Date : 16/06/2020

# Lecture no.1

# Vernier calliper

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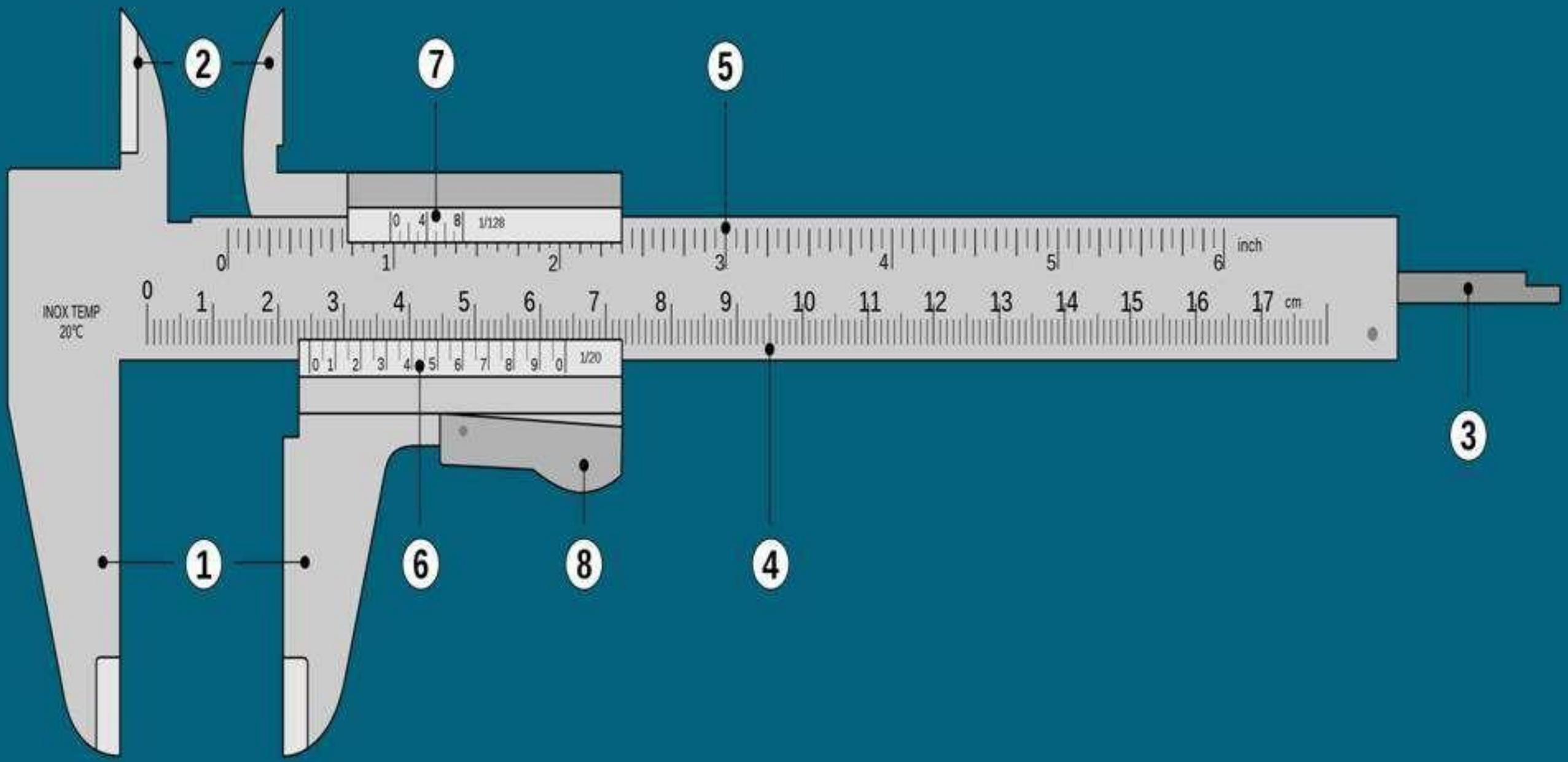
# Vernier calliper

1. **Outside jaws**: used to measure external length
2. **Inside jaws**: used to measure internal length
3. **Depth probe**: used to measure depth
4. **Main scale** (cm)
5. **Main scale** (inch)
6. **Vernier** (cm)
7. **Vernier** (inch)
8. **Retainer**: used to block/release movable part



Least count of an instrument is the smallest quantity that can be accurately measured with it.

