Chemistry 1A Week 1-12 Notes

Contents

Lecture 1

The Atom

- Matter
  - Classified by state or pure/mixture
    - Matter (has mass, occupies space)
      - Pure (distinct composition + properties
        - Element (simplest form, cannot be broken down)
        - Compound (2 or more elements bonded)
      - Mixture (1 or more substance, retain own properties)
        - Homogenous (uniform composition)
          - e.g. copper sulphate solution
        - Heterogenous (varied composition)
          - e.g. iron filings in sulphur powder
- Separation of mixtures
  - Filtration: based on difference of solubility (e.g. dirt + water)
  - Distillation: based on difference of boiling point (e.g. salt + water)
  - Chromatography: based on differences in affinity between compound and substrate (e.g. pigments in ink, forensics)
- Physical states
  - Solid, liquid or gas depending on temperature and pressure
- Physical + Chemical Properties/Changes
  - Physical property measured/observed without changing composition/identity (e.g. colour, melting point)
  - Physical change: change form but not chemical identity (e.g. state)
  - Chemical property involves chemical change (reaction which involves transformation of products to reactants, cannot recover reactants using physical techniques)
- The Atom
  - Neutral chemical species with a positive nucleus comprised of neutrons and protons surrounded by negative electrons
  - Dalton's atomic theory
    - Matter consists of particles, particles are indestructible + can rearrange in reactions, all particles are identical in pure element, different elements differ in properties, particles in compound present in constant ratio
  - Molecule: neutral collection of atoms held together by covalent bonds from shared electrons
  - Ion: atom with electrons added to give negative charge or removed to give positive charge
  - Element: atoms of the same type categorised by number of protons (Z)
  - Compound: substance containing more than one element in a set proportion; comprised of molecules, ions or a covalent network
  - Isotope: atoms with the same number of protons but different number of neutrons and thus different mass (A)
- Conservation of Mass
  - No gain or loss of mass in chemical reactions
  - Elements always combine in same proportions by mass in a specific compound

Lecture 2

The Atom (cont.)

- Weighing atoms
  - Can weigh atom using a mass spectrometer, which separates atoms to weigh them
  - Mass of C-12 is 1.99255 x 10^{-23}g; as it is so small chemists use atomic mass units (amu) and C-12 is equivalent to 12amu
    - 1amu = 1/12 x mass of C-12 = 1.66054 x 10^{-24}g
    - C-12 is used as a standardiser for masses
  - Can find molecular mass by adding relative atomic mass of constituent elements
- Periodic table
  - Elements ordered by increasing atomic number; organised in periods and groups
    - Elements of the same group have the same properties, elements of the same period have the same number of electron shells
      - Group 2 = alkaline earth metals
      - Group 3-12 = transition metals
      - Group 15 = pnictogens
      - Group 16 = chalcogens
      - Group 17 = halogens
      - Group 18 = inert gases
  - First published in 1869 by Mendeleev but ordered by increasing atomic mass
    - Organised by patterns in properties of known elements, left spaces for undiscovered elements
  - Atomic theory: s, p, d, and f block

Lecture 3

Measurement

- Units: specific standard quantity for property used to measure all other quantities of property
  - Specific properties have standard (SI) units and can be built from seven base units
  - Temperature is property of matter that determines whether heat/energy can be transferred; measured in Kelvin (Celsius + 273.15) with 0K as absolute zero
- Exponential + Scientific Notation: convention for writing very large/small numbers using 10^x
- Uncertainty: exact (defined values/counting) + inexact (limited equipment accuracy) numbers
    - Absolute certainty: same units as quantity; % uncertainty: $\frac{\text{absolute uncertainty}}{\text{measured quantity}} \times 100$
  - Significant figures: all digits except zeros on left hand side (and right if no decimal point)
    - Addition/subtraction: same number of decimal places as measurement with fewest
    - Multiplication/division: same number of sig fig as measurement with least sig fig
    - Multi-step calculations rules applied at end of each step (retaining one additional digit)
  - Accuracy is proximity to true value, precision is proximity to previous measurements

Representation of molecules

- Chemical formulae: relative number of each type of atom present (e.g. H_2O)
  - For binary compounds, elements further to the left appear first, (hydrogen is written last except with group 16/17), if in same group lowest element is first
  - Ionic compounds: cation then anion with total charge zero, may have form hydrate (.H_2O)
  - For covalent compounds carbon, hydrogen, then remaining elements alphabetically
- Structural formulae: