# YAKEEN NEET 2.0

## 2026

## Units and Measurements

**Physics** | **Lecture - 10**

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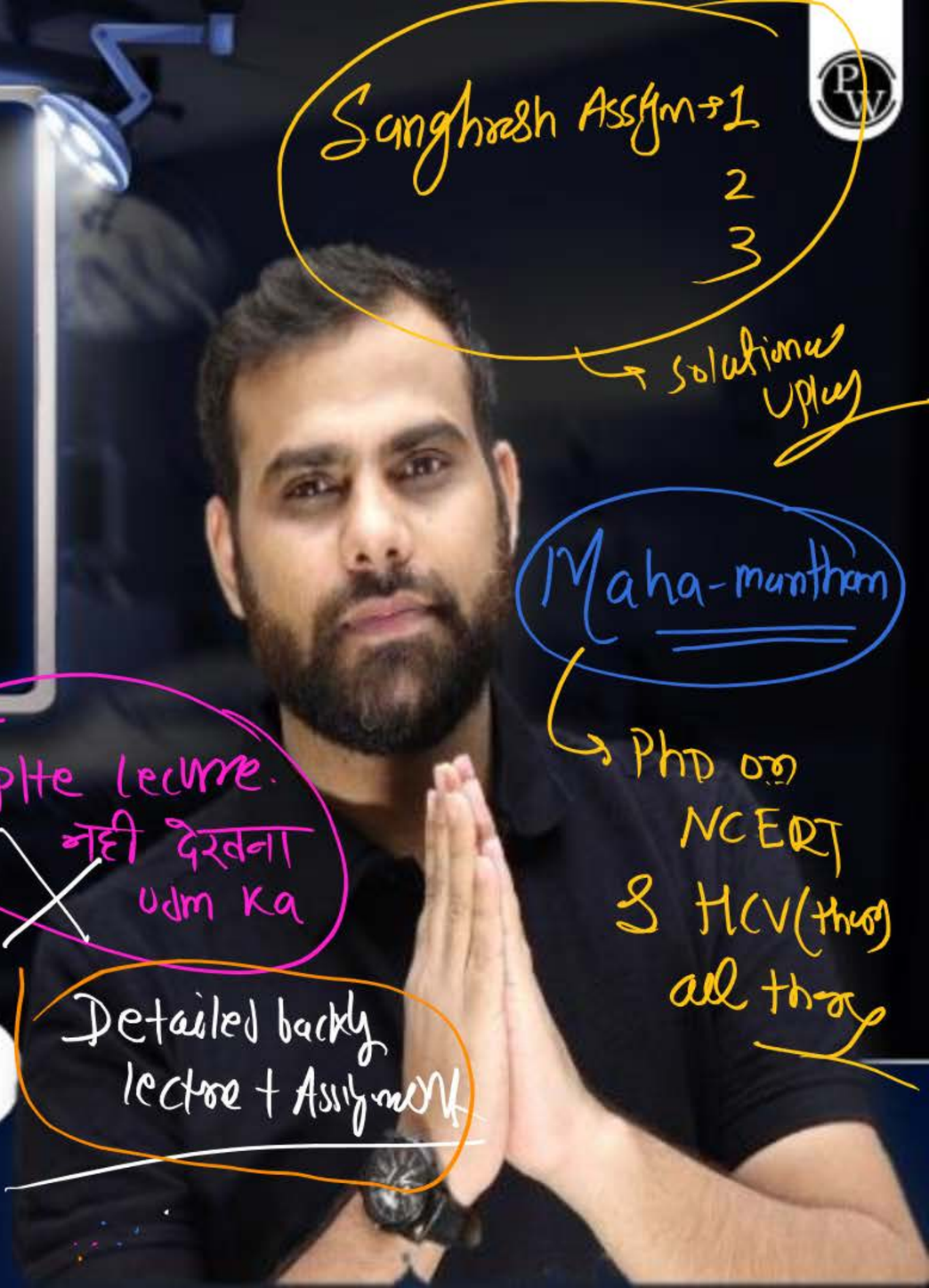
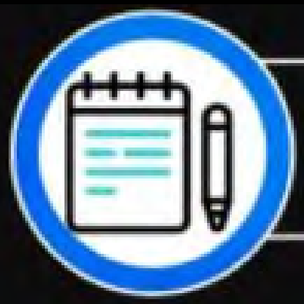




