Answer on Question#39761 – Physics – Other

A student repeatedly measured the length of a simple pendulum and recorded the results in centimetre as: 36.9, 36.7, 36.8 and 36.6. What is the precision index of this measurement in cm?

Solution:
Therefore, it is quite common to forego the complete information provided by the error distribution and instead to describe the errors by an error or precision index. We typically write:

$$x_{exact} = x_{observed} \pm \Delta x$$

where Δx is the precision index or error. Note that the definition of Δx can be ambiguous. It is a single number used to characterize the actual distribution of errors. Some choose to define Δx in terms of the standard deviation of the distribution, s:

$$s = \frac{1}{n-1}\sum_{i=1}^{n}[x_i - \bar{x}]^2 \quad (1)$$

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \quad (2)$$

Table with the results of experiment:

n	1	2	3	4
x, cm	36.9	36.7	36.8	36.6

$$(2): \bar{x} = \frac{1}{4}\sum_{i=1}^{4} x_i = \frac{1}{4}(36.9 + 36.7 + 36.8 + 36.6) = 36.75 \quad (3)$$

$$(3)\text{in}(1):$$

$$s = \frac{1}{4-1}\sum_{i=1}^{4}[x_i - \bar{x}]^2$$
$$= \frac{1}{4-1}(36.9 - 36.75)^2(36.75 - 36.7)^2(36.8 - 36.75)^2(36.75 - 36.6)^2 = 1 \times 10^{-9}\text{cm}$$

The magnitude of Δx can then be defined as some multiple of s. So a measurement might be reported as:

$$x_{exact} = \bar{x} \pm 2s \implies$$

$$\Delta x = 2s = 2 \times 10^{-9}\text{cm}$$

Solution: precision index of this measurement is equal to $2 \times 10^{-9}\mathrm{cm}$.