Nishant Jindal

ERROR

↳ (Measured value − True value)

Systematic Error

- Instrumental error
- Imperfection in experimental technique.
- Variation in experimental Condition
- Personal Error

Random Error

↳ Doesn't associated With any fixed Cause.

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ERROR

Absoulute Error

It is difference b/w individual measured value & true value.

True value

let, $a_1, a_2 - - - a_n$ be n observations.

$$a_{mean} = \left(\frac{a_1 + a_2 - - \cdot + a_n}{n}\right)$$

$\Downarrow$

(True Value)

Absolute Error.

$$\Delta a_1 = |a_1 - a_{mean}|$$

$$\Delta a_2 = |a_2 - a_{mean}|$$

$$\vdots$$

$$\Delta a_n = |a_n - a_{mean}|$$

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Relative Error

$$\text{Relative Error} = \left(\frac{\text{Mean of all absolute errors}}{\text{True Value}}\right) = \left(\frac{\Delta a_{mean}}{a_{mean}}\right)$$

Mean of absolute error

$$\Delta a_{mean} = \left(\frac{\Delta a_1 + \Delta a_2 \dots + \Delta a_n}{n}\right)$$

Percentage Error

$$= \left(\frac{\Delta a_{mean}}{a_{mean}} \times 100\right)$$

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Error in Sum or difference

$$Z = a+b.$$

$$Z \pm \Delta Z = (a \pm \Delta a) + (b \pm \Delta b)$$

$$\cancel{Z} \pm \Delta Z = \cancel{(a+b)} \pm \Delta a \pm \Delta b.$$

$$\pm \Delta Z = \pm \Delta a \pm \Delta b$$

Maximum permessible error $\rightarrow (+)$

$$\boxed{\Delta Z = \Delta a + \Delta b}$$

$$Z = a-b.$$

$$(Z \pm \Delta Z) = (a \pm \Delta a) - (b \pm \Delta b)$$

$$\cancel{Z} \pm \Delta Z = \cancel{(a-b)} \pm \Delta a \mp \Delta b.$$

$$(\pm \Delta Z = \pm \Delta a \mp \Delta b)$$

Maximum permessible error

$\hookrightarrow$ + sign

$$\boxed{\Delta Z = \Delta a + \Delta b}$$

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Error in Multiplication & Division

$Z = ab$

$(Z \pm \Delta Z) = (a \pm \Delta a)(b \pm \Delta b)$

$\cancel{Z} \pm \Delta Z = \cancel{ab} \pm a\Delta b \pm b\Delta a \pm \cancel{\Delta a \cdot \Delta b}$ $\rightarrow 0$

$\pm \Delta Z = \pm a\Delta b \pm b\Delta a$

$\frac{\pm \Delta Z}{Z} = \frac{\pm a\Delta b}{ab} \pm \frac{b\Delta a}{ab}$

$\left(\pm \frac{\Delta Z}{Z} = \pm \frac{\Delta b}{b} \pm \frac{\Delta a}{a}\right)$

Maximum Relative error

**

$$\boxed{\frac{\Delta Z}{Z} = \frac{\Delta a}{a} + \frac{\Delta b}{b}}$$

$Z = ab$

$\log Z = \log a + \log b$

Differenting w.r.t a

$\frac{1}{Z}\frac{dZ}{da} = \frac{1}{a} + \frac{1}{b}\frac{db}{da}$

$\left(\frac{dZ}{Z} = \frac{da}{a} + \frac{db}{b}\right)$ ✓

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Error in Case of division

$$z = \frac{a}{b}.$$

$$(z \pm \Delta z) = \frac{(a \pm \Delta a)}{(b \pm \Delta b)}$$

$$\cancel{z}\left(1 \pm \frac{\Delta z}{z}\right) = \frac{\cancel{a}\left(1 \pm \frac{\Delta a}{a}\right)}{\cancel{b}\left(1 \pm \frac{\Delta b}{b}\right)}$$

$$\left(1 \pm \frac{\Delta z}{z}\right) = \left[\left(1 \pm \frac{\Delta a}{a}\right)\left(1 \mp \frac{\Delta b}{b}\right)\right]$$

$$\cancel{1} \pm \frac{\Delta z}{z} = \cancel{1} \mp \frac{\Delta b}{b} \pm \frac{\Delta a}{a} \pm \underbrace{\left(\frac{\Delta a}{a}\right)\left(\frac{\Delta b}{b}\right)}_{\to 0}$$

$$\left(\pm \frac{\Delta z}{z}\right) = \left(\pm \frac{\Delta a}{a} \mp \frac{\Delta b}{b}\right)$$

Maximum Relative error → +ve sign

$$\boxed{\frac{\Delta z}{z} = \frac{\Delta a}{a} + \frac{\Delta b}{b}}$$

$$z = \frac{a}{b}$$

$$\log z = \log a - \log b.$$

$$\frac{1}{z}\frac{dz}{da} = \frac{1}{a} - \left(\frac{db}{b}\right) \pm$$

For Maximum Relative error → (+ve)

$$\left(\frac{dz}{z} = \frac{da}{a} + \frac{db}{b}\right) \checkmark$$

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$$Z = \left(\frac{a^m \cdot b^n}{c^p} \right)$$

$$\boxed{\frac{\Delta Z}{Z} = m\left(\frac{\Delta a}{a}\right) + n\left(\frac{\Delta b}{b}\right) + p\left(\frac{\Delta c}{c}\right)}$$

Maximum Relative error

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Resistance in parallel

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

Differentiating both Side w.r.t R_1

$$-\frac{1}{R^2}\frac{dR}{dR_1} = -\frac{1}{R_1^2} - \frac{1}{R_2^2}\frac{dR_2}{dR_1}$$

$$\frac{dR}{R^2} = \frac{dR_1}{R_1^2} + \frac{dR_2}{R_2^2}$$

$$\frac{\Delta R}{R^2} = \frac{\Delta R_1}{R_1^2} + \frac{\Delta R_2}{R_2^2}$$

ERROR

Q.1 The maximum error in the measurement iof resistance, current and time for which current flows in an electrical circuit are $1\%, 2\%$ and 3% respectively. The maximum percentage error in the detection of the dissipated heat will be:

(+ve sign)

[July 25, 2022 (II)]

(A) 2 (B) 4 (C) 6 (D) 8

$$H = i^2 R t$$

$$\log H = 2\log i + \log R + \log t$$

$$\frac{1}{H}\frac{dH}{di} = \frac{2}{i} + \frac{1}{R}\frac{dR}{di} + \frac{1}{t}\frac{dt}{di}$$

$$\frac{dH}{H} = 2\frac{di}{i} + \frac{dR}{R} + \frac{dt}{t}$$

$$H = i^2 R t$$

$$100 \times \frac{\Delta H}{H} = \left[2\left(\frac{\Delta i}{i}\right) + \left(\frac{\Delta R}{R}\right) + \left(\frac{\Delta t}{t}\right)\right] \times 100$$

$$= 2\left(\frac{\Delta i}{i} \times 100\right) + \left(\frac{\Delta R}{R} \times 100\right) + \left(\frac{\Delta t}{t} \times 100\right)$$

$$= (2 \times 2) + (1) + 3 = 8$$

ERROR

True value

Q.2 A silver wire has mass $(0.6 \pm 0.006)\mathrm{g}$, radius (0.5 ± 0.005) mm and length $(4 \pm 0.04)\mathrm{cm}$. The maximum percentage error in the measurement of its density will be :

error error

[June 27, 2022 (I)]

(A) 4% (B) 3% (C) 6% (D) 7%

$$\rho = \frac{m}{Al}$$

$$A = \pi r^2$$

$$\rho = \frac{m}{\pi r^2 l}$$

$$\frac{\Delta\rho}{\rho} = \frac{\Delta m}{m} + 2\left(\frac{\Delta r}{r}\right) + \left(\frac{\Delta l}{l}\right)$$

$$100 \times \frac{\Delta\rho}{\rho} = \left[\left(\frac{0.006}{0.6}\right) + 2\left(\frac{0.005}{0.5}\right) + \left(\frac{0.04}{4}\right)\right] \times 100$$

ERROR

Q.3 For $z = a^2x^3y^{1/2}$, where ' a ' is a constant. If percentage error in measurement of ' x ' and ' y ' are 4% and 12%, respectively, then the percentage error for ' z ' will be %.