# Topics to be covered

- Question on error
- Instrument
  - Metre scale
  - Vernis callipy
  - Screw gauge
- HOME-WORK
  - (Assignment-3)

* If $y = m\tan\theta$ then find Angle at which Percentage error in y will be minimum.

Soln

$$y = m\tan\theta$$

$$\frac{dy}{d\theta} = m\frac{d\tan\theta}{d\theta}$$

$$\frac{dy}{d\theta} = m\sec^2\theta$$

$$dy = m\sec^2\theta\, d\theta \quad -(1)$$

$$\frac{dy}{y}\times 100 = \frac{m\sec^2\theta\, d\theta}{m\tan\theta}\times 100$$

$$\frac{dy}{y}\times 100 = \frac{d\theta \times 100}{\cos\theta\,\frac{\sin\theta}{\cos\theta}}$$

$$\left(\frac{dy}{y}\times 100\right)_{min} = \frac{2\times 100\, d\theta}{2\times\sin\theta\cdot\cos\theta} = \frac{200\, d\theta}{|\sin 2\theta|_{max}}$$

$$= |\sin 2\theta|_{max} = 1$$

$$2\theta = 90$$

$$\theta = 45^\circ$$

Ans

## Question

$y = \frac{1}{x}$ find $\frac{dy}{dx}$ and $\frac{dy}{dt}$

$$\frac{dy}{dx} = \frac{d\,1/x}{dx} = \frac{dx^{-1}}{dx}$$

$$\frac{dy}{dx} = -1\, x^{-1-1}$$

$$\boxed{\frac{dy}{dx} = \frac{-1}{x^2}}$$

$$y = \frac{1}{x} = x^{-1}$$

$$\frac{dy}{dt} = \frac{dx^{-1}}{dt} \times \frac{dx}{dx}$$

$$= \frac{dx^{-1}}{dx} \times \frac{dx}{dt}$$

$$\frac{dy}{dt} = -\frac{1}{x^2}\frac{dx}{dt}$$

use

$$Y = \frac{1}{R} = R^{-1}$$

$$\frac{dy}{dt} = \frac{dR^{-1}}{dt} \times \left(\frac{dR}{dR}\right)$$

$$= \frac{dR^{-1}}{dR} \times \frac{dR}{dt}$$

$$\frac{dy}{dt} = \frac{-1}{R^2} \times \frac{dR}{dt}$$

Working

## In serial Combination of Resistance

$$R_{eq} = R_1 + R_2$$

$$\Delta R_{eq} = \Delta R_1 + \Delta R_2$$ ✡

## # Parallel Combination of Resistance

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

diff$^n$ w.r.t 't'

$$\frac{dR_{eq}^{-1}}{dt} = \frac{dR_1^{-1}}{dt} + \frac{dR_2^{-1}}{dt}$$

$$-\frac{1}{R_{eq}^2}\frac{dR_{eq}}{dt} = -\frac{1}{R_1^2}\frac{dR_1}{dt} - \frac{1}{R_2^2}\frac{dR_2}{dt}$$

$$\frac{dR_{eq}}{R_{eq}^2} = \frac{dR_1}{R_1^2} + \frac{dR_2}{R_2^2}$$

absolute error in $R_{eq}$

$$dR_{eq} = R_{eq}^2\left(\frac{dR_1}{R_1^2} + \frac{dR_2}{R_2^2}\right)$$

Percentage error in $R_{eq}$ $\Rightarrow \left(\frac{dR_{eq}}{R_{eq}}\right)\times 100 = R_{eq}\left[\frac{dR_1}{R_1^2} + \frac{dR_2}{R_2^2}\right]\times 100$ Ans

## Question

Two wire of resistance $R_1 = (50 \pm 2)\Omega$ and $R_2 = (100 \pm 4)\Omega$ find equivalent resistance in (a) series (b) parallel with absolute error.

