

ERROR AND MEASUREMENT

Type of Error :-

① Random Error → randomly

② Systematic Error → error in procedure / miscalibration of instrument

Significant figure :-

Q) find no. of significant figure :-

① 5332 → 4 ⑦ 6500. → 4

② 152.32 → 5 65 00.0 → 5

③ 152.320 → 6 006500.0 → 5

5.3000 → 5

④ 00692 → 3

0.0061 → 2

⑤ 832000 → 3

⑥ 65 $\times 10^8$ → 2

2.8 $\times 10^9$ → 2

Rules for Rounding off the digits

- ① Sabse pahle ye dekho kitne digits me answer dena hai aur use underline ker do.
- ② Baki digits agar 5/50/500 se jada hai to pichla digit ko 1 badha do aur agar 5/50/500 se km hai to as it is chor do.
- ③ Agar 5/50/500 hi hai to agar pichla word odd hai to 1 badha kr even kr do aur even hai to as it is chor do.

Q) Round off following numbers into 3 sig. fig.

① <u>1.8762</u> = 1.88	⑥ <u>1.8732</u> = 1.87
② <u>1.8769</u> = 1.88	⑦ <u>1.8750</u> = 1.88
③ <u>1.8758</u> = 1.88	
④ <u>1.8752</u> = 1.88	⑧ <u>1.8650</u> = 1.86
⑤ <u>1.8751</u> = 1.88	* * ⑨ <u>1367</u> = 137

Rules for add. & sub. (in correct no. of sig. fig.)

Jis me km digits hai uske terms me hi answer dena hai

$$\begin{array}{r} 3.478 \\ 4.2 \\ \hline 7.678 \end{array} \times \quad \underline{\text{Ans} = 7.7}$$

$$2.4732$$

$$1.834$$

$$2.03$$

$$\underline{6.3372} \quad \text{Ans} \rightarrow \underline{6.34}$$

Addⁿ aur sub. me point ke baad kitne digit hai har number ke pas pahle wo dekho.

Aur hamne ans us form me dena hai jisme point ke baad min. digit ha

Rules for multiplication & div.

(In correct no. of sig. fig.)

$$6.321 \times \underline{5.87} = 37.10427 \times$$

$$\underline{\text{Ans} \rightarrow 37.1}$$

$$2.73 \times 5.2 = 14.196$$

$$\underline{\text{Ans} \rightarrow 14}$$

$$\begin{array}{r} 3.68 \\ \hline 0.07925 \end{array} = 46.4353312$$

$$\underline{\text{Ans} \rightarrow 46.4}$$

multiplication aur div. me jis no. ke
pas min. sig. fig. hoi ans. utne hi
min. sig. fig. me dena hoi.

Jorne ghatane me decimal ke baad
min digit dekho & multiply aur
divid me min sig. fig. dekho

Error of Measurement

Experimental value = $a_1, a_2, a_3, \dots, a_n$

$$\text{True value} = \frac{a_1 + a_2 + a_3 + \dots + a_n}{n} = a_m$$

↑

(mean value)

$$\text{gadbadhi in Exp. no 1} = a_m - a_1 = \Delta a_1 \\ (\text{absolute error})$$

$$\begin{aligned} " & " & " & " & 2 & = a_m - a_2 = \Delta a_2 \\ & & & & \vdots & \vdots & \vdots \\ & & & & & & \\ & & & & & & = \Delta a_n \end{aligned}$$

$$\text{mean absolute Error} = \frac{|\Delta a_1| + |\Delta a_2| + \dots + |\Delta a_n|}{n}$$

↳ Δa_m

Representation of Physical Quantity

$$= (a_m \pm \Delta a_m)$$

$$\text{Fractional Error} = \frac{\Delta a_m}{a_m}$$

$$\% \text{ Error} = \frac{\Delta a_m}{a_m} \times 100$$

Q.) In calculation of value of g experimentally result is represented as

$$g = 10 \pm 0.2$$

Find relative error & % error.