Least count of Vernier Callipers is mathematically defined as,

$$\text{Least count} = \frac{\text{Smallest division on main scale}}{\text{Total number of divisions on vernier scale}}$$

Smallest division on main scale = 1 mm = 0.1 cm

Total number of divisions on vernier scale N = 10

Therefore,

$$\text{Least count} = \frac{1\text{ mm}}{10}$$

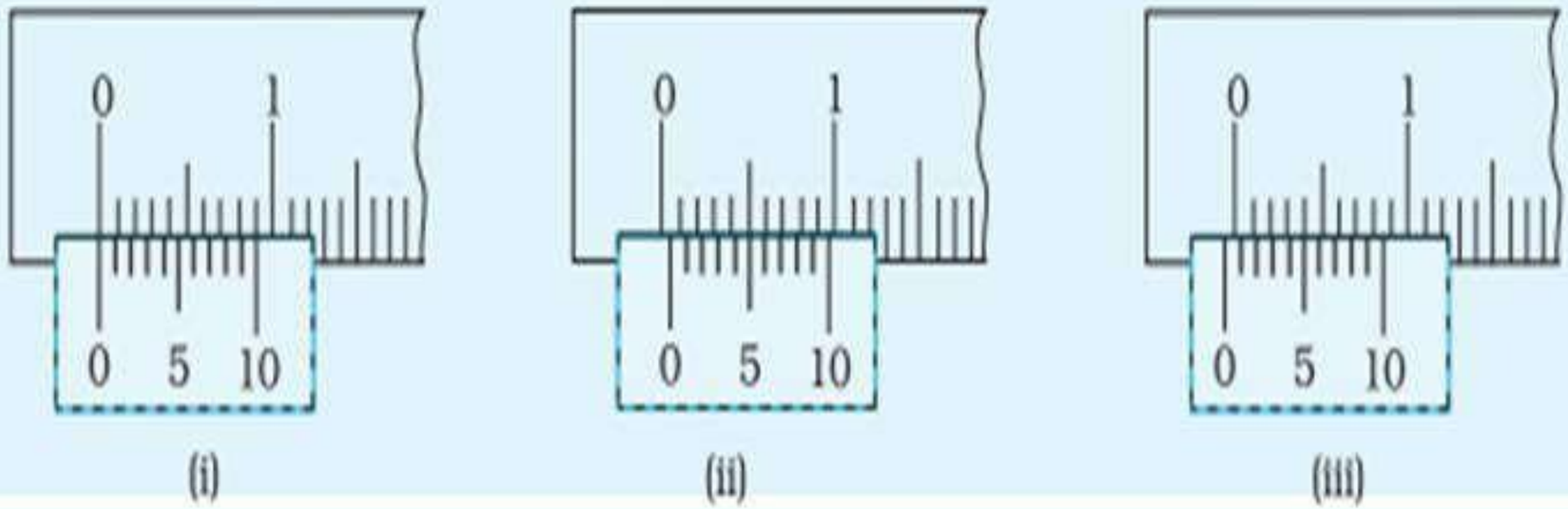
$$= 0.1\text{ mm}$$

$$= 0.01\text{cm}$$

# Zero error

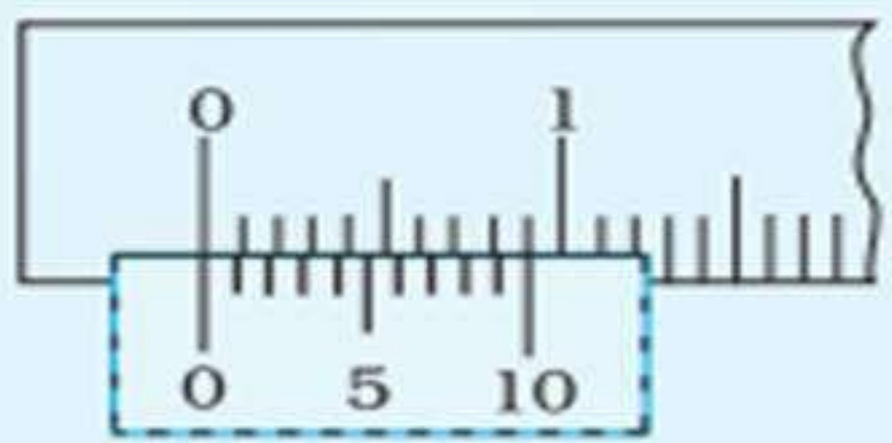
When both the inside and outside jaws touch each other, the zero of the Vernier should coincide with the zero of the main scale. If it is not so, the instrument is said to possess zero error

Zero error may be positive or negative, depending upon whether the zero of vernier scale lies to the right or to the left of the zero of the main scale. This is shown by the Fig. (ii) and (iii). In this situation, a correction is required to the observed readings.




(i) (ii) (iii)