Sol?

(a) Series

$R_{eq} = R_1 + R_2$

$= 50\Omega + 100\Omega$

$R_{eq} = 150\Omega$

$\Delta R_{eq} = \Delta R_1 + \Delta R_2$

absolute error in $R_{eq}$ $= 2 + 4 = 6\Omega$

$R_{eq} = (150 \pm 6)\Omega$

(b) Parallel

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$

$\frac{1}{R_{eq}} = \frac{1}{50} + \frac{1}{100} = \frac{2+1}{100} = \frac{3}{100}$

$R_{eq} = \frac{100}{3}\Omega$

$+\frac{dR_{eq}}{R_{eq}^2} = +\frac{dR_1}{R_1^2} + \frac{dR_2}{R_2^2}$

$dR_{eq} = R_{eq}^2\left[\frac{dR_1}{R_1^2} + \frac{dR_2}{R_2^2}\right] = \left(\frac{100}{3}\right)^2\left[\frac{2}{(50)^2} + \frac{4}{(100)^2}\right]$

$= \frac{2 \times 100 \times 4}{50 \times 50 \times 9} + \frac{100 \times 4}{9 \times 100^2} = \frac{8}{9} + \frac{4}{9}$

$= \frac{12}{9} = \frac{4}{3}$

$R_{eq} = \left(\frac{100}{3} + \frac{4}{3}\right)\Omega$

Ans

## Question

Two resistance $R_1 = (20\Omega + 2\Omega)$ and $R_2 = (5 \pm 1\Omega)$ are connected in parallel then find % and absolute error.

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{20} + \frac{1}{5} = \frac{1+4}{20} = \frac{5}{20}\,\Omega$$

$$R_{eq} = 4\,\Omega$$

$$\frac{dR_{eq}}{R_{eq}^2} = \frac{dR_1}{R_1^2} + \frac{dR_2}{R_2^2}$$

$$\left(\frac{dR_{eq}}{R_{eq}}\right) = R_{eq}\left(\frac{dR_1}{R_1^2} + \frac{dR_2}{R_2^2}\right)$$

$$= 4\left(\frac{2}{(20)^2} + \frac{1}{(5)^2}\right)$$

$$100 \times \frac{dR_{eq}}{R_{eq}} = 4\left(\frac{2}{400} + \frac{1}{25}\right) \times 100$$

$$= \frac{4 \times 2 \times 100}{400} + \frac{4 \times 100}{25}$$

$$= 18\,\%$$

$$* \; 100 \times \frac{dR_2}{R_2} = 18$$

$$dR_2 = \frac{18 \times R_2}{100}$$

$$dR_2 = \frac{18 \times 4}{100}$$

$$\frac{1}{C_q} = \frac{1}{C_1} + \frac{1}{C_2}$$

← Series comb$^n$ of capacitor

$$\frac{dC_q}{C_q^2} = \frac{dC_1}{C_1^2} + \frac{dC_2}{C_2^2}$$

M W F revision on Telegram

7 to 8 Am ✓

mirror formula

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\frac{dv}{v^2} + \frac{du}{u^2} = \frac{df}{f^2}$$