Sol:

$$\frac{0.2}{10} = 0.02 \leftarrow \text{rel. error}$$

$$\frac{0.2}{10} \times 100 = 2\% \leftarrow \% \text{ error}$$

Propagation of Error

$$A = a \pm \Delta a$$

$$B = b \pm \Delta b$$

$$\underline{A+B = (a+b) \pm (\Delta a + \Delta b)}$$

$$A = a \pm \Delta a$$

$$B = b \pm \Delta b$$

$$\underline{A-B = a-b \pm (\Delta a + \Delta b)}$$

$$y = K \frac{ab^2c^3}{d^4}$$

$$\left(\frac{\Delta y}{y} \right)_{\text{max. possible error}} = \frac{\Delta a}{a} + 2 \frac{\Delta b}{b} + 3 \frac{\Delta c}{c} + 4 \frac{\Delta d}{d}$$

↑ Constant ko bhul jao

↑ ye formula tab hi lagega jab % error chota ho i.e. (1%, 2%, 10%, etc.)

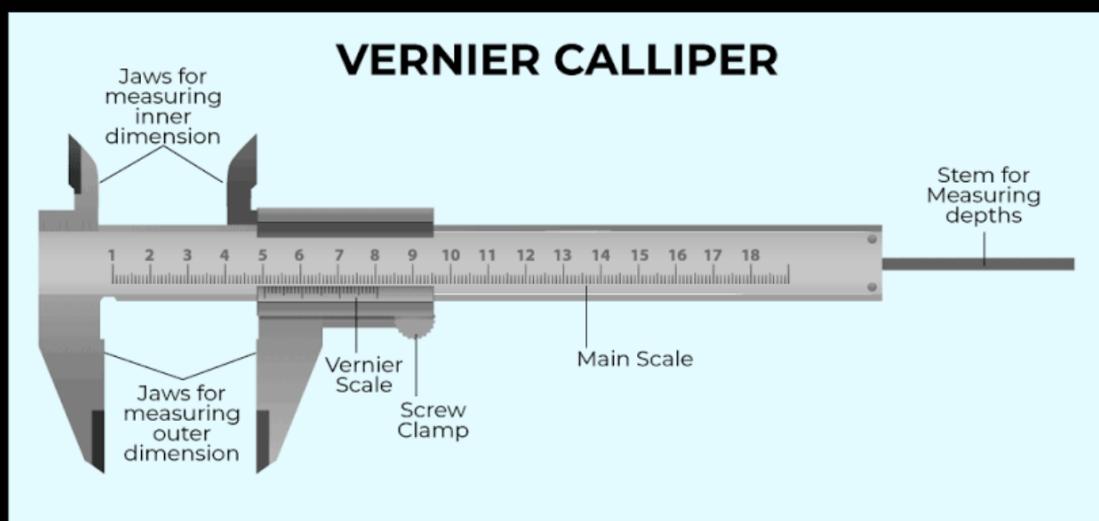
Q.) $y = \frac{a^3 b^2}{c^5}$ If % error in a, b, c
 are 0.5% , 0.3% & 0.2%
 respectively. find % error
 in y .

Soln:-

$$\frac{\Delta y}{y} \times 100 = 3 \frac{\Delta a}{a} \times 100 + 2 \frac{\Delta b}{b} \times 100 + 5 \frac{\Delta c}{c} \times 100$$

$$\begin{aligned}\% \text{ error in } y &= (3 \times 0.5 + 2 \times 0.3 + 5 \times 0.2)\% \\ &= (1.5 + 0.6 + 1)\% \\ &= 3.1\%\end{aligned}$$

