**Absolute Error, Relative Error and Percentage Error**

**Absolute Error**- It is the magnitude of the difference between the true value & the individual

measured value of the quantity.

Let a physical quantity is measured n times and the measured values are a1, a2, a3 ….an. Now the true value (i.e. the arithmetic mean) is

So, the absolute error for first observation is Δa1=am-a1

the absolute error for second observation is Δa2=am-a2 and so on

\*The absolute errors can be both positive and negative

**Mean absolute error** - It is the arithmetic mean of the magnitudes of absolute errors.

\*While taking arithmetic mean we ignore the sign ( ) of absolute errors.

**Relative Error**-It is defined as the ratio of mean absolute error to the mean value of the quantity measured.

**Percentage Error** - Relative error expressed in percentage

**Propagation or combination of errors**

1. **Error in a sum**

Suppose X = a + b

Let Δa – absolute error in measurement of a

Δb – absolute error in measurement of b

ΔX – absolute error in measurement of X

So, X ΔX = ( a Δa )+ (b Δb)

X ΔX =( a + b) Δa Δb

X ΔX =X Δa Δb

ΔX = Δa Δb

So, the maximum value is ΔX = (Δa + Δb)

Q. The lengths of 2 cylinders are measured to be l1 = (5.62 0.01) cm and l2 = (4.34 0.02) cm.

Calculate the total length with error limits

Ans. L = l1 + l2 =5.62 + 4.34 = 9.96cm

ΔL = (Δ l1 + Δ l2)= (0.01 + 0.02)=0.03

Total length is (9.96 0.03)cm

1. **Error in a difference**

Suppose X = a - b

Let Δa – absolute error in measurement of a

Δb – absolute error in measurement of b

ΔX – absolute error in measurement of X

So, X ΔX = ( a Δa )- (b Δb)

X ΔX =( a - b) Δa ∓Δb

X ΔX =X Δa ∓ Δb

ΔX = Δa ∓ Δb

So, the maximum value is ΔX = (Δa + Δb)

Q. The lengths of 2 cylinders are measured to be l1 = (5.62 0.01) cm and l2 = (4.34 0.02) cm.

Calculate the difference in length with error limits

Ans. L = l1 - l2 =5.62 - 4.34 = 1.28cm

ΔL = (Δ l1 + Δ l2)= (0.01 + 0.02)=0.03

Total length is (1.28 0.03)cm

1. Error in difference