[June 25, 2022 (II)]

$$\frac{\Delta z}{z} = 3\left(\frac{\Delta x}{x}\right) + \frac{1}{2}\left(\frac{\Delta y}{y}\right)$$

$$\frac{\Delta z}{z}\times 100 = 3\left(\frac{\Delta x}{x}\times 100\right) + \frac{1}{2}\left(\frac{\Delta y}{y}\times 100\right)$$

$$= (3\times 4) + \frac{1}{2}\times 12$$

$$= 12 + 6$$

$$= \underline{18\%}$$

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ERROR

Q.4 A student determined Young's Modulus of elasticity using the formula $Y = \frac{MgL^3}{4bd^3\delta}$. The value of g is taken to be $9.8\ m/s^2$, without any significant error, his observation are as following.

Constant.

Physical Quantity	Least count of the Equipment used for measurement	Observed value
Mass (M)	Δm. ← $1\ g$	$2\ kg$
Length of bar (L)	Δl ← $1\ mm$	$1\ m$
Breadth of bar (b)	Δb ← $0.1\ mm$ Error	$4\ cm$
Thickness of bar (d)	Δd ← $0.01\ mm$	$0.4\ cm$
Depression (δ)	$\Delta \delta$ ← $0.01\ m$	$5\ mm$

Check

$$\frac{\Delta Y}{Y} = \frac{\Delta M}{M} + 3\left(\frac{\Delta L}{L}\right) + \left(\frac{\Delta b}{b}\right) + 3\left(\frac{\Delta d}{d}\right) + \left(\frac{\Delta \delta}{\delta}\right)$$

Then the fractional error in the measurement of Y is : **[Sep. 1, 2021 (II)]**

(A) 0.0083 (B) 0.0155 (C) 0.155 (D) 0.083

ERROR

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ERROR

Q.5 Two resistors $R_1 = (4 \pm 0.8)\Omega$ and $R_2 = (4 \pm 0.4)\Omega$ are connected in parallel. The equivalent resistance of their parallel combination will be: **[Sep.1, 2021 (II)]**

(A) $(4 \pm 0.4)\Omega$ (B) $(2 \pm 0.4)\Omega$

(C) $(2 \pm 0.3)\Omega$ (D) $(4 \pm 0.3)\Omega$

$$\frac{\Delta R}{R^2} = \frac{\Delta R_1}{R_1^2} + \frac{\Delta R_2}{R_2^2}$$

$$\frac{\Delta R}{R^2} = \frac{0.8}{4^2} + \frac{0.4}{4^2}$$

$$\Delta R = \left(\frac{0.8 + 0.4}{4^2} \times 2^2\right)$$

$$\Delta R = \frac{1.2}{4} = \underline{0.3}$$

$$\underline{\underline{R}} = \frac{R_1 R_2}{R_1 + R_2} = \frac{4 \times 4}{2 \times 4} = \frac{4}{2} = 2$$

$$R' = (2 \pm 0.3)\Omega$$

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ERROR

Q.6 If the length of the pendulum in pendulum clock increases by 0.1%, then the error in time per day is: [Aug. 26, 2021 (II)]

(A) $86.4\ s$ (B) $4.32\ s$ (C) $43.2\ s$ (D) $8.64\ s$

$\frac{\Delta L}{L} \times 100 = 0.1$

$\left(\frac{\Delta L}{L}\right) = \left(\frac{0.1}{100}\right)$

$T = 2\pi\sqrt{\ell/g}$

$\frac{\Delta T}{T} = \frac{1}{2}\left(\frac{\Delta L}{L}\right)$

$\frac{\Delta T}{T} = \frac{1}{2}\left(\frac{\Delta L}{L}\right)$

$= \frac{1}{2} \times \left(\frac{0.1}{100}\right)$

$= \frac{1}{2} \times 10^{-3}$

0.5×10^{-3}

Per day

$= 0.5 \times 3600 \times 24 \times 10^{-3}$

$= 43200 \times 10^{-3}$

$= 43.2\ sec$

ERROR

Q.7 The radius of a sphere is measured to be $(7.50 + 0.85)\text{cm}$. Suppose the percentage error in its volume is x. The value of x, to the nearest x, is 34.

[March 18, 2021 (11)]

$$V = \underbrace{\frac{4}{3}\pi}_{\text{constant}} r^3$$

$$\frac{\Delta V}{V} = 3\left(\frac{\Delta r}{r}\right)$$

$$= 3\left(\frac{0.85}{7.50}\right)$$

$$x = \frac{\Delta V}{V} \times 100 = 3 \times \left(\frac{0.85}{7.50} \times 100\right)$$

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ERROR

Q.8 The resistance $R = \frac{V}{I}$, where $V = (50 \pm 2)V$ and $I = (20 \pm 0.2)A$. The percentage error in R is $'x'\%$. 5%

The value of ' x ' to the nearest integer is **[March 16, 2021 (I)]**

$$\frac{\Delta R}{R} \times 100 = \left(\frac{\Delta V}{V} \times 100\right) + \left(\frac{\Delta I}{I} \times 100\right)$$

$$= \left(\frac{2}{50} + \frac{0.2}{20}\right) \times 100$$

$$= \left(\frac{1}{25} + \frac{1}{100}\right) \times 100$$

$$= \frac{5}{\cancel{100}} \times \cancel{100}$$

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ERROR

Q.9 The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{\frac{L}{g}}$. Measured value of '$L$' is $1.0\ \text{m}$ from meter scale having a minimum division of $1\ \text{mm}$ and time of one complete oscillation is $1.95\ \text{s}$ measured from stopwatch of $0.01\ \text{s}$ resolution. The percentage error in the determination of 'g' will be: **[Feb. 24, 2021 (II)]**

L.C = error = ΔL

ΔT

(A) 1.13% (B) 1.03% (C) 1.33% (D) 1.30%

$$T^2 = 4\pi^2 \frac{L}{g}$$

$$g = \frac{4\pi^2 L}{T^2}$$

$$\frac{\Delta g}{g} \times 100 = \left[\frac{\Delta L}{L} + 2\left(\frac{\Delta T}{T}\right)\right] \times 100$$

$$= \left[\left(\frac{1\times10^{-3}}{1}\right) + \left(2 \times \frac{0.01}{1.95}\right)\right] \times 100$$

ERROR

Q.10 A physical quantity z depends on four observables a, b, c and d, as $z = \frac{a^2 b^{\frac{2}{3}}}{\sqrt{c} d^3}$. The percentages of error in the measurement of a, b, c and d are $2\%, 1.5\%, 4\%$ and 2.5% respectively. The percentage of error in z is :

[Sep. 05, 2020 (I), 2017 (S); Online April 9 (S), 2017 (S)]

(A) 12.25% (B) 16.5% (C) 13.5% (D) 14.5%

$$\frac{\Delta z}{z} \times 100 = \left[2\left(\frac{\Delta a}{a}\right) + \frac{2}{3}\left(\frac{\Delta b}{b}\right) + \frac{1}{2}\left(\frac{\Delta c}{c}\right) + 3\left(\frac{\Delta d}{d}\right)\right] \times 100$$