Measuring Instrument :-

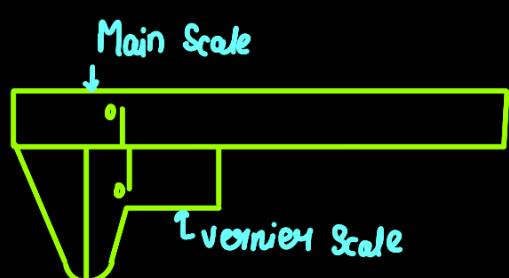


$$L.C. = 1 \text{ M.S.D.} - 1 \text{ V.S.D.}$$

Reading in Vernier Calliper

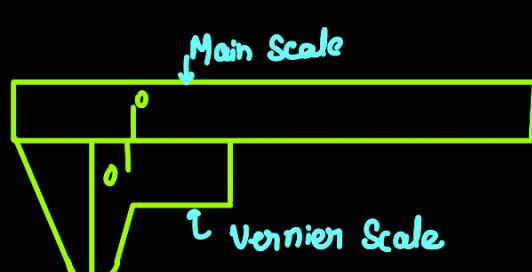
$$\text{Main scale reading} + \left(\begin{array}{l} \text{Vernier caliper} \\ \text{ka coinciding} \\ \text{danda} \end{array} \right) \times L.C. - \left(\begin{array}{l} \text{zero} \\ \text{error} \end{array} \right)$$

(with sign)



↳ Positive zero error

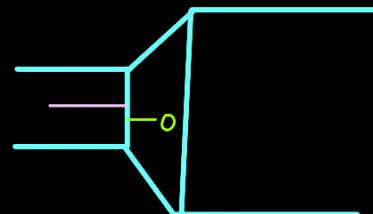
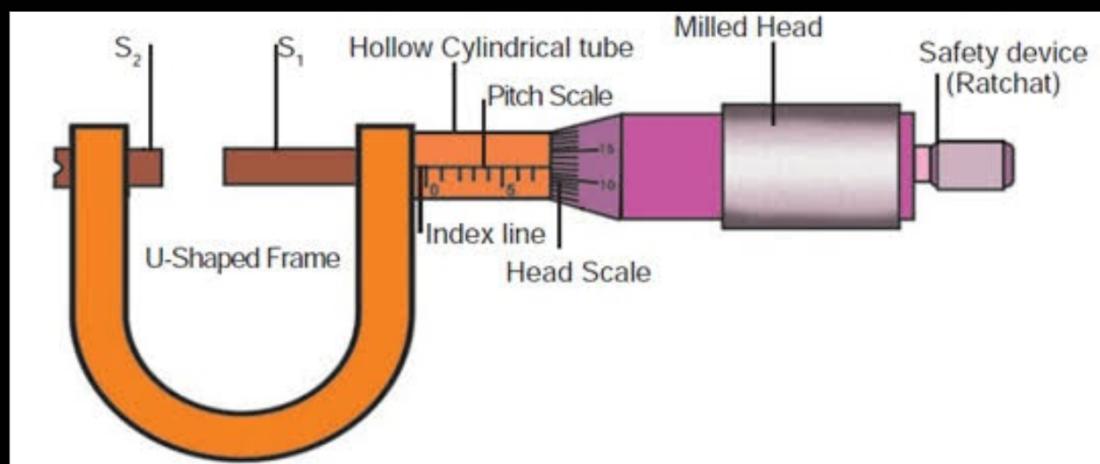
$$\text{Zero error} = + \left(\begin{array}{l} \text{coinciding danda} \\ \text{aage se} \end{array} \right) \times L.C.$$



↳ Negative zero error

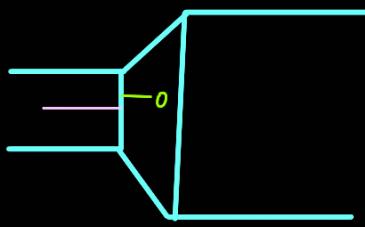
$$\text{Zero error} = - \left(\begin{array}{l} \text{coinciding danda} \\ \text{piche se} \end{array} \right) \times L.C.$$

Screw Gauge



↪ Positive Error

zero error = no. of coinciding danda
aage se.



↪ Negative Error

zero error = no. of coinciding danda
piche se.

$$\text{Reading} = \text{M.S.R.} + \left(\begin{array}{l} \text{coinciding} \\ \text{division} \end{array} \right) \times \text{L.C.} - \text{zero error}$$

$$\text{L.C.} = \frac{\text{Pitch}}{\text{no. of div on circular scale}}$$

Pitch = circular scale ke 1 revolution me
main scale jitna reading de is
called pitch.

