

**Basic Skills for Chemistry**  
**CHEM-1020**  
**Chapter 2 Lecture Notes**  
**Kroschwitz, 3rd edition**

**Measurements and Chemical Arithmetic**

**Measurements**

Importance of measurements in scientific work  
Importance of *Quantitative* measurements  
Importance of Metric system over the English system  
Math tools are needed to carry out and interpret scientific measurements

**Scientific Notation**

Purpose is to express very large and small numbers legibly and conveniently.

Convenience, Meaning and Interpretation of *Exponential Notation* examples:

$10^1$ ,  $10^5$ ,  $10^{+3}$ ,  $10^0$ ,  $10^{-1}$ ,  $10^{-5}$ ,  $10^{-10}$

**Define *Scientific* Notation**

**Define *Proper* Scientific Notation**

Significant part, Exponential Part

How to convert ordinary numbers to Proper Scientific Notation and vice-versa

Calculations with Exponential Terms

How to enter exponential terms on your **calculator** (Use of +/- key)

Exponent Rules for Multiplication of Exponential Numbers

How to calculate without a calculator

Exponent Rules for Division of Exponential Numbers

How to calculate without a calculator

Show why  $10^0 = 1$

Addition and subtraction of exponential numbers

## SI, The international Metric System

History of the metric system

Evolution to SI

Use of universal metric prefixes for all units

Most commonly-used metric prefixes and their numerical values

**d, c, m,  $\mu$ , n, da, h, k, M**

### **Base SI Units**

m, s, mol, kg, K.

Derived units, L, joule, etc

**Length:** derivation of metre, m; also mm, cm, dm,  $\mu$ m, nm, km.

How to write metric equalities using m and various derived length units

Need to memorize equations

**Volume:** SI use  $m^3$ ,  $cm^3$ ,  $dm^3$ . Convenience of one L = 1000  $cm^3$ .  $1 cm^3 = 1 mL$ . Also  $\mu L$ .

**Mass:** mass vs. weight

Original definition of  $1 g = 1 cm^3$

Now based on Paris kg

Also use of mg,  $\mu g$ , etc.

**Time:** Use of s, ms,  $\mu s$ , ns.

**Chemical Quantity:** the mole, mol, mmol,  $\mu mol$ .

**Temperature:** History of  $^{\circ}C$  and  $^{\circ}F$  scales. Memorize formulas

History of K scale

Memorize C to K equation

## Per Cent

Define per cent

Per Cent equation to be memorized

Per cent equation can be rearranged to find part and whole

## Significant Figures

- Reason for applying the concept of significant figures
- How to count sig all nonzero integers as significant figures
- Zeros holding the decimal (also exponential terms) are not significant
- Relationship to scientific notation
- Zeros indicating precision are significant
- Indefinite zeros should be clarified
- Counting numbers have an infinite number of sig figs.

## Types of Calculation and their rules:

- Multiplication/Division Rule
- Addition/Subtraction rule
- Rounding off rule
- Mixed Calculations

## Significant Figure use Examples

- $3.45 \text{ m} \times 14.7529 \text{ m} = 50.8975 \text{ m}^2 \approx 50.9 \text{ m}^2$
- $0.025 \text{ m/s} \times 29.15 \text{ s} = 0.72875 \approx 0.73 \text{ m}$
- $4.59 \text{ g} + 8.73 \text{ g} = 13.32 \text{ g}$
- $28.76 \text{ cm} - 7.76 \text{ cm} = 21.00 \text{ cm}$
- $25 \text{ kg} - 0.3 \text{ kg} \approx 25 \text{ kg}$
- $125.7 \text{ cm} + 2537.1 \text{ cm} + 0.7 \text{ cm} = 2663.5 \text{ cm}$
- per cent error calculations (learn formula)

## Relationship of sig figs to Measurements

- How to read an analog measuring instrument
- Accuracy
- Precision
- How to estimate between the *smallest divisions*
- Meaning of last digit
- Relation to Measurement Precision
- Relation to digital instrument readings
- Differences between 1 m, 1.0 m, 1.00 m, and 1.000 m.
- How to read a metric ruler, the gram balances and graph axes

## Units

- Importance of always recording units in a measurement
- (Points taken off for misuse)
- How to combine units
- How to cancel units
- How to follow units in a complex fraction

## Graphing

- Refer to rules in Graphing Handout
- Why is graphing important?
- Hand graphing vs. computer graphing
- Define x and y axes, independent and dependent variables
- How to establish a scale for each variable
- How to label axes and insert numbers
- Need for graph title
- How to read the graph axes by estimating between the divisions
- Interpolation
- Extrapolation
- Calculation of slope
- Graphing Examples