BRAIN MAP

UNITS AND MEASUREMENTS

CLASS XI

MEASUREMENT

defined by the

- Units of measurement
  - that can be related in terms of fundamental base quantities
  - Internationally accepted
    - **SI units**
      - which consist of
        - seven Base SI units
        - Derived units
        - Supplementary units
      - Practical units in different scales
        - Small scale
          - Length
            - 1Å (angstrom) = 10^{-10} m
            - 1 fermi = 10^{-15} m
          - Mass
            - mass of atoms in a.m.u.
        - Large scale
          - Mass
            - metric ton = 10^3 kg
            - solar mass ≈ 10^{30} kg
          - Interstellar distance
            - 1 AU = 1.49×10^{11} m
            - 1 ly = 9.46×10^{15} m
            - 1 parsec = 3.08×10^{16} m
            - Method to measure such intersteller distances from earth → **Parallex Method**
  - **Dimension**
    - which can be deduced by
      - **Dimensional analysis**
        - which is useful to
          - Show the relationship between different system of units
          - Implicitly tell how to derive a relation
          - Provide a check on relation between quantities
      - using five base quantities
        - mass **M**
        - length **L**
        - time **T**
        - temperature **K**
        - electric current **A**
- Magnitude of measurement
  - accurately known digits plus first uncertain digit in a measurement
  - **Significant figures**

ERROR

- Uncertainty in the measured values
  - Combination of errors
    - for basic operations
      - $Z = A \pm B$, $\Delta Z = \Delta A + \Delta B$
      - $Z = A^2$, $\frac{\Delta Z}{Z} = 2\frac{\Delta A}{A}$
      - $Z = A \cdot B$ or A/B, $\frac{\Delta Z}{Z} = \frac{\Delta A}{A} + \frac{\Delta B}{B}$
  - arising from
    - **Systematic error**
      - causes
        - range of observed values
          - determined by
            - **Precision** of measurement
    - **Random error**
      - results in
        - scatter of repeated measurement
          - characterized by
            - range of observed values
            - deviation of mean from "true value"
              - determined by
                - **Accuracy** of measurement
              - which can be calculated by
                - **Absolute error** $\Delta a_n = a_n - a_{mean}$
                - **Relative error** Rel $\Delta a = \frac{\Delta a_m}{a_m}$
                - **Percentage error** $\delta_a = \frac{\Delta a_m}{a_m} \times 100\%$
      - caused by
        - noise (fluctuation in values)
    - **Least count error**
      - caused by
        - error in resolution of the instrument

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CLASS XII