Lesson 2 for book 1

Review Question---Calculation about Combustion → Learning Stiochiometry

Actually, this type of question will not appear in HKAL. But, it is basic for us to use Avogadro's Law when we deal with questions involving g_____ species.

Equations required:

1) $C_xH_y + (x + y/4)\ O_2 \rightarrow y/2\ H_2O + x\ CO_2$

2) $C_xH_yO_z + (x + y/4 - z/2)\ O_2 \rightarrow y/2\ H_2O + x\ CO_2$

Question: $20cm^3$ of a gaseous covalent compound containing only carbon, hydrogen and oxygen were mixed with $110cm^3$ of oxygen which was in excess. The mixture was **exploded** at 105℃ and the volume of the gaseous mixture was 150 cm^3. After **cooling** to room temperature, the residual volume was **reduced** to $90cm^3$. On adding concentrated potassium hydroxide solution, the volume **further decreased** to $50cm^3$. Calculate the molecular formula of the compound.

(Hint = adding conc. KOH is to absorb CO_2 gas) (C_2H_6O 5M)

About Titration (Further discussion on notes for Book 2)

Titration = involving the use of titrant (上/下), the titrate (上/下)

→ **Titrant** is the reagent with k_____ concentration while the **titrate** is the sample with unknown concentration.

Titration is used in analytical Chemistry (分析化學). The common type that we often encounter in HKAL is called A_____B_____ titration. Regarding the set up, titration involves the use of p_____ , b_____, volumetric flask , conical flask, indicator.

Dealing with titration result, two important but confusing terms = e_____ point and e___ point should be noted carefully.

→ equivalent point is **not** the point of which the **pH** of the solution is 7, it is the theoretical point that all acid and base were **reacted** or **neut_____** completely (sample and titrant) to form the salts.

→ end point is the point of which we observe the colour change of the i_____.

→ Calculation Skill : concentration = no of mole of the analyte / volume , unit = _____

vs. molarity = mass of the analyte / volume, unit = _____

Exercise 1 (Frequently asked)

A standard **iodine** solution was prepared by dissolving 0.953 g of KIO_3 (s) inexcess KI (aq) and H_2SO_4 (aq) and then making up the solution to 250.0 cm^3.

a) Why are standard iodine solutions not prepared directly solid iodine?

→ Actually, ***In situ* preparation** is employed**.**

b) Calculate the molarity of the standard iodine solution.

(Hint = write the equation first)

c) 25.00 cm^3 of the standard iodine solution was **titrated against** 0.0981 M $Na_2S_2O_3$ (aq). 27.25cm^3 of the $Na_2S_2O_3$ (aq) was required to reach the end-point. Deduce the stoichiometry of the reaction of I_2 with $Na_2S_2O_3$, and write a balanced equation for the reaction.

(Hint : Draw the set up of the titration first . Who is the titrate? _____) ($[I_2] = 0.05344M$)

→ $I_2 + 2\ S_2O_3^{2-} \rightleftarrows S_4O_6^{2-} + 2\ I^-$

Actually, this reaction is an example of R_____ reaction. In the reaction, iodine is the _____ agent while thiosulphate is the _____ agent.

d) What is the indicator being used in this titration? What should be the colour change at the end-point?

Starch solution is the typical indicator used for the titration involving iodine. The colour change should be from _____ to _____.

Electronic Strusture of atoms

In HKCEE, we learn the drawing of electronic diagram. Indeed, it represents a **wrong concept** that electrons are moving in orbit. But, this kind of drawing help us learn about how to count the no. of electrons and how to occupy an electron shell with electrons.

To learn about the electronic structure of atoms, we should understand the following parts. That is the investigation of the simpliest element, **hydrogen,** through the analysis of its **atmoic emission line spectrum**.