$=$

$$\frac{\Delta a}{a} \times 100 = 2$$

ERROR

Q.11 The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{\frac{L}{g}}$. Measured value of L is 20.0 cm known to 1 mm accuracy and time for 100 oscillations of the pendulum is found to be 90 s using a wrist watch of 1 s resolution. The accuracy in the determination of g is : **[2015]**

(A) 1% (B) 5% (C) 2% (D) 3%

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VERNEIR CALLIPER

(Main Scale)

(Vernier Scale)

(Division of vernier slightly less than Main scale in general)

Size of 1 main Scale unit = S unit

Size of 1 vernier Scale unit = V unit

let, N^{th} division of vernier concide with $(N-1)^{th}$ division of Main scale

$$(N-1)S = NV$$

$$NS - S = NV$$

$$N(S-V) = S$$

$$S - V = \frac{S}{N}$$

$$\boxed{(1 \cdot M \cdot S \cdot D) - (1 V \cdot S \cdot D) = \frac{S}{N}}$$

$\Downarrow$

Least Count or Vernier Constant

L.C or V.C

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Ex:-

24th division of Main Scale Concide With 25th division of vernier. 1 unit of Main scale is 1mm

25th divison of V.S.D = 24th division of M.S.D

$$1 (V.S.D) = \left(\frac{24}{25}\right) \underline{M.S.D}$$

1 M.S.D = 1mm

$$\text{least Count} = 1\ M.S.D - 1\ V.S.D$$

$$= M.S.D\left(1 - \frac{24}{25}\right)$$

$$= \frac{1}{25}\,\underline{\underline{mm}} = 0.04\,mm$$

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least Count of Standard vernier ($1 M.S.D = 1 mm$)

9^{th} division of M.S.D concide with 10^{th} division of V.S.D.

$$1 V.S.D = \left(\frac{9}{10} M.S.D\right)$$

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

$$= \left(1 - \frac{9}{10}\right) M.S.D$$

$$= \frac{1}{10} \times (\underset{\Downarrow}{M.S.D})$$

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

$$= \boxed{0.1 mm \text{ or } 0.01 cm}$$

✓

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Reading :- $M.S.R + V.S.R$

$$V.S.R = (n \times L.C)$$

$n =$ (No of division of vernier Conciding with main scale)

$$\boxed{\text{Reading} = M.S.R + (n \times L.C)}$$

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ERROR

No ERROR :- (zero of vernier concide with zero of Main Scale)

Zero ERROR

(+ve zero error
zero of vernier at the right of zero of Main Scale)

$$\boxed{\text{True Value} = \begin{pmatrix}\text{Measured}\\ \text{Value}\end{pmatrix} - (\text{+ve Error})}$$

(-ve Error)
zero of vernier at the left side of zero of Main scale.

$$\boxed{\text{True value} = \begin{pmatrix}\text{Measured}\\ \text{Value}\end{pmatrix} + \begin{pmatrix}\text{-ve}\\ \text{Error}\end{pmatrix}}$$

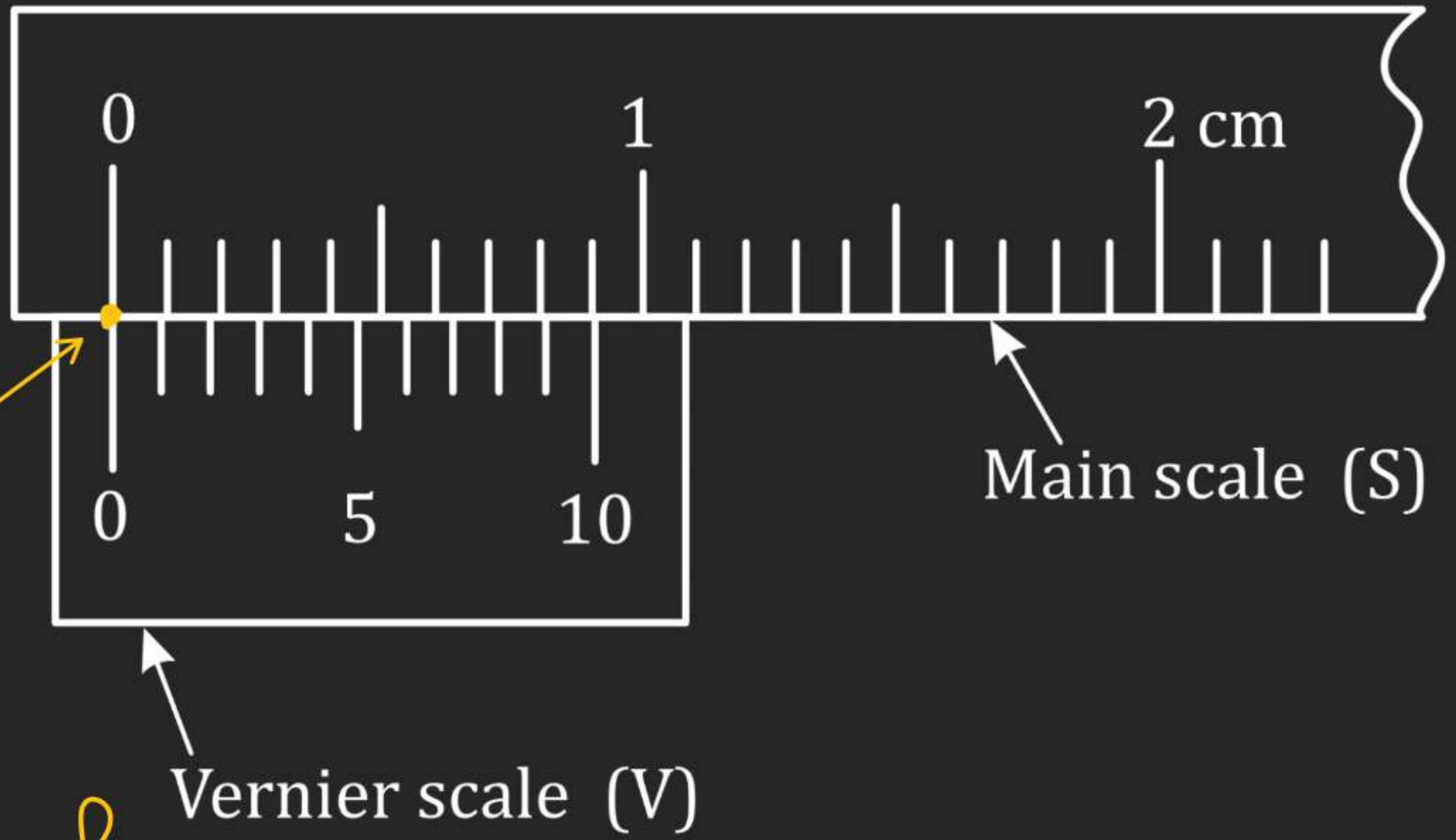
+ve Error

$$= \left(\text{Zero position of vernier}\right) + \left(\text{No of division of vernier Conciding with Main scale}\right) \times L.C.$$

-ve Error

$$= \left(\text{Zero position of vernier}\right) + \left[\left(\text{Total No of division on Vernier}\right) - \left(\text{No of division Conciding With Main Scale}\right)\right] \times L.C$$