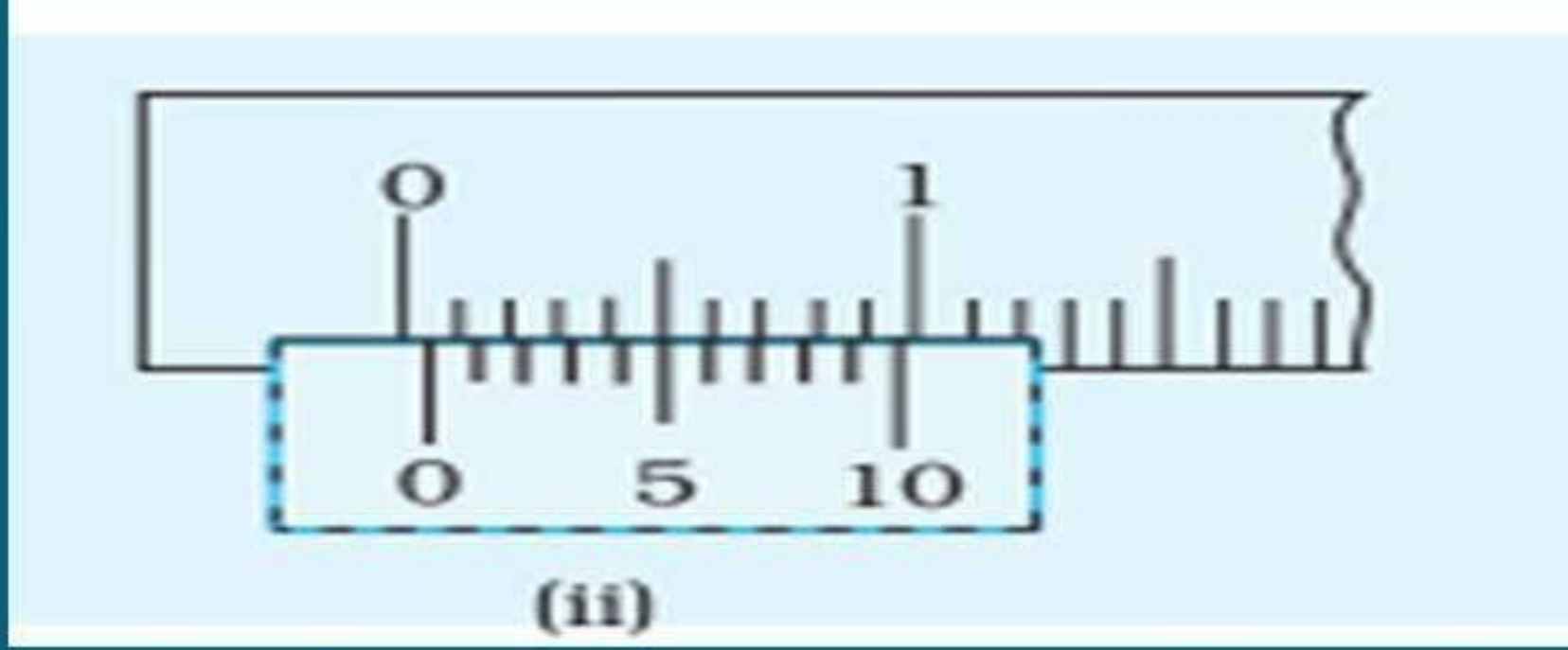
## No zero error



(i)

Fig (i) shows an example of no zero error. From the figure, one can see that when both jaws are touching each other, zero of the vernier scale is exactly coincide with of zero of the main scale. Hence, there is no zero error in this case.

## Positive zero error



(ii)