Ans

# Measuring Instrument

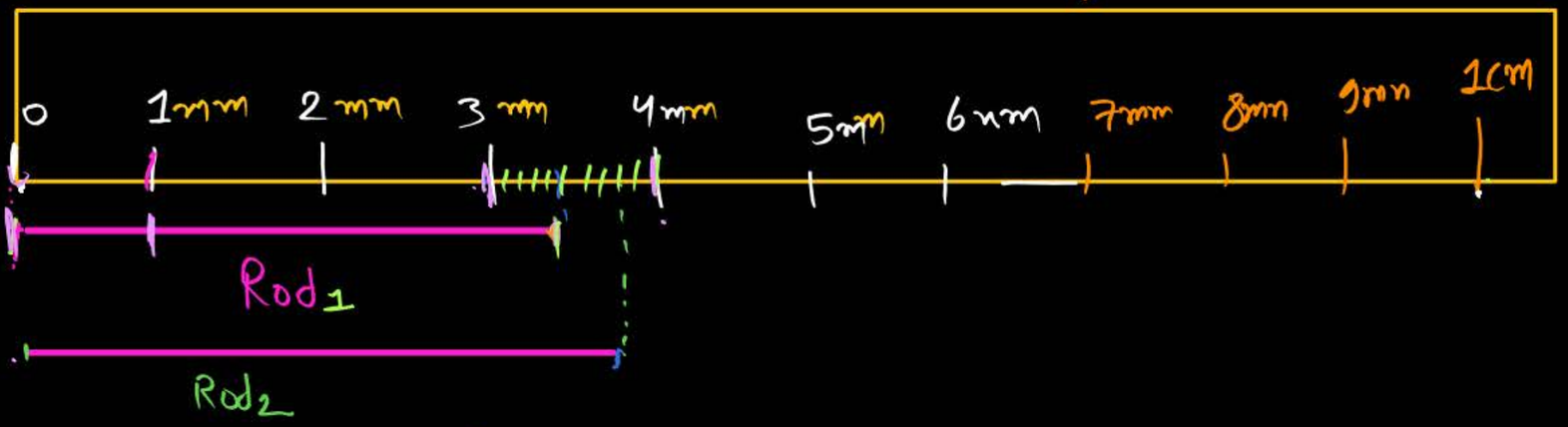
1. Metre Scale
2. Vernier Calliper
3. Screw gauge

# Metre scale

1 cm = 10 mm

1 Metre scale division = 1 mm

Metre scale




- Maximum error can be produce by metre scale = 1 mm = L.C
- L.C = minimum reading taken by instrument is least count