No Error



[Zero of Vernier Conciding with zero of Main scale

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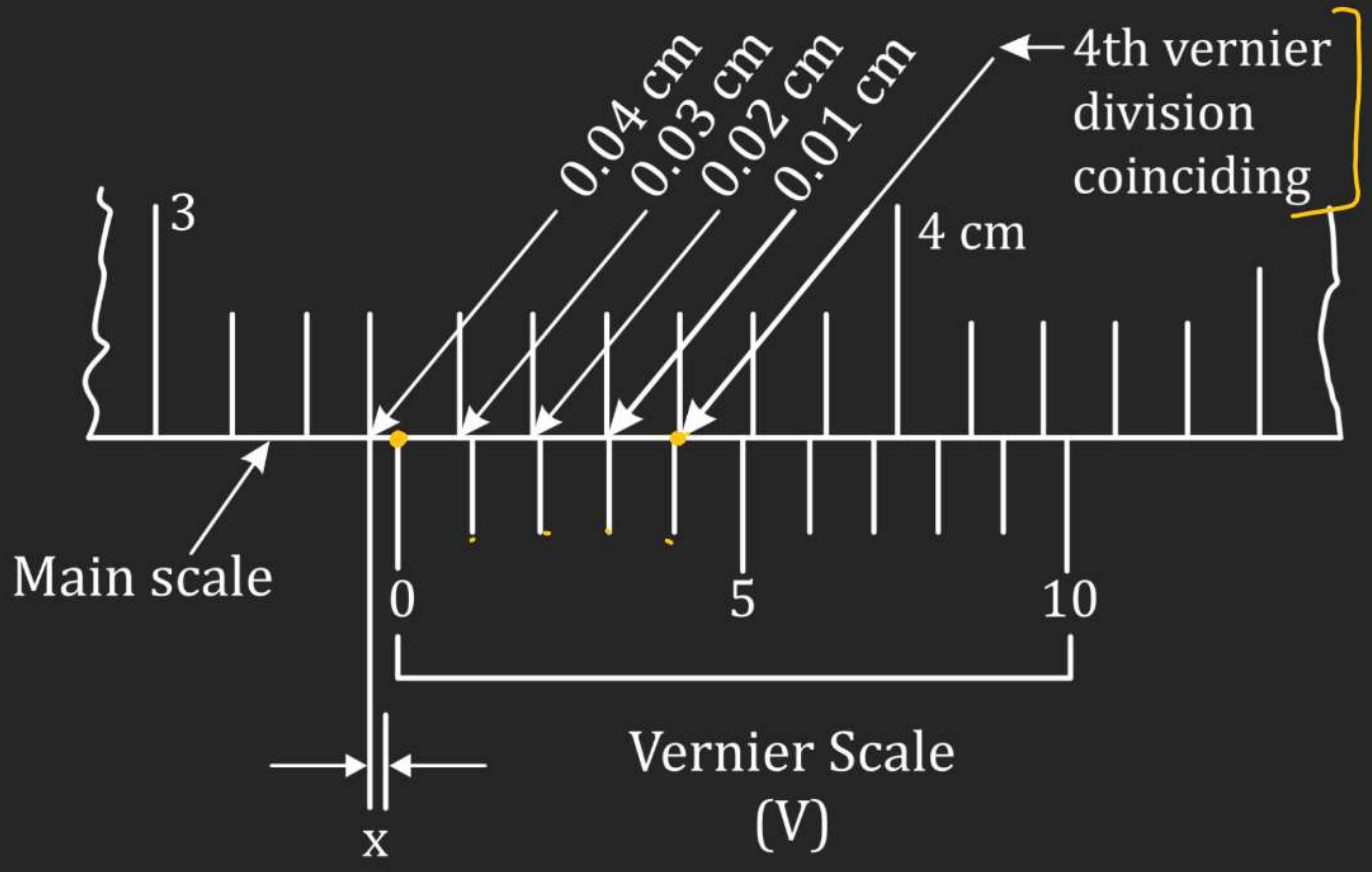
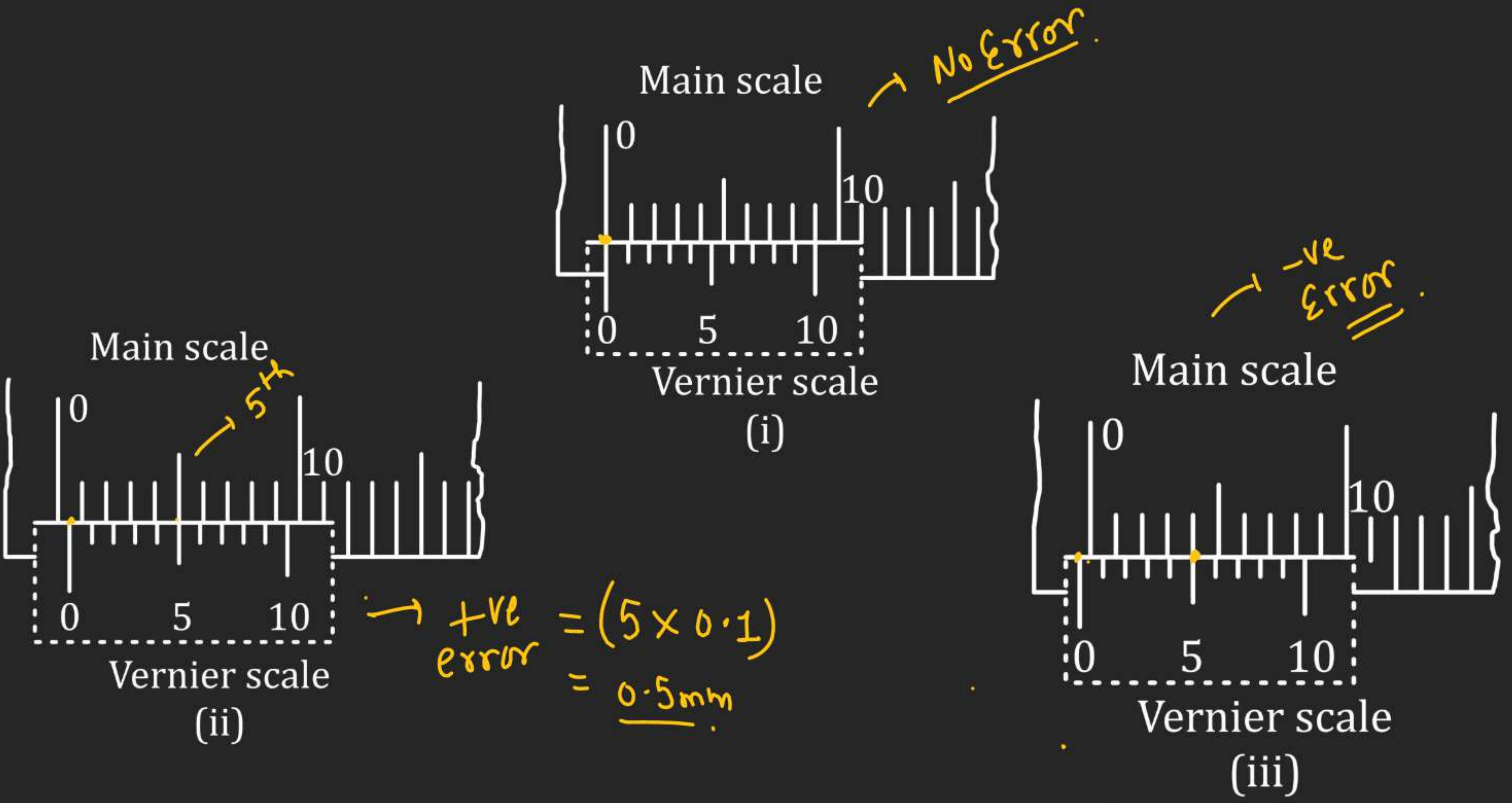


Fig. Reading a vernier. 4th division of vernier scale coincides with a division on main scale.



+ve error $= (5 \times 0.1)$

$= 0.5\,mm$.

Fig. Zero error of the Vernier Callipers.

(i) error nil, (ii) error positive and (iii) error negative.

-ve error $= -(10-5) \times L.C$

$= -5 \times 0.1\,mm$

$= -0.5\,mm$.

