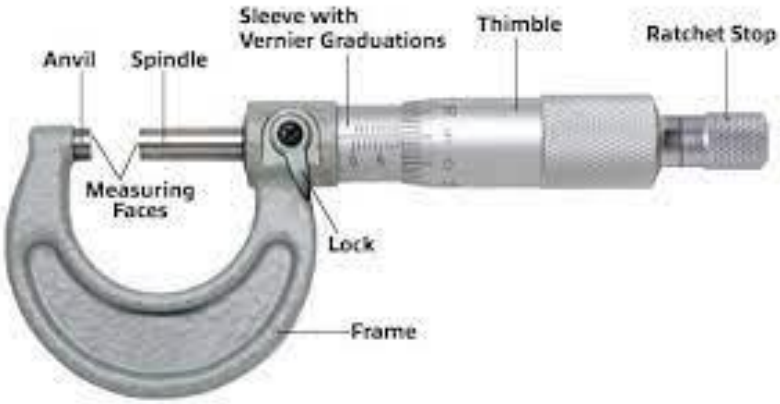


- If zero of the circular scale is exactly on the base line, the instrument said to be free from zero error.
- If zero of the circular scale is below the base line, there exists a positive zero error.
- If zero of the circular scale is above the base line, there exists a negative zero error.
- Correction for the zero error is done by the formula given below.
- Correct reading = (Observed reading) – (Zero error taken with sign)

4. **Draw a labeled neat sketch of Vernier calipers.**

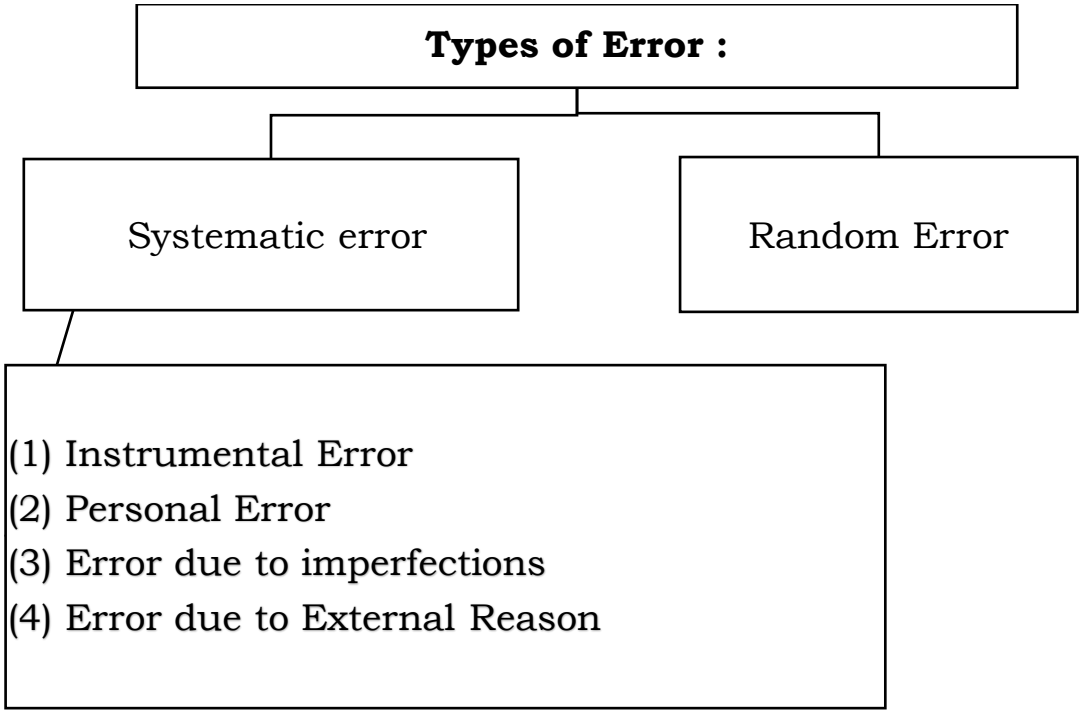


5. **Draw and label: micrometer screw**.



