Lecture 1

Thursday, 12 March 2015
11:10 AM

- Dalton's atomic theory describes an atom as a tiny indivisible particle that can be neither created nor destroyed.
- Each element has atoms which are unique to them.
- An element is a substance which can't be divided into subsequent substances.
- A molecule consists of two or more atoms
- A compound consists of two or more elements
- A mixture is more than one substance and can be homogenous or heterogeneous.

Lecture 2

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- A physical change is a change in state - liquid, solid, gas
- A chemical change is the change of composition of a substance.
- Physical properties of a substance are independent of the environment:
    - Colour
    - Melting point
    - Conductivity
    - Density
    - Surface tension
- Chemical properties result from the formation of a new substance:
    - Flammability
    - Corrosiveness
    - Reactivity to acid
- Intensive properties are independent of the amount of the substance
- Extensive properties depend on the amount

Lecture 3

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- 1897 - JJ Thomson studied cathode rays and found:
    - They were negatively charged particles
    - Produced by all metals
    - Approx. 1000 times lighter than hydrogen - disproving Dalton's atomic theory of indivisibility
    - Named them electrons
- The plum pudding model

- 1909 - Millikan measured charge of electron to be 1.6×10^{-19} C
- 1909 - Rutherford showed alpha particles can pass through thin gold foil:

    - Atoms mostly empty space
    - All positive charge and nearly all mass contained in nucleus
    - Nucleus made of protons and neutrons - nucleons
- Atomic number Z - number of protons, element determinant
- Nucleons held together by strong nuclear force which is only effective at short distances and is strong enough to overcome electrostatic repulsion.
- Anions are negatively charged ions, i.e. More electrons than protons
- Cations are positively charged ions, i.e. Less electrons that protons

Lecture 4

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- Wavelength is the distance between two crests (λ)
- Frequency is the number of crests passing in a given time unit

  $c = 2.988 \times 10^{8}\ ms^{-1}$ >>> speed of light constant
  $C = \lambda v$
  $E = hv$ >>> $h = 6.626 \times 10^{-34}$ Js (planck's constant)

  $\lambda \propto 1/v$ $\lambda \propto 1/E$
- Atoms emit electromagnetic radiation when supplied energy (e.g. Heat, electricity) - this is made up of fixed frequencies characteristic of the particular element - atomic emission spectrum.
- Light from H gas has a few lines:
    - Only certain energies emitted
    - Pattern lines unique to H
    - Process is quantised - comes in discrete packages.
- Neils Bohr:
    - Electrons occupy certain energy levels
    - When electrons move between levels, energy is absorbed or emitted in quantised amounts
    - Energy corresponds to light of specific frequency/energy

Lecture 5

Wednesday, 11 March 2015
8:37 PM

- If electrons could have any energy [as satellites orbiting around the Earth can], then atoms could absorb and emit light at any frequency. If this were the case, everything would be white. Colour results because only light of certain energies can be absorbed or emitted leading to, for example, yellow sodium lamps or fireworks. Only certain energy light can be absorbed or emitted because the electrons are restricted to certain orbits.
- Gain of electrons - anion - negative charged atom
- Loss of electron - cation - positive charged atom
- More than one electron may be gained or lost but >3 electrons lost/gained is rare
- Noble gases occupy the last group of the periodic table and they all have 8 electrons in their outermost shell except for He which has 2.

- The full outer electron shell of noble gases makes them electronically stable and hence they occur as isolated atoms. These do not gain or lose electrons and are called isoelectronic.
- Electrostatic attraction of ions result in ionic bonds being formed - no sharing of electrons, just a transfer of electrons is present. These result from metals bonding with non metals.
- Ionic bonding produces a solid crystal lattice.
- Ions are packed so as to maximise the attractive forces and minimise repulsion.
- Ratio of cations to anions ensures zero overall charge of the compund.
- Ionic bonding is non-directional bonding
- Brittleness is a result of changing electrostatic forces between ions (cations near cations repel each other - hence ionic bonds aren't very strong because they rely on electrostatic attraction to remain bonded.
- We generally do not get highly charged ions because too much energy is required to form them (it takes energy to remove an electron from an atom)