Interpretation of the Atomic Hydrogen Emission Spectrum (Frequently – asked)

1) Origin of atomic emission

For each electron existing in an atom, it has a certain energy state. Their energies are **quantized.** When an atom abosorbs a certain amount of energy in the form of heat or elecrtrical energy, an electron can be excited from a _____ energy level to a _____ one. This process is called **excitation**. After that, when the electron returns to its ground state, it emits a discrete amount of energy which is equal to the d_____ between the two energy levels , in the form of **photon**. This results in the formation of spectrum line with corresponding frequency . (Note: **energy = hν = hc/ λ**)

2) Why does each series of atomic emission lines of hydrogen converges at the lower wavelength?

In fact, the emission lines of hydrogen can be divided into ____ series according to their frequecy. The **energy differences** between successive electron shells are not the same. The **energy difference between** electronic state **decreases with** principal quantum no (**n**) / decreases towards high frequency. If the n gets higher, the **energy difference** between the later successive energy levels becomes smaller and hence, the lines converge at the lower wavelength end.

(**Note** : Lower wavelength = higher frequency = larger amount of energy involved.)

→ n=1 , ground state with energy = __ J ;

→ n= ∞ , the electron is **leaving** from the atom's nucleus , energy = 2.18×10^{-18} J

3) What can you deduce from the fact that the spectral lines in the atomic emission spectrum of hydrogen are **not** equally spaced?

It indicates the energy levels of the electron in the hydrogen atom are ____ equally spaced out

→ so, the lines converge at the lower wavelength end.

Some Reminders

1) The lines are formed by the **jumping and r_____** of an electron in a certain energy level.
2) The energy involved to form a line is "A DIFFERENCE" → Δ**energy**.
3) Using the convergence limit (a freq) of hydorgen can find the first I_____ enthalpy of hydrogen atom. (But be careful of the concept of **one** electron and **one mole** of electron?)

Exercise 2

In the atomic emission spectrum of hydrogen, the convergence limit for the Lyman series occurs at $3.275*10^{15}$ Hz. Calculate the ionization energy of hydrogen, in kJ mol-1

(Given h = $6.626*10^{-34}$ Js ; Avogadro constant , $6.023*10^{23}$mol-1)

Hint = E =_____ 1.307×10^{3} kJmol^{-1}

Some Definitions For important terms

1) **Electron shell** is a collection of subshell ; **Subshell** is the collection of orbital ;

Most importantly, **orbital** is used to define the region of space of finding an electron with high (>90 %) propability. (Atomic Orbital)

2) Electrons have a **dual Wave-Particle nature.** It has no defined shape and pathway to move. We can describe the motion of electrons in terms of **possibility/ distribution** only,

3) **Orbitals** have defined shape. s-orbital is in _____ ; p-orital is in _____.

The nucleus of an atom can be found at the c_____ of the orbital.

Building up **electronic configuration**

My skills = think about the total number of electrons of the atom involved

= remember the fact that s-orbital can hold ____ electrons.

= p-orbital can hold ____ electrons.

= d-orbital can hold ____ electrons.

= remember some tricks e.g.Cr , Cu, that is, half/full filled orbital is a preferred configuration.

Principles governing the electronic configuration

1) Aufbau Principle = electrons will enter the possible orbitals in an order of as_____ order.

2) Pauli exclusion principle states that electrons occupying the same orbital must have o_____ spins.

3) Hund's rule states that electrons must occupy orbitals of the same energy s_____before p_____ takes place.

Be careful : orbitals with the same energy are called d_____ orbitals.

Question : Please write down the electron configuration of chromium and copper.

(Hint : Please know their atomic numbers and hence their total number of electrons first.)

Cr :

Cu :

Comparing ionization energy

Ionization energy is the energy required to remove one / one mole ? of electron from an atom in **gaseous** state.

→ Please write down the equation representing the **second I.E.** of Mg (with clear state)

To determine the relative value of ionization energy of some elements, we should consider the factors :

→ Nuclear charge and Effective nuclear charge **(across a period)**, Screening effect **(going down a group),** atomic radius (_____ _____ a group) and the most important one --- electronic config **(everytime you come across such question, you should write down the configuration for the element.)**

→ **Also,** removing electron from a half/full filled shell is more e_____ costing.

→ By **shifting** the graph of First I.E. to the **RIGHT** by one unit **and upwