From the writer

To learn chemistry better, you should:

1) Understand the Periodic Table thoroughly. *2) Remember the **definitions** of some important terms.

3) Do exercises after revision. 4) Write your own set of notes.

Lesson 1 For Book 1

Atomic Structure

- What are the **basic components** of an atom's nucleus? They are _____, _____, and _____.
- For a (neutral) **atom**, the no. of p_____ must be the same as the e_____.
- Definition of atomic number = **Z** is the no of _____/_____ in the nucleus of the atom.
- Definition of mass number = **A** is the no of _____/_____ and _____ in the nucleus of the atom.
- How about isotope? I_____ are atoms of the same e_____ with the same number of p_____ but different number of _____. Basically, different isotopes should have the **same** physical properties (except for the radio-reactivity) and also chemical properties. However, it is likely that isotopes have a different abundance in the earth.

Exercise 1

$^{10}BCl_3$ and **$^{11}BCl_3$** are compounds formed respectively from the two isotopes of boron with chlorine. $^{10}BCl_3$ reacts with water to give white fumes. State, with explanation, the expected observation when $^{11}BCl_3$ is added to water.

→ The concept of isotope is applied for atom, but not for molecule. However, the compounds formed from the different isotopes of an element should have the _____ chemical property.

Basic Calculation about no of moles, molar mass, mass , no of particles……

i) What is the mass of **a** water molecule? (Given : Avogadro's no = $6.02*10^{23}$)

ii) How many Cl- anions in 24g $CaCl_2$ (s) ?

iii) ***Which of the following gases is the **densest**? (Hint : Consider their relative molecular mass.)

A. CO_2 - carbon dioxide C. CH_4 - methane

B. Cl_2 – chlorine D. C_3H_8 – propane

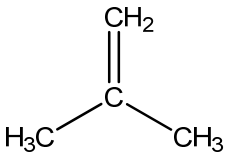
Empirical Formula and Molecular Formula and Structural Formula --- For organic compounds

- In fact, empirical formula of an **organic sample** (It is the compound which contains the elements of _____ and _____) is found by the complete c_____ of the sample. It is the **simplest number ratio** of the **atoms** present in the compound.

e.g. $(CH_2)_n$ = _____, where n must be an integer.

→ If n is = 4, _____ is the **Molecular formula** of the compound.

- **Structural formulae** is the most important one because it can enable us to find the **exact structure** of the compound. As for the above example, C_4H_8 represents a lot of possible compounds, e.g.



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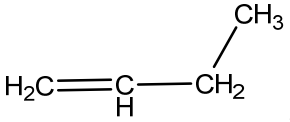

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So, to draw the actual structure of C_4H_8, we need to determine the _____ formula, again.

Exercise 2

Compound X has the following composition by mass:

C = 70.6% H = 5.9% O = 23.5%

i) Please find out the empirical formula of L.

ii) Given that its rel. molecular mass is around 136, what is its molecular formular?

Exercise 3

Determine the **empirical formula** of Copper (II) oxide using the following results.

Mass of test tube = 21.430 g

Msass of test tube + copper (11) oxide = 23.321 g

Mass of test tube + copper = 22.940 g (Hint : Find the mass of the oxide and copper respectively.)

→ Actually, you should have the answer in your mind and you should know what the process is, that is, R_____ of the oxide by town gas = CO and hydrogen.

- Although the structural formulae is useful, but it can be hardly found. Later, you will learn the methods to find and identify the structural formula for an organic sample. But now, you should know the basic thing about **Mass Spectrometry** first.

Mass Spectrometer Please sketch the main parts of a typical mass spectrometer.

Important components

1) **Vaporization chamber :** To vaporize the **sample** → limits to sample without a very high _____ point.

2) **Ionization chamber** : To ionize the g_____ sample by the fast moving e^- bombardment.
   → i.e. X (g state) + e- → X^+ +___e-

3) **Electric Field** : To speed up the ionized sample → should be cation/ anion?

4) **Magnetic field** : To deflect the cations towards the i_____ detector according to their mass to charge ratio. i.e. m/z , where we assume z = ___.

Related Questions

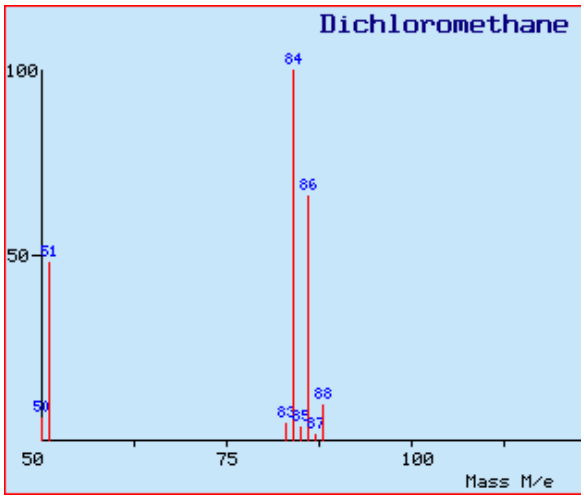
1) How the ionization of the sample can be achieved?

2) How the ions can be detected?

3) From the data obtained by M.S., cal the rel. atomic mass of Gallium

Ga-69	Ga-71
Rel. Abundance = 60.4%	Rel. Abundance = 39.6%

Features of a mass spectrum



Here is the spectrum of **dichloromethane** .

From the **last line**, we can find out the **molecular mass** of the sample.

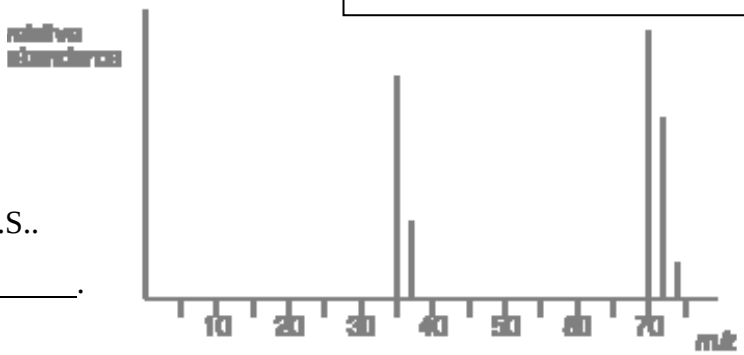
i.e. = _____ (unit =)

From the Rel. Abundance and the m/z ratio, we can find the **Rel. molecular mass** of the molecule**.**

(rel. = no unit)

Exercise 5

E D C B A



Consider the mass spectrum of **Chlorine gas,** answer the following question.

a) Explain why there are **five peaks** in the M.S..

→ Note that Cl has the isotopes _____ and _____.

b) The ratio of rel. Abundance of **D to E is 1:3**

i) find the rel. atomic mass of Chlorine. (but **not** chlorine molecule)

ii) find the ratio of rel. abundance of A to B to C.

(35.5 **a.m.u** , 1:6:9)

Ideal Gas Equation

- In the equation, Pressure = Nm^{-2} (Pa) ; V = m^3 mol^{-1} ; T= K ;
  and R is the ideal gas constant= 8.314 JK-1mol-1

→ Actually, P*V has the unit of ___, which is an **energy** term.

Some conversions = 1) PV=nRT 2) P M = ρ RT (M = molar mass) 3) P = CRT (C = molarity)

Exercise 6

A mixture of Krypton and Xenon is obtained from air. At 300 K and a pressure of 0.790 **atm**, the mass of 1.00 **dm^3** of the mixture is 2.79 g. What is the apparent molar mass of this mixture?

(Hint : Be careful of the units) (86.9 $gmol^{-1}$)