Units and Measurements

Systematic Errors

The systematic errors are those errors that tend to be in one direction, either positive or negative. Some of the sources of systematic errors are:

- **Instrumental errors** that arise from the errors due to imperfect design or calibration of the measuring instrument, zero error in the instrument, etc. For example:
    - The temperature graduations of a thermometer may be inadequately calibrated (it may read 104°C at the boiling point of water at STP whereas it should read 100°C).
    - In a vernier calipers, the zero mark of the vernier scale may not coincide with the zero mark of the main scale.
    - An ordinary meter scale may be worn off at one end.
- **Imperfection in experimental technique or procedure**
    - To determine the temperature of a human body, a thermometer placed under the armpit will always give a temperature lower than the actual value of the body temperature.
    - Other external conditions (such as changes in temperature, humidity, wind velocity, etc.) during the experiment may systematically affect the measurement.
- **Personal errors** that arise due to an individual's bias, lack of proper setting of the apparatus or individual's carelessness in taking observations without observing proper precautions, etc. For example:
    - If you, by habit, always hold your head a bit too far to the right while reading the position of a needle on the scale, you will introduce an error due to parallax.

Systematic errors can be minimized by improving experimental techniques, selecting better instruments, and removing personal bias as far as possible. For a given set-up, these errors may be estimated to a certain extent and the necessary corrections may be applied to the readings.