Fig (ii) shows an example of positive zero error. From the figure, one can see that when both jaws are touching each other, zero of the vernier scale is shifted to the right of zero of the main scale But in Fig. (ii), 5th vernier division is coinciding with a main scale reading.

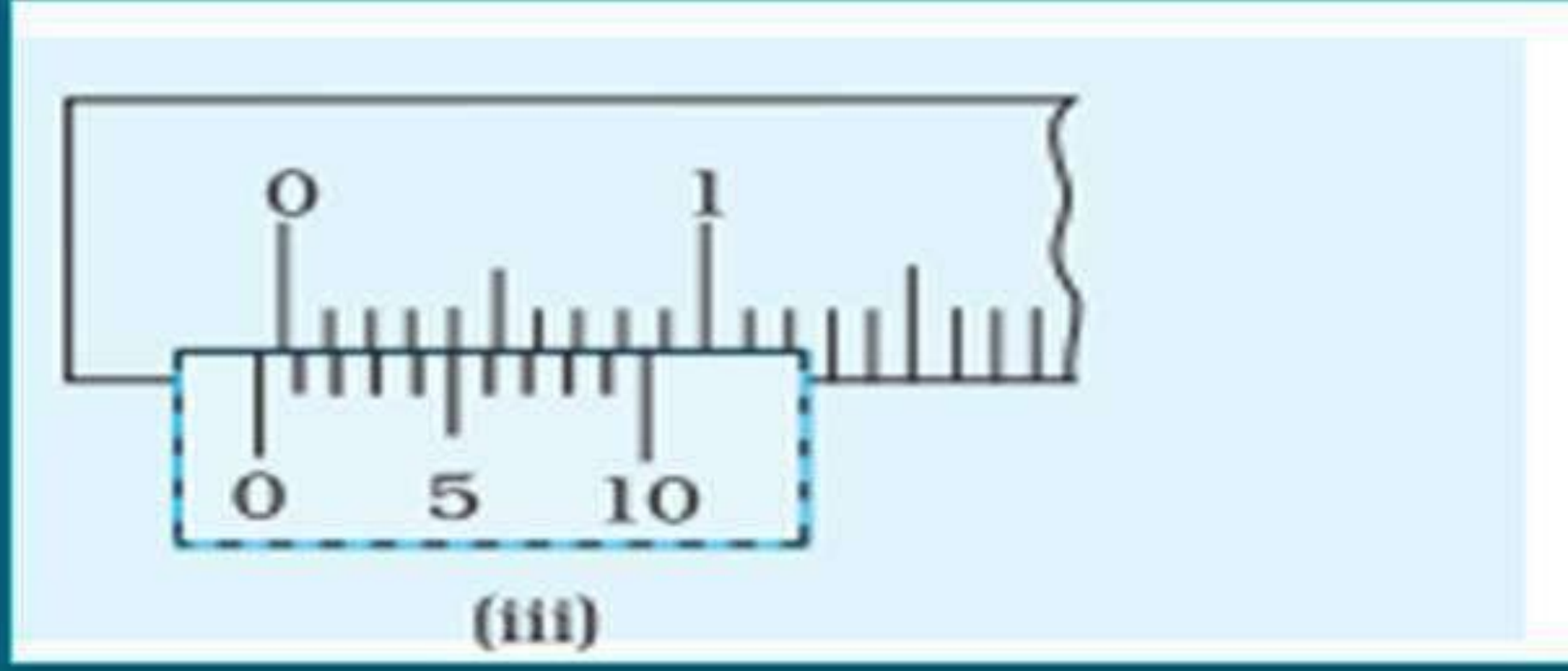
∴ Zero Error = + 5 × Least Count = + 0.05 cm