6. **Define Error and Explain types of error.**

Error: Error is the difference between the true value of a physical quantity and the measured value.



Systematic error: Systematic error is one that always produces an error of the same sign. It is subdivided into following types.

(a)Instrumental Error: this type of error arises due to imperfect design or improper design calibration of the measuring instruments.

(b) Observational or personal Error: Such errors arise due to an individual's carelessness in taking observations or due to faulty method

(c) Error due to external causes: These errors are caused by external conditions like pressure temperature, wind, etc.

(d) Error due to imperfections. Sometimes even when we know the nature of the error it cannot be eliminated due to imperfections in experimental arrangement. This error will always exist but observations can be corrected for them.

2. Random Error: (Chance Error)

these errors are due to unknown causes and are sometimes termed as chance errors. It arises due to random and unpredictable fluctuations in experimental conditions.

These types of can be both positive and negative. Such errors can be estimated by taking many observations and then taking their mean

7. **Pitch of the micrometer screw is 0. 5mm. If the total no of divisions on the circular scale is 50, calculate the L.C.M. of the micrometer screw.**

Given:-
Pitch = 0.5 mm
Total no. of division on C.S. = 50

So,

$$LC = \frac{\text{Pitch}}{\text{Total no. of div on C.S}}$$

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

$$= 0.01\ mm$$

8. **A Vernier caliper is calibrated in mm. If 10 divisions of the Vernier scale are equal to 9 mm of the main scale, find out the L.C.M. of Vernier calipers.**

Here, Given.
Smallest division on m.S. = 1mm
Total no. of division on V.S = 10

So, $LC = \frac{\text{Smallest division on m.S}}{\text{Total no. of division on C.S.}}$

$$= \frac{1\ mm}{10}$$

$$LC = 0.1\ mm$$

9. **Calculate the least count of the micrometer screw gauge; the micrometer screw gauge has a pitch of 1mm and the number of divisions on the head scale is 100.**

Pitch = 1 mm
$n = 100$

$$\therefore L.C = \frac{\text{Pitch}}{n}$$

$$= 1/100$$

$$= 0.01\ mm$$

10. **A main scale of Vernier calipers is calibrated in mm. If the total number of divisions on the Vernier scale is 20 then find out the Least Count Measurement.**

Here,

Smallest division on M.S = 1mm

Total no. of division on V.S = 20

So,

$$LC = \frac{\text{Smallest division on M.S}}{\text{Total no. of division on V.S}}$$

$$= \frac{1\,mm}{20}$$

$$\therefore LC = 0.05\,mm$$

11. **Calculate percentage error for the following observations: 1.33, 1.39,1.31,1.36,1.35,1.32,1.34, and 1.37.**

$$\bar{a} = \frac{1.33 + 1.39 + 1.31 + 1.36 + 1.35 + 1.32 + 1.34 + 1.37}{8}$$

$$= 1.35$$

$\Delta a_1 = |1.35 - 1.33| = 0.02$

$\Delta a_2 = |1.35 - 1.39| = 0.04$

$\Delta a_3 = |1.35 - 1.31| = 0.04$

$\Delta a_4 = |1.35 - 1.36| = 0.01$

$\Delta a_5 = |1.35 - 1.35| = 0$

$\Delta a_6 = |1.35 - 1.32| = 0.03$

$\Delta a_7 = |1.35 - 1.34| = 0.01$

$\Delta a_8 = |1.35 - 1.37| = 0.02$

$$\Delta\bar{a} = \frac{0.02 + 0.04 + 0.04 + 0.01 + 0 + 0.03 + 0.01 + 0.02}{8}$$

$$= 0.17/8 = 0.021$$

$$\therefore \text{Relative error} = \frac{\Delta\bar{a}}{\bar{a}} = \frac{0.021}{1.35} = 0.015$$

$$\therefore \%\ \text{Error} = 0.015 \times 100 = 1.5\ \%$$