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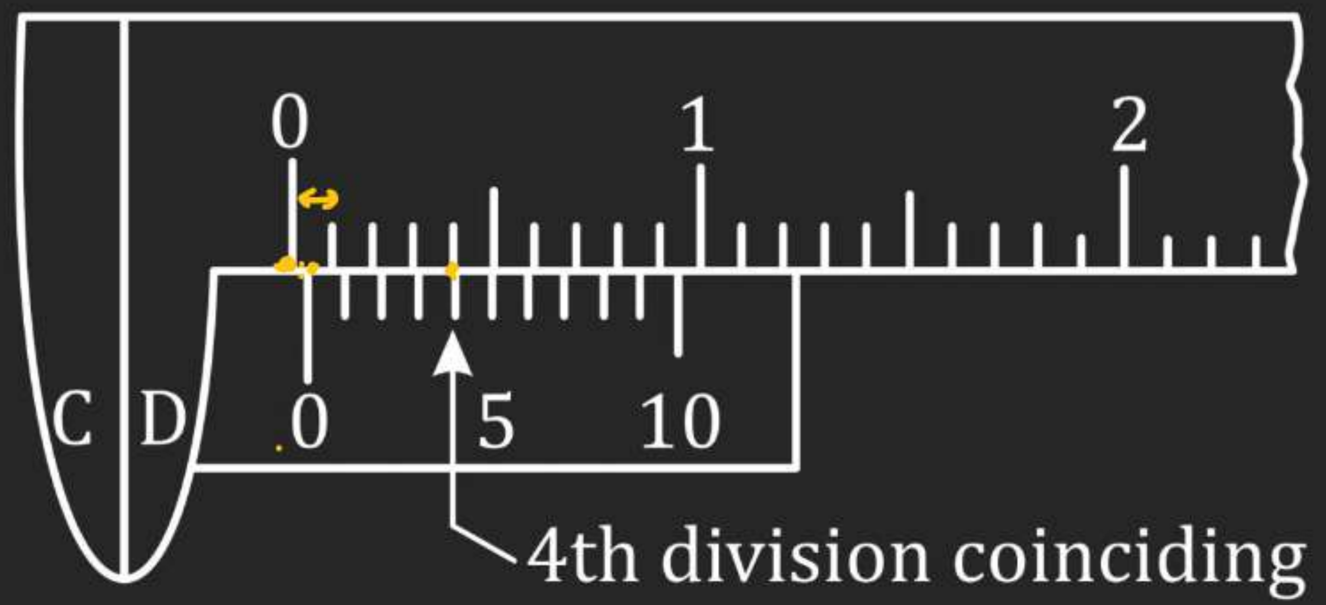

Fig. Positive zero error (+0.04 cm) and its correction.

+ve Error = $4 \times (0.1)$ mm

= $\underline{0.4 \text{ mm}}$

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−ve Error

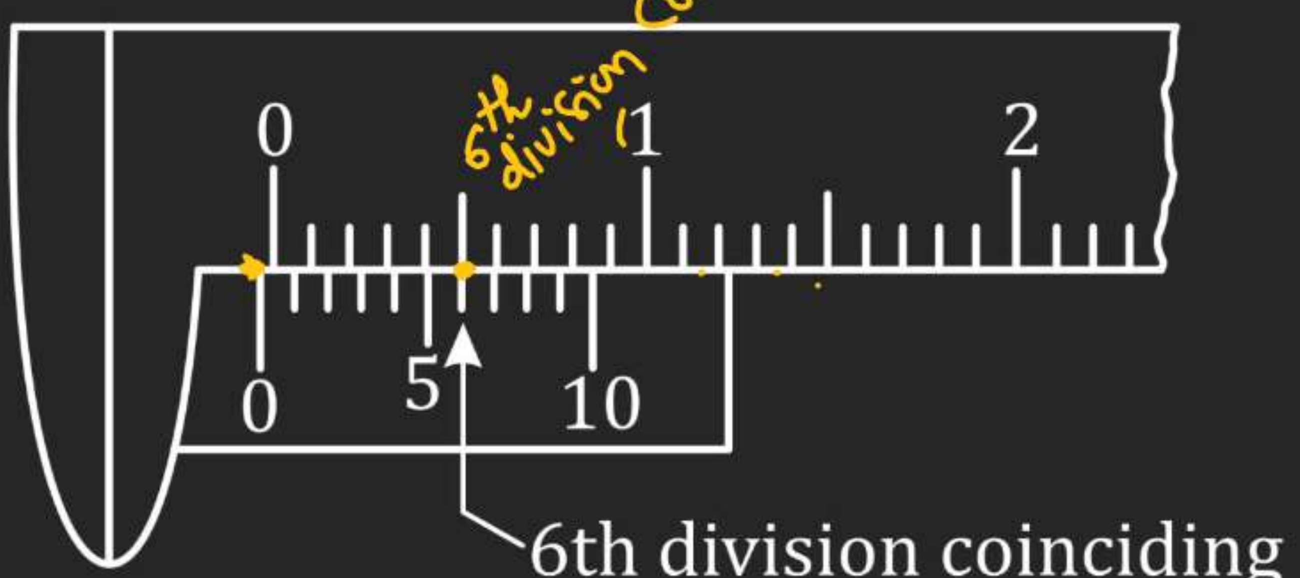

Fig. Negative zero error (-0.04cm) and its correction.

Total No of division on vernier

$$\left(\begin{matrix}-ve \\ Error\end{matrix}\right) = (10 - 6) \times L \cdot C$$

$$= (4 \times 0 \cdot 1)\,mm$$

$$= 0 \cdot 4\,mm$$

or $0 \cdot 04\,cm$

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SCREW GAUGE

Pitch

If y be the no of Rotation

x be the linear distance travelled

$$\text{pitch} = \frac{\text{linear distance}}{\text{No of Rotation}} = \left(\frac{x}{y}\right) \checkmark$$

Least Count

$$= \left(\frac{\text{pitch}}{\text{No of division on Circular scale}}\right) \checkmark$$

if pitch = 1mm
No of division on circular scale = 100

$$\rightarrow L.C = \left(\frac{1}{100}\right)\text{mm}$$
$$= 0.01\,\text{mm}$$
$$= 0.001\,\text{cm}$$

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$$\boxed{\text{Reading} = (M \cdot S \cdot R + C \cdot S \cdot R) \rightarrow \left(\begin{array}{c}\text{Without} \\ \text{any error}\end{array}\right)}$$

$$C \cdot S \cdot R = (n \times L \cdot C)$$

(n = No of division of Circular Scale Conciding with Main scale division)

Error:

No Error: (Zero of Main scale concide with zero of circular scale)