Metre scale ki aukad pata chal gai

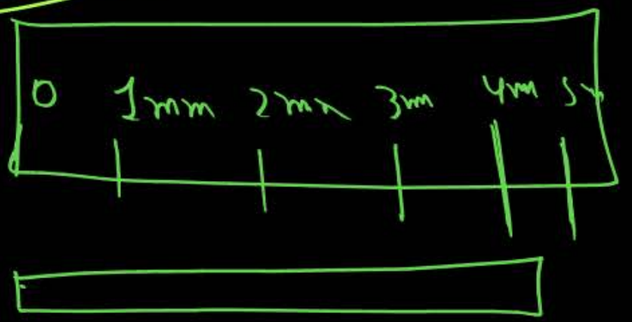
length of Rod 1 = 3mm

length of Rod 2 = 3m

final reading by metre scale $= (l_s \pm L.C)\ mm$

# $L.C$ → can be consider as **absolute error**

## #metre scale




Rod $= (4mm \pm 1mm)$ Ans

# Vernier callipers:

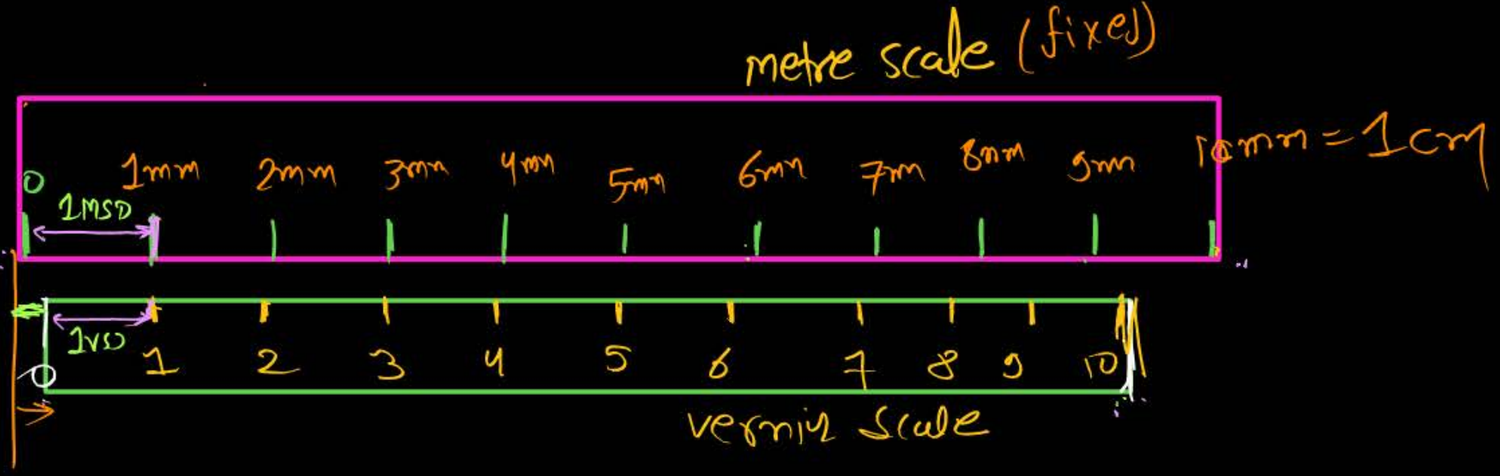
(main scale divion)

**1 M.S.D = 1mm**

$$1\ V.S.D = \frac{9mm}{10}$$

**1 V.S.D = 0.9 mm**

Vernier scale division




L.C (minimum reading that can be taken) = 1 M.S.D − 1 V.S.D

6 metre scale division (main scale) is coinside with 10 vernier scale division if 1 M.S.D = 1mm then find L.C of vernier calliper

$$6\,M.S.D = 10\,V.S.D$$

$$\frac{6 \times 1mm}{10} = 1\,V.S.D$$

$$1\,V.S.D = 0.6mm$$

$$L.C = 1\,M.S.D - 1\,V.S.D = 1mm - 0.6mm = 0.4\,mm$$

**Question**

Main scale division is 1 cm and 9 MSD coinside with 12VSD then find LC?

$1\ M.S.D = 1\ cm$

$9\ MS.D = 12\ VS.D$

$1\ VS.D = \frac{9}{12}\ MS.D$ — (1)