Hence, the zero error is positive in this case.

For any measurements done, the zero error should be 'substracted' from the observed reading.

∴ True Reading = Observed reading – (+ Zero error)

## Negative zero error



(iii)

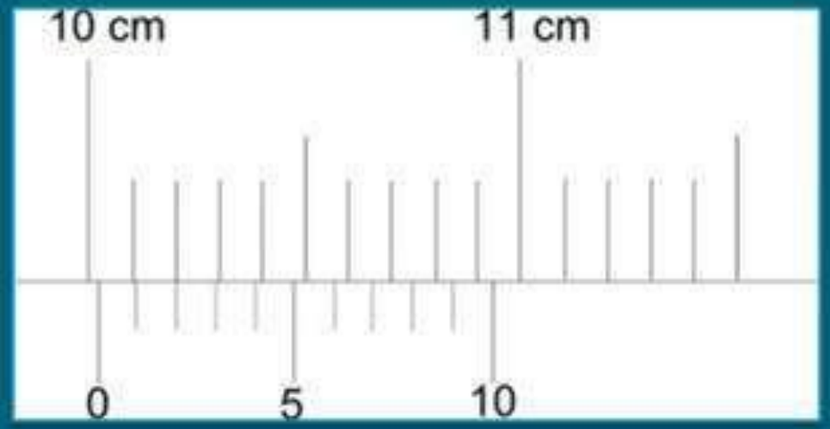
Fig (iii) shows an example of negative zero error. From the figure, one can see that when both jaws are touching each other, zero of the vernier scale is shifted to the leftt of zero of the main scale But in Fig. (iii), 5th vernier division is coinciding with a main scale reading.