Either 100 division or 50 division

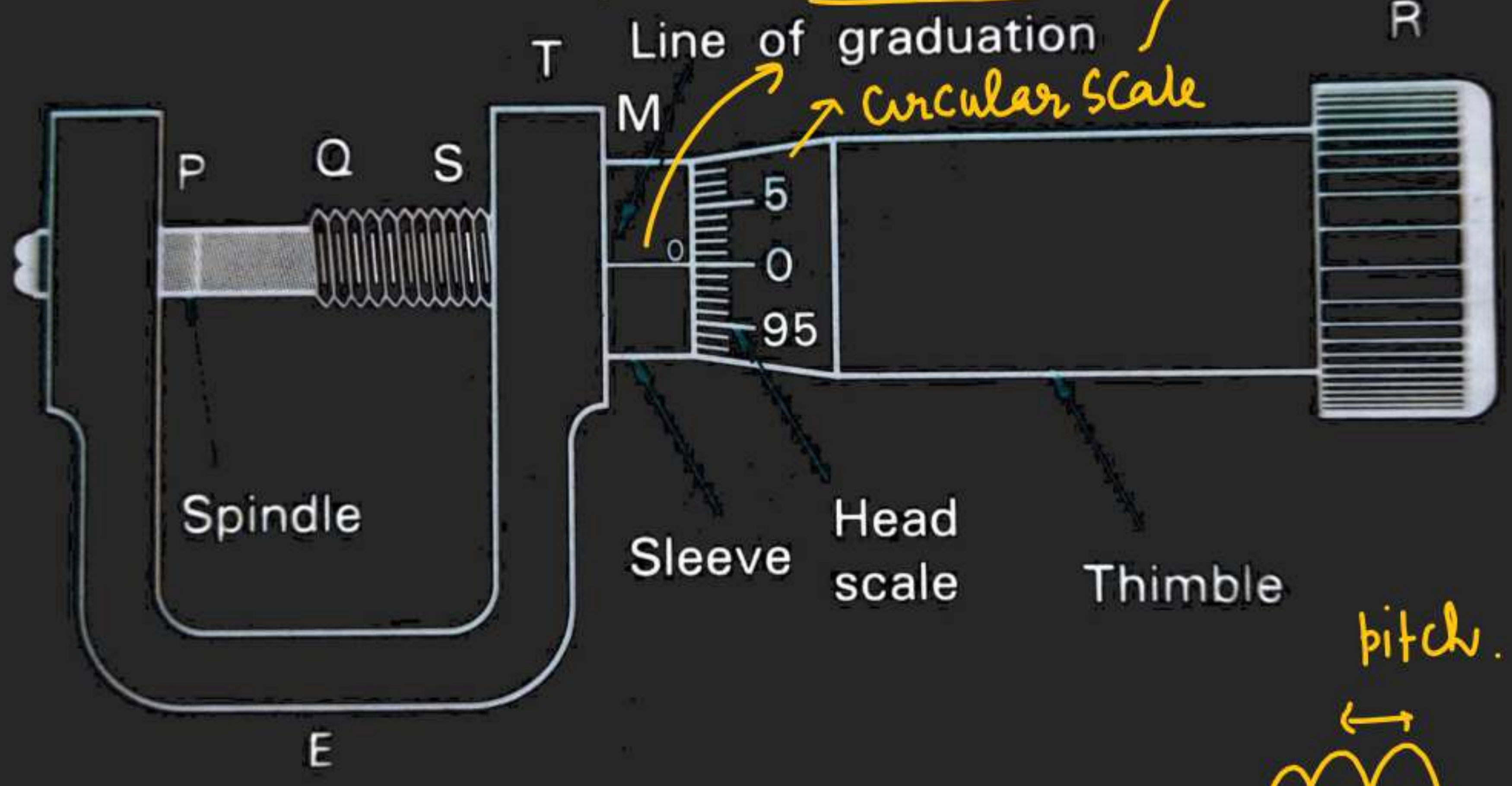

Fig. Screw gauge with no zero error.

pitch.

(+ve zero error)

[zero of circular scale lie below the zero of Main scale]

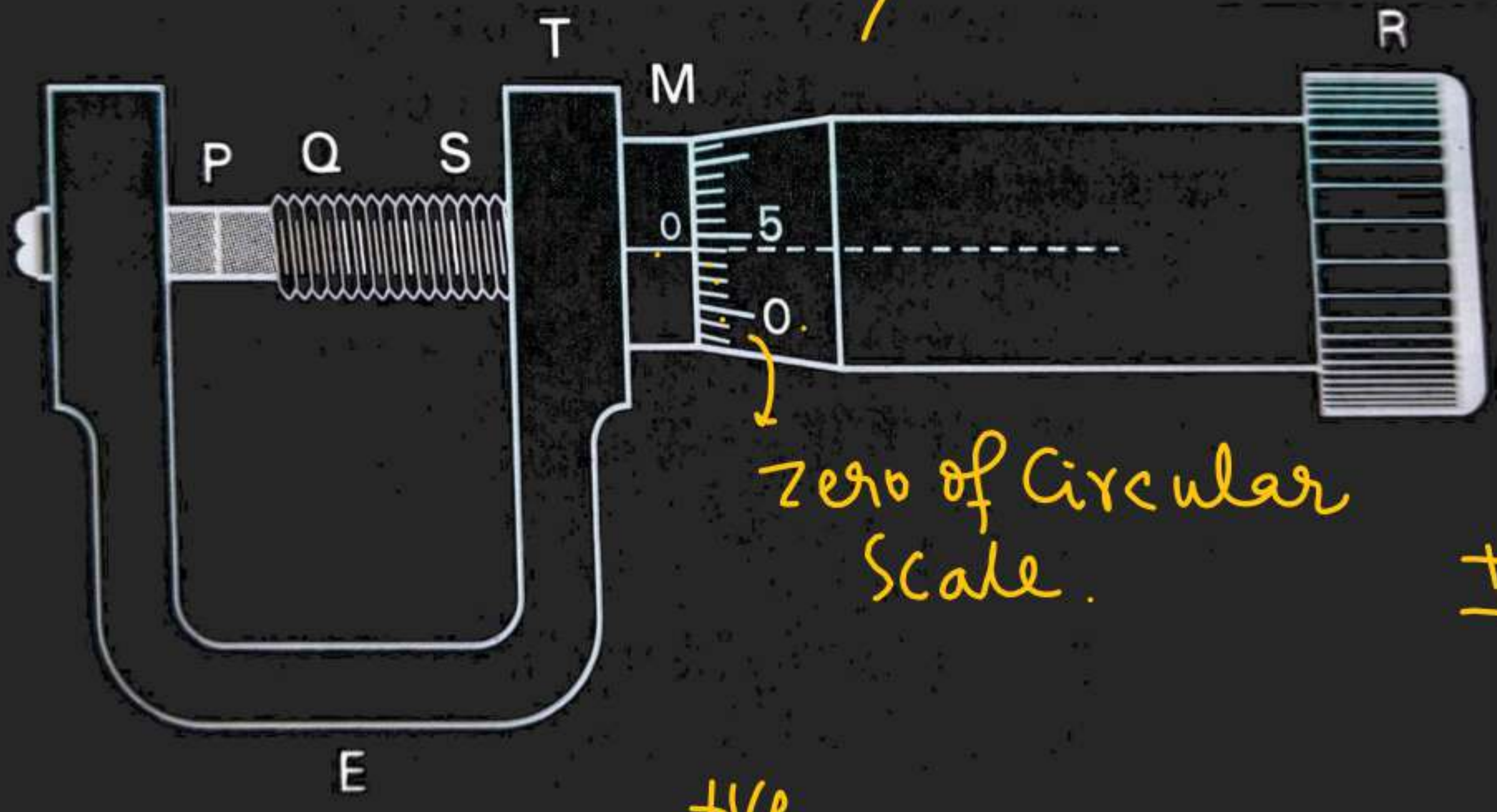

Fig. Screw gauge with +ve zero error.

+ve Error = (No of division of circular scale conciding with zero of Main scale) × L.C

= (4×0.01) mm

= (0.04) mm.

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−ve Error :- Zero of Circular Scale lie above the zero of Main Scale.