$L.C = 1\ MS.D - 1\ VS.D$

$= 1cm - \frac{9}{12}cm$

$= \frac{12-9}{12} = \frac{3}{12}cm = \frac{1}{4}cm = 0.25cm$

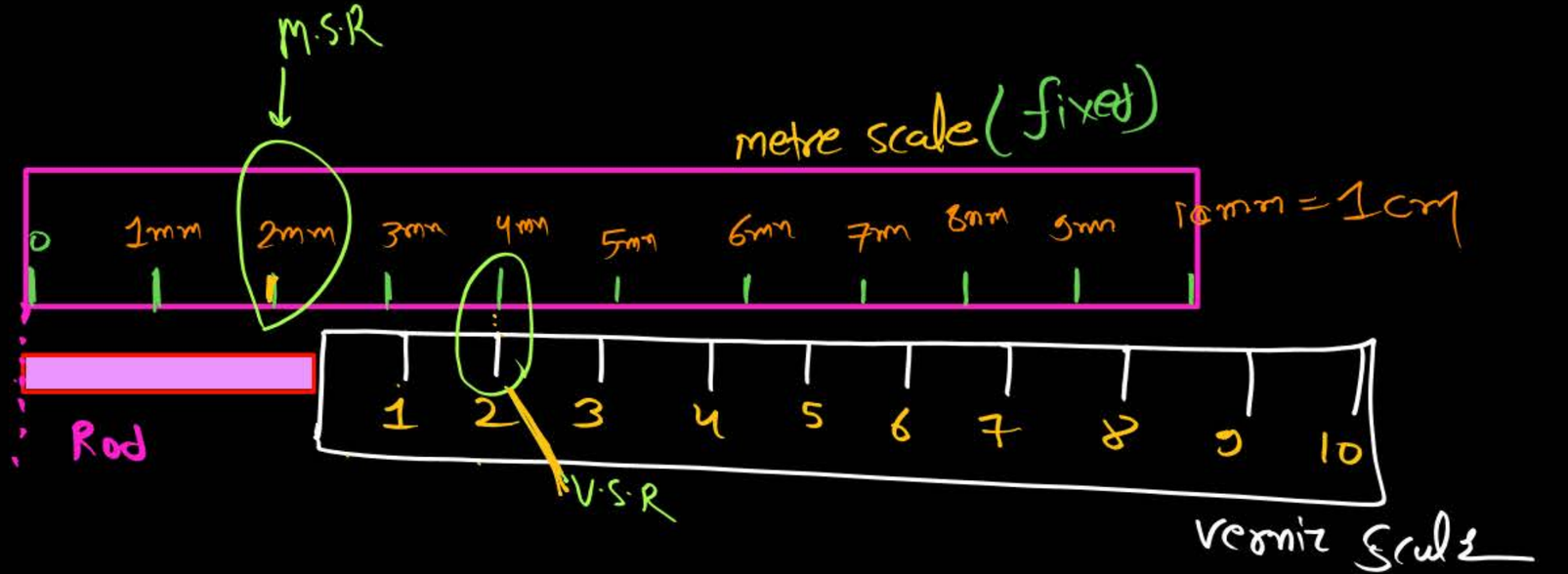
MR* Box

Vernier Callipers ke L.C. ke like question se 2 information find karo,

1. M.S.D ki value ✓
2. Kitne M.S.D, kitne V.S.D coinside kiya ✓
3. Use $L.C = 1\ M.S.D - 1\ V.S.D$

# Reading by vernier Callipers:-

L.C = 0.1mm




$$\text{length of Rod} = \{\underbrace{\text{M.S.R}}_{\text{main scale Reading}} + [\underbrace{\text{V.S.R}}_{\text{vernier}} \times \text{L.C}]\}$$

$$\text{final reading} = (\text{If} \pm \text{l.c})$$

$$= (2.2\text{mm} \pm 0.1\text{mm})$$

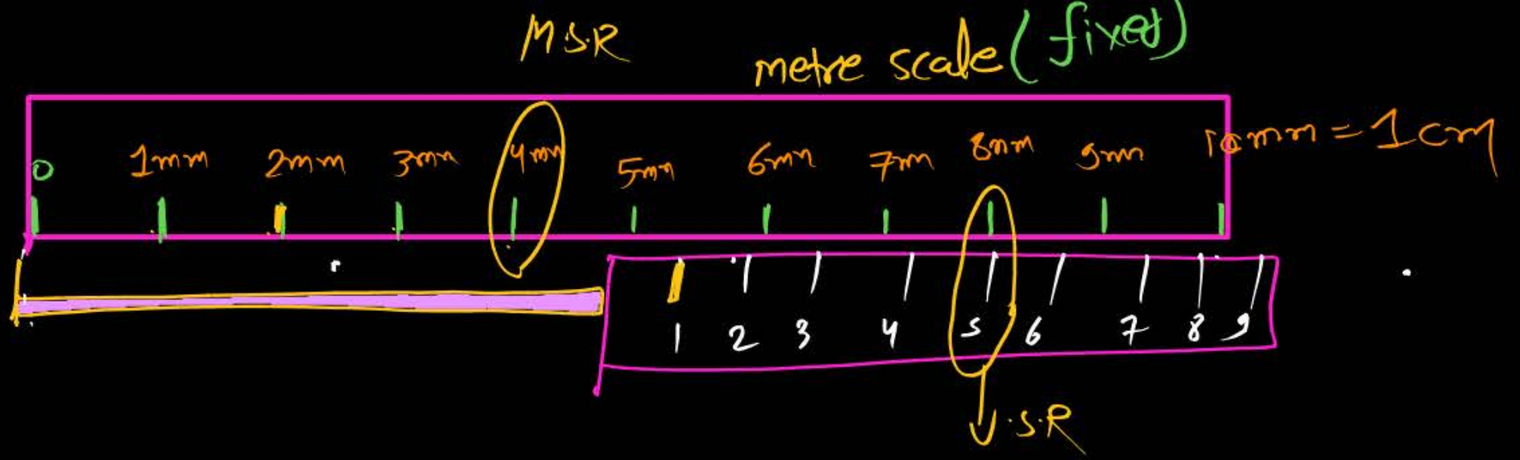
$$= 2\text{mm} + 2 \times (0.1)\text{mm} = 2\text{mm} + 0.2\text{mm}$$