∴ Zero Error = - 5 × Least Count = - 0.05 cm

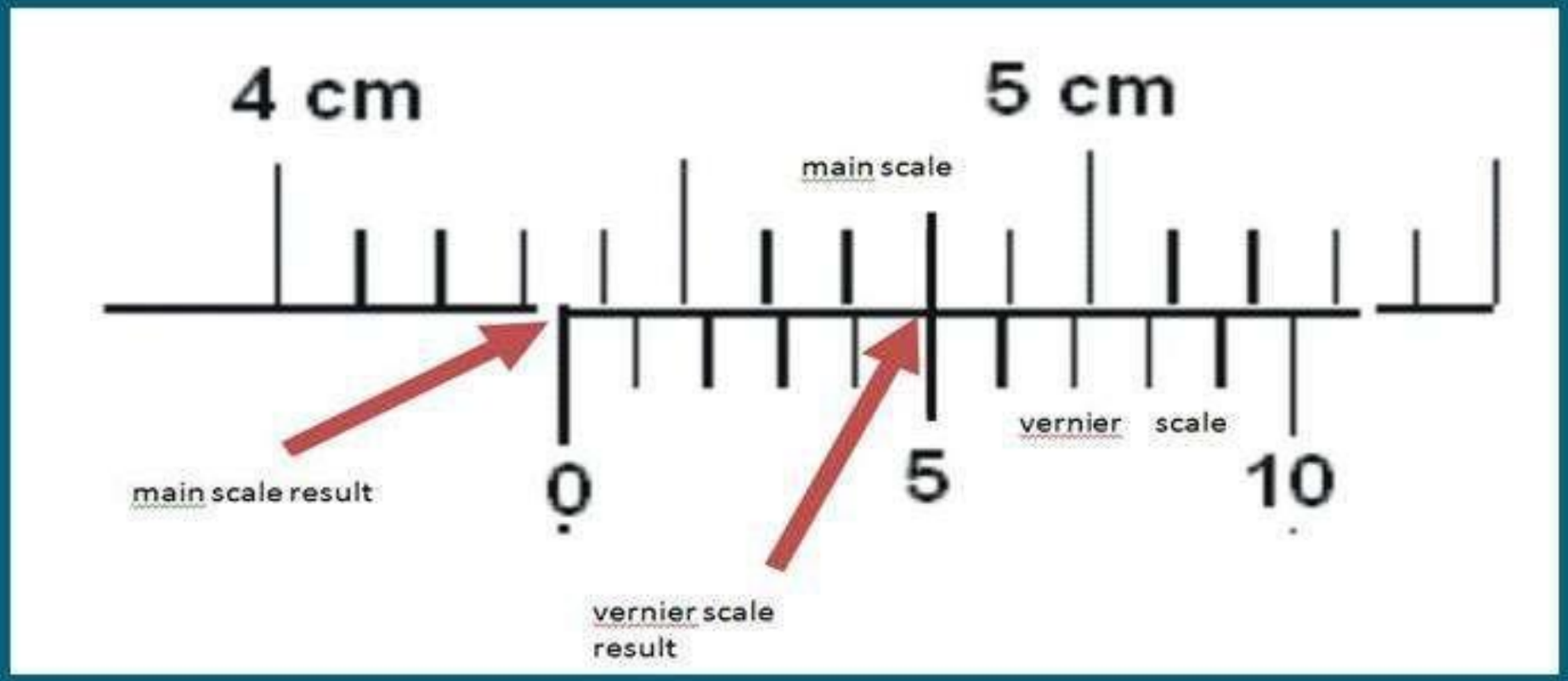
Hence, the zero error is negative in this case.

For any measurements done, the zero error should be 'subtracted' from the observed reading.

∴ True Reading = Observed reading – (- Zero error)




**Main scale reading: 10.0 cm (Immediate left of zero)**
**Vernier scale reading: 2 (Alignment of scale lines i.e. coincide line)**
**Vernier scale reading × least count = 2 × 0.01 = 0.02**
**Obtained reading = Main scale reading +Vernier scale reading × least count**
**= 10.0 + 2 × 0.01**
**= 10.02 cm**




**Main scale reading: 4.3 cm (third line left of zero)**
**Vernier scale reading: 5 (Alignment of scale lines i.e. coincide line)**
**Vernier scale reading × least count = 5 × 0.01 = 0.05**
**Obtained reading = Main scale reading +Vernier scale reading × least count**
**= 4.3 + 5 × 0.01**
**= 4.35 cm**

# Measurement of different lengths

| Sr. No. | Main scale reading (a) cm | Vernier Scale reading (b) cm | Vernier Scale reading × LC (c) cm | Total Reading = Main scale reading + (Vernier Scale reading × LC ) |
|---|---|---|---|---|
| 1 | 1.5 | 4 | 4 × 0.01=0.04 | 1.5 +(4 × 0.01)=1.54 |
| 2 | 1.7 | 3 | 3 × 0.01=0.03 | 1.7 +(3 × 0.01)=1.73 |
| 3 | 1.4 | 6 | 6 × 0.01=0.06 | 1.4 +(6 × 0.01)=1.46 |
| 4 | 1.2 | 8 | 8 × 0.01=0.08 | 1.2 +(8 × 0.01)=1.28 |
| 5 | 1.9 | 3 | 3 × 0.01=0.03 | 1.9 +(3 × 0.01)=1.93 |
| 6 | 2.4 | 3 | 3 × 0.01=0.03 | 2.4 +(3 × 0.01)=2.43 |
| 7 | 2.8 | 5 | 5 × 0.01=0.03 | 2.8 +(5 × 0.01)= 2.85 |