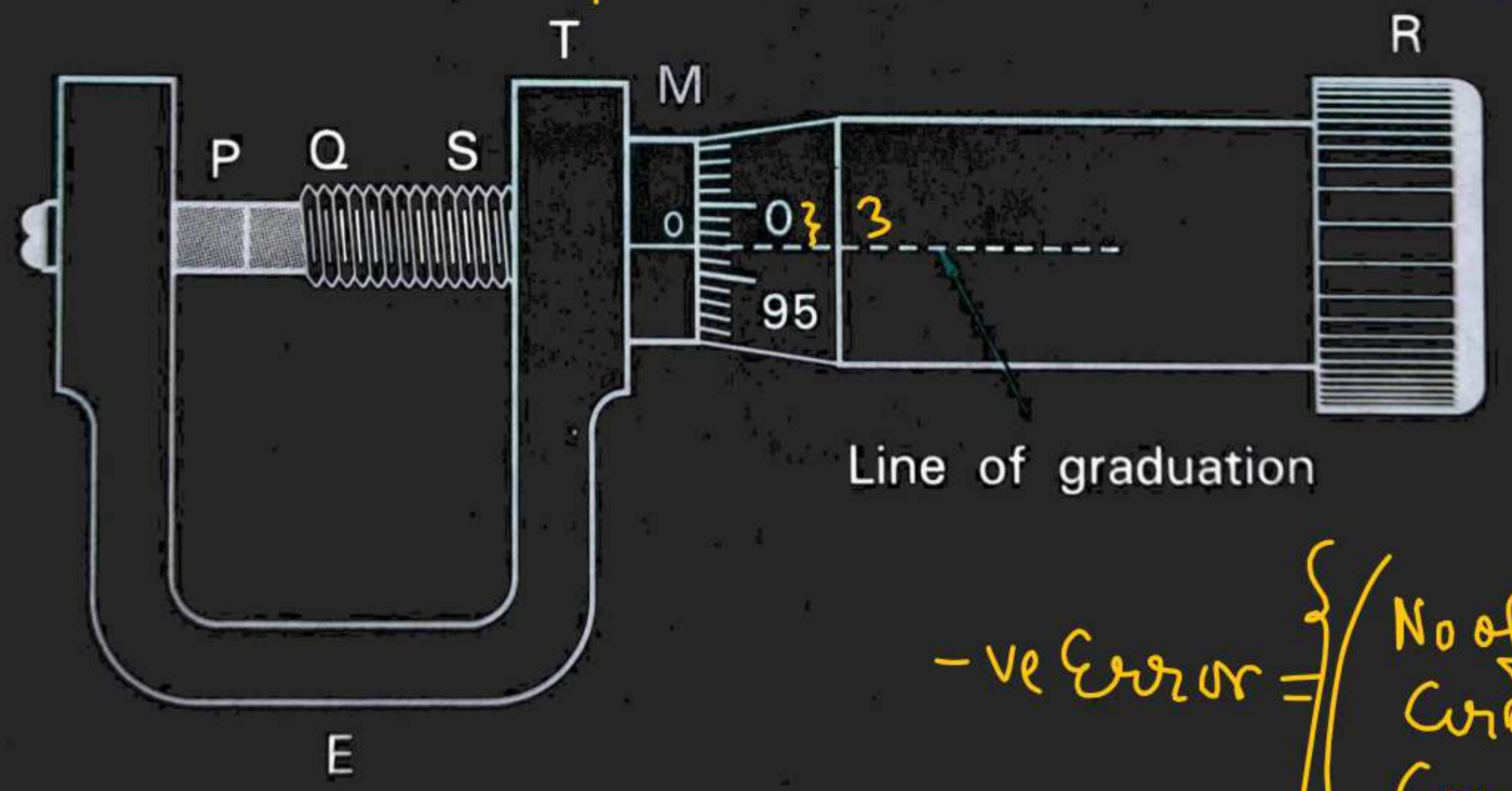

Fig. Screw gauge with no zero error.

$$-\text{ve Error} = \left\{ \left(\begin{array}{l}\text{No of division of} \\ \text{Circular scale} \\ \text{Conciding with} \\ \text{zero of Main scale}\end{array} \right) - \left[\begin{array}{l}\text{Total No} \\ \text{of division} \\ \text{in Circular} \\ \text{scale}\end{array} \right] \right\} \times \text{L}$$

$$= (97 - 100) \times 0.01$$

$$= -0.03\,\text{mm}$$

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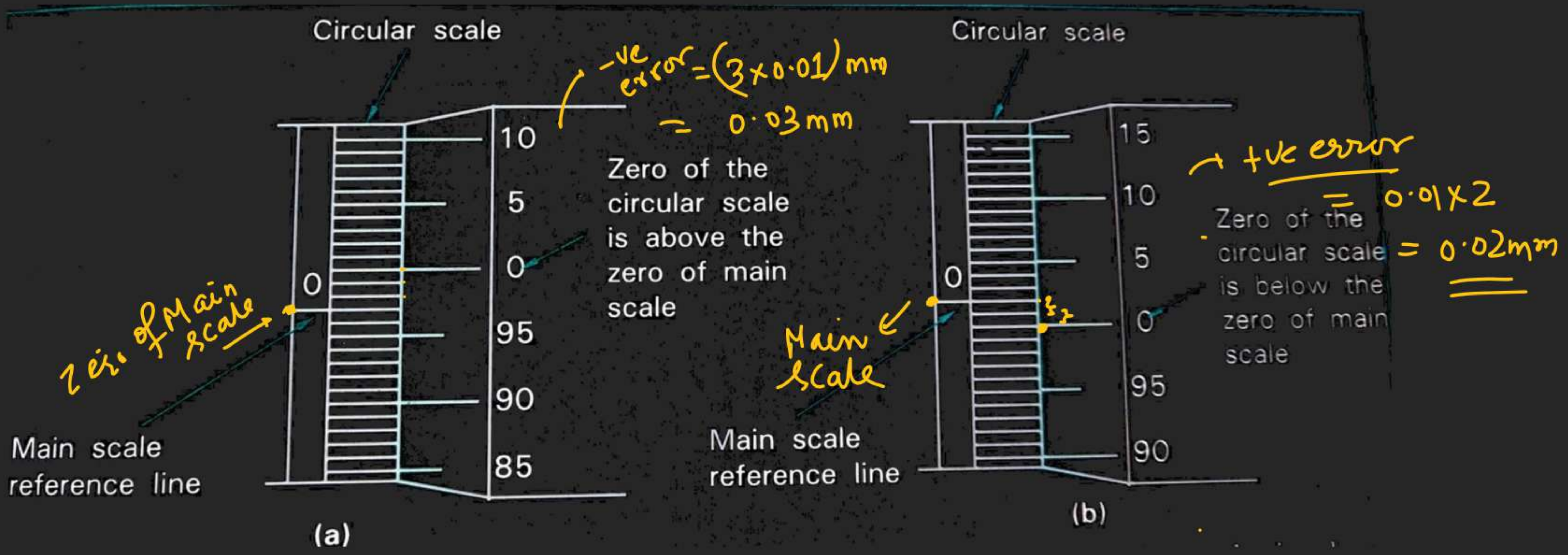

Fig. (a). Negative zero error (-0.03 mm) when the zero of the circular scale is above the line of graduation.

(b). Positive zero error (+0.02mm) when the zero of the circular scale is below the line of graduation.

VERNIER & SCREW GAUGE

Q.1 A travelling microscope has 20 divisions per cm on the main scale while its Vernier scale has total 50 divisions and 25 Vernier scale divisions are equal to 24 main scale divisions, what is the least count of the travelling microscope?