$$= 2.2\text{mm}.$$

$$=$$

# Reading by vernier Callipers:-

L.C = 0.1mm




$$\text{length of Rod} = \left[ \text{M.S.R} + (\text{L.C} \times \text{V.S.R}) \right]$$

$$= (4 + 0.5)\text{mm}$$

$$= 4.5\text{mm}$$

**Question**

In certain vernier callipers, 25 divisions on the vernier scale have the same length as 24 divisions on the main scale. One division on the main scale is 1 mm long. The least count of the instrument is

1. 0.04 mm
2. 0.01 mm
3. 0.02 mm
4. 0.08 mm

25 V.S.D

1 M.S.D = 1 mm

25 V.S.D = 24 M.S.D

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

$$= 1\ mm - \frac{24}{25}\ 1\ mm$$

$$= \left(\frac{25-24}{25}\right) 1\ mm = \frac{1\ mm}{25}\left(\frac{4}{100}\right) = 0.04\ mm$$

## Question

In a Vernier calliper, one main scale division is $x$ cm and $n$ division of Vernier scale coincide with $(n-1)$ division of the main scale. The least count of the Vernier caliper in cm is:

1. $\left(\frac{n-1}{n}\right)x$
2. $\frac{nx}{(n-1)}$
3. $\frac{x}{n}$
4. $\frac{x}{n-1}$

$1\ \text{MSD} = x\ \text{cm}$

$n\ \text{VSD} = (n-1)\ \text{MSD}$

$\text{L.C} = 1\ \text{MSD} - 1\ \text{VSD}$

$= x\ \text{cm} - \left(\frac{n-1}{n}\right)\text{M.S.D}$

$= x\ \text{cm}\left[1 - \frac{(n-1)}{n}\right] = x\ \text{cm}\left(\frac{n-n+1}{n}\right)$

$= \frac{x}{n}\ \text{cm}.$

## MR Problem

main scale
vernier Scale

One cm on the main scale of vernier callipers is divided into ten equal parts. If 20 divisions of vernier scale coincide with 8 small divisions of the main scale. What will be the least count of callipers?

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

$$= 1mm - \frac{8}{20}(1mm)$$

$$= 1mm\left(\frac{20-8}{20}\right) = \frac{12}{20}mm$$

$$= \frac{3}{5}mm$$

$$= 0.6mm$$

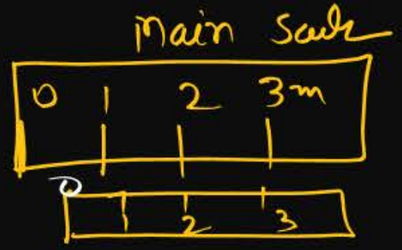
$1cm = 10\ M.S.D$

$1\ M.S.D = \frac{1cm}{10} = 1mm$

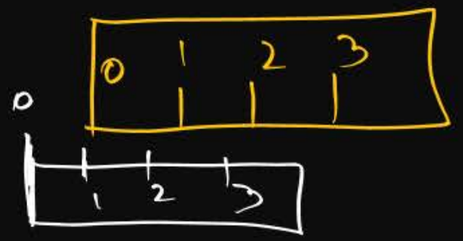
$20\ V.S.D = 8\ M.S.D$

# ZERO ERROR

→ Zero error always subtracted with proper sign.




{ zero → +ve zero error }



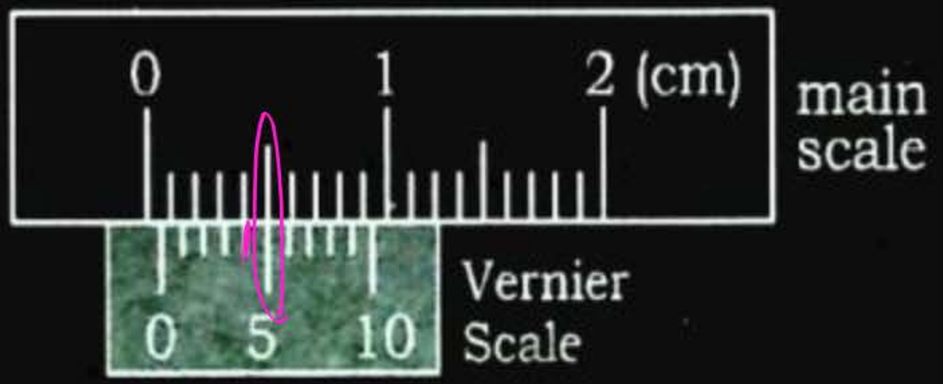

zero error = -ve.

**Question**

Vernier Constant → L.C of vernier Scale

Find the zero correction in the given figure.

1. 0.4 mm
2. 0.5 mm ✓
3. −0.5 mm ✗
4. −0.4 mm ✗




zero error = +ve

= 5 × 0.1 mm

= 0.5 mm

# Screw gauge

Metre scale

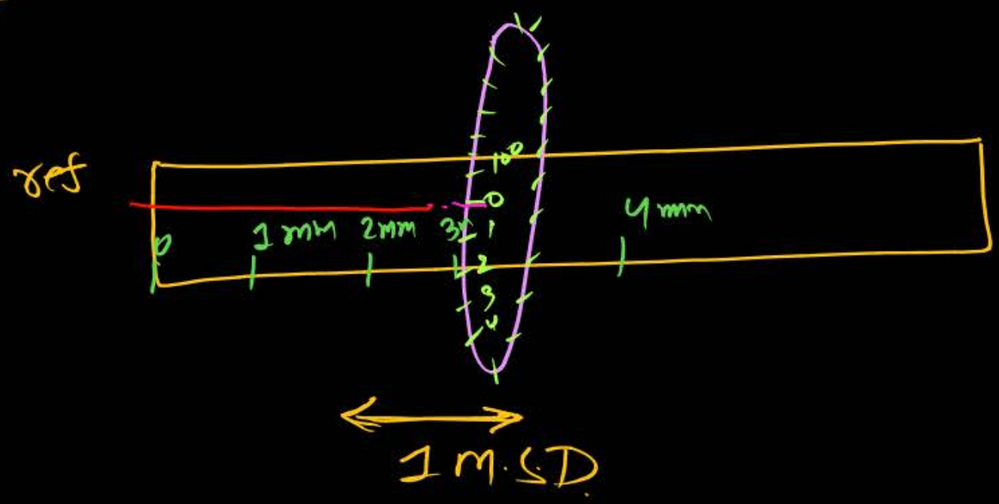
L.C = 1mm

Vernier Calliper

L.C = 0.1mm

Screw gauge

L.C = 0.01mm




* $$L.C = \frac{\text{distance travelled by circular Scale in one Rotation}}{\text{No of circular division}} = \frac{\text{Pitch}}{\text{No of circular division}}$$ ✓

## Question

A screw gauge has least count of 0.01 mm and there arc 50 divisions in its circular scale. The pitch of the screw gauge is

[NEET-2021]

1. 0.01 mm
2. 0.25 mm
3. 0.5 mm
4. 1.0 mm

$$L.C = 0.01mm = \frac{\text{Pitch}}{\text{no of circul division}}$$

$$\text{Pitch} = L.C \times \text{no of circul}$$

$$= 0.01mm \times 50$$

$$= 0.5\,mm$$

@MRPHYSICSS

# THANK YOU