Edexcel GCSE Chemistry

Topic 1:Key concepts in chemistry

Atomic Structure

Notes

1.1 *Describe how the Dalton model of an atom has changed over time because of the discovery of subatomic particles*

John Dalton (1803):

- He published his own three-part atomic theory:
    1. All substances are made of atoms. Atoms are small particles that cannot be created, divided, or destroyed.
    2. Atoms of the same element are exactly alike, and atoms of different elements are different.
    3. Atoms join with other atoms to make new substances.
- Much of Dalton's theory was correct, but some of it was later proven incorrect and revised as scientists learned more about atoms.

J.J. Thomson (1897):

- Used a cathode-ray tube to conduct an experiment
- This discovery identified an error in Dalton's atomic theory. Atoms can be divided into smaller parts.
- Because the beam moved away from the negatively charged plate and toward the positively charged plate, Thomson knew that the particles must have a negative charge.
- Thomson proposed a model of an atom called the "plum-pudding" model, in which negative electrons are scattered throughout soft blobs of positively charged material.

Ernest Rutherford (1909):

- Shot a beam of positively charged particles into a sheet of gold foil.
- Most of the particles did continue in a straight line (as you would expect from plum pudding model). However some of the particles were deflected to the sides a bit, and a few bounced straight back.
- Rutherford developed a new model which said that most of the atom's mass is found in a region in the center called the nucleus.
- In Rutherford's model the atom is mostly empty space, and the electrons travel in random paths around the nucleus.

1.2 *Describe the structure of an atom as a nucleus containing protons and neutrons, surrounded by electrons in shells*

1.3 Recall the relative charge and relative mass of protons, neutrons and electrons

particle	relative charge	relative mass
proton	+1	1
neutron	0	1
electron	-1	1/1836

1.4 Explain why atoms contain equal number of protons and electrons

- Atoms are neutral and the charges on a proton are +1 and on an electron are -1
- therefore amount of protons = amount of electrons, so that the charges cancel

1.5 Describe the nucleus of an atom as a very small compared to the overall size of the atom

1.6 Recall that most of the mass of an atom is concentrated in the nucleus

1.7 Recall the meaning of the term mass number of an atom

- Mass (nucleon) Number = number of protons + neutrons

1.8 Describe atoms of a given element as having the same number of protons in the nucleus and that this number is unique to that element

1.9 Describe isotopes as different atoms of the same element containing the same number of protons but different numbers of neutrons in their nuclei

1.10 Calculate the numbers of protons, neutrons and electrons in atoms given the atomic number and mass number

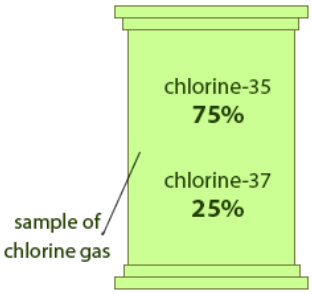
- Atomic (proton) Number = number of protons (= number of electrons if it's an atom, because atoms are neutral)
- therefore, you can calculate number of neutrons by doing mass number å atomic number

1.11 *Explain how the existence of isotopes results in relative atomic masses of some elements not being whole numbers*

- because isotopes have the same number of protons but different numbers of neutrons, they are still atoms of the same element, but they have different atomic masses
- the relative atomic mass is calculated using the abundance of different isotopes and because it is an average it can lead to the relative atomic mass not being a whole number (atomic number and mass number will always be whole numbers- they are not averages)
- since the mass of atoms is so small, we compare their masses to each other. A carbon atom having a mass number 12, i.e. (^{12}C) is taken as standard for this comparison and its relative atomic mass is 12.
- It is written as **Ar** or **R.A.M.**.

1.12 *(higher tier) Calculate the relative atomic mass of an element from the relative masses and abundances of its isotopes*

A sample of chlorine gas is a mixture of 2 isotopes, chlorine-35 and chlorine-37. These isotopes occur in specific proportions in the sample i.e. 75% chlorine-35 and 25% chlorine-37. Calculate the R.A.M. of chlorine in the sample.



The average mass, or R.A.M. of chlorine can be calculated using the following equation:

$$\text{R.A.M.} = \frac{(\text{mass of isotope-A} \times \%\text{ of isotope-A}) + (\text{mass of isotope-B} \times \%\text{ of isotope-B})}{100}$$

$$= \frac{(35 \times 75) + (37 \times 25)}{100}$$

$$= \frac{3550}{100}$$

$$\text{R.A.M.} = 35.5$$