[July 29, 2022 (I)]

(A) 0.001 cm (B) 0.002 mm (C) 0.002 cm (D) 0.005 cm

$1\ M.S.D = \frac{1}{20}\ cm.$

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

$1\ V.S.D = \left(\frac{24}{25}\right) M.S.D.$

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

$= \left(1 - \frac{24}{25}\right)(1\ M.S.D)$

$= \frac{1}{25} \times \frac{1}{20}$

$= \frac{1}{500} = 0.2 \times 10^{-2}\ cm.$

$= \underline{0.002\ cm}$

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VERNIER & SCREW GAUGE

Q.3 The one division of main scale of vernier callipers reads $1\ \mathrm{mm}$ and 10 divisions of Vernier scale is equal to the 9 divisions on main scale. When the two jaws of the instrument touch each other the zero of the Vernier lies to the right of zero of the main scale and its fourth division coincides with a main scale division. When a spherical bob is tightly placed between the two jaws, the zero of the Vernier scale lies in between $4.1\ \mathrm{cm}$ and $4.2\ \mathrm{cm}$ and 6 th Vernier division coincides with a main scale division. The diameter of the bob will be___$10^{-2}\ \mathrm{cm}$ → 43 **[July 27, 2022 (I)]**

$L.C = 0.1\,mm$

$+ve\ Error = (4 \times 0.1)\,mm$

$= 0.4\,mm$

$M.S.R = 4.1\,cm$

$V.S.R = 6 \times 0.1\,mm$

$= 0.6\,mm.$

$Reading = (M.S.R + V.S.R) - (+ve\ Error)$

$= (4.1 + 0.6 - 0.4)$

$= 4.3\,mm \quad 43 \times 10^{-2}\,cm$

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VERNIER & SCREW GAUGE

Q.5 In a Vernier Calipers 10 divisions of Vernier scale is equal to the 9 divisions of main scale. When both jaws of Vernier calipers touch each other; the zero of the Vernier scale is shifted to the left of zero of the main scale and 4^{th} Vernier scale division exactly coincides with the main scale reading. One main scale division is equal to $1\ \text{mm}$. While measuring diameter of a spherical body, the body is held between two jaws. It is now observed that zero of the Vernier scale lies between 30 and 31 divisions of main scale reading and 6^{th} Vernier scale division exactly coincides with the main scale reading. The diameter of the spherical body will be :

[July 26, 2022 (II)]

(A) $3.02\ \text{cm}$ (B) $3.06\ \text{cm}$ (C) $3.12\ \text{cm}$ (D) $3.20\ \text{cm}$

$M.S.R = 30$

Error (−ve) $= (10-4)\times 0.1\ \text{mm}$
$= 0.6\ \text{mm}$

$V.S.R = 6 \times L.C$
$= 6 \times 0.1\ \text{mm}$
$= 0.6\ \text{mm}$

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$$\text{Diameter} = (M.S.R + V.S.R) + (-\text{ve Error})$$

$$= (30 + 0.6 + 0.6)\,mm$$

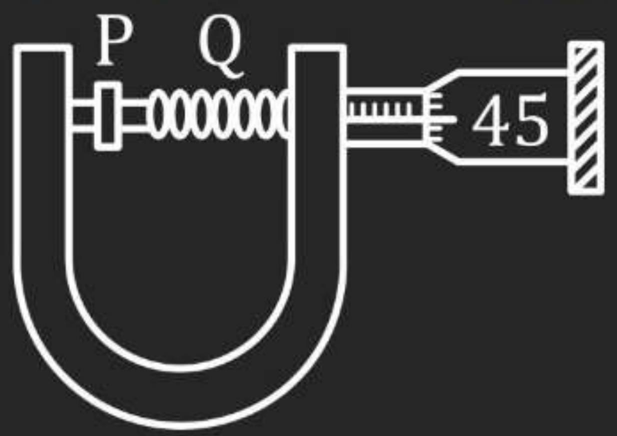
$$= (30 + 1.2)\,mm$$

$$= \underline{31.2\,mm}$$

$$= \underline{3.12\,Cm}\ \checkmark$$

VERNIER & SCREW GAUGE

Q.2 In an experiment to find out the diameter of wire using screw gauge, the following observation were noted: **[July 29, 2022 (1)]**



(a) Screw moves 0.5 mm on main scale in one complete rotation.

(b) Total divisions on circular scale = 50

(c) Main scale reading is 2.5 mm (M.S.R)

(d) 45^{th} division of circular scale is in the pitch line

(e) Instrument has 0.03 mm negative error Then the diameter of wire is :

(A) 2.92 mm (B) 2.54 mm (C) 2.98 mm (D) 3.45 mm

$$\begin{array}{r} 2.5 \\ 0.45 \\ 0.03 \\ \hline 2.98 \\ \hline \end{array}$$

$$\text{pitch} = \frac{0.5}{1}$$

$$L.C = \frac{0.5}{50} = 0.01\,\text{mm}$$

$$C.S.R = (45 \times 0.01)\,\text{mm} = 0.45\,\text{mm}$$

$$\text{Reading} = \underbrace{2.5}_{M.S.R} + \underbrace{0.45}_{C.S.R} + \underbrace{0.03}_{-\text{ve error}}$$

VERNIER & SCREW GAUGE

Q.6 The vernier constant of Vernier callipers is $0.1\ \text{mm}$ and it has zero error of $(-0.05)\text{cm}$. While measuring diameter of a sphere, the main scale reading is $1.7\ \text{cm}$ and coinciding vernier division is 5 . The corrected diameter will be $\times 10^{-2}\ \text{cm}$. [June 29, 2022 (II)]

VERNIER & SCREW GAUGE

Q.4 A screw gauge of pitch $0.5\ \text{mm}$ is used to measure the diameter of uniform wire of length $6.8\ \text{cm}$, the main scale reading is $1.5\ \text{mm}$ and circular scale reading is 7 . The calculated curved surface area of wire to appropriate significant figures is :

[Screw gauge has 50 divisions on its circular scale] [July 26, 2022 (I)]

(A) $6.8\ \text{cm}^2$ (B) $3.4\ \text{cm}^2$ (C) $3.9\ \text{cm}^2$ (D) $2.4\ \text{cm}^2$

VERNIER & SCREW GAUGE

Q.7 In a vernier callipers, each cm on the main scale is divided into 20 equal parts. If tenth vernier scale division coincides with nineth main scale division. Then the value of vernier constant will be $\times 10^{-2}\ \mathrm{mm}$. [June 26, 2022 (I)]

VERNIER & SCREW GAUGE

Q.8 In a Screw Gauge, fifth division of the circular scale coincides with the reference line when the ratchet is closed. There are 50 divisions on the circular scale, and the main scale moves by $0.5\ \mathrm{mm}$ on a complete rotation. For a particular observation the reading on the main scale is $5\ \mathrm{mm}$ and the 20^{th} division of the circular scale coincides with reference line. Calculate the true reading.

[Aug. 26, 2021 (I)]

(A) $5.00\ \mathrm{mm}$ (B) $5.25\ \mathrm{mm}$ (C) $5.15\ \mathrm{mm}$ (D) $5.20\ \mathrm{mm}$

VERNIER & SCREW GAUGE

Q.9 A screw gauge has 50 divisions on its circular scale. The circular scale is 4 units ahead of the pitch scale marking, prior to use. Upon one complete rotation of the circular scale, a displacement of $0.5\ \text{mm}$ is noticed on the pitch scale. The nature of zero error involved, and the least count of the screw gauge, are respectively:

[Sep. 06, 2020 (I)]

(A) Negative, $2\mu\text{m}$

(B) Positive, $10\mu\text{m}$

(C) Positive, $0.1\ \text{mm}$

(D) Positive, $0.1\mu\text{m}$

VERNIER & SCREW GAUGE

Q.10 Using screw gauge of pitch $0.1\ \mathrm{cm}$ and 50 divisions on its circular scale, the thickness of an object is measured. It should correctly be recorded as :

[Sep. (03, 2020 (I)]

(A) $2.121\ \mathrm{cm}$ (B) $2.124\ \mathrm{cm}$

(C) $2.125\ \mathrm{cm}$ (D) $2.123\ \mathrm{cm}$

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Best of Luck
for your
future endeavour

I Wish at the end of
your all exams you all
Sing this Song

Finally thanks to
all my Beloved
Students

"आज मैं ऊपर
आसमां नीचे
आज मैं आगे
जमाना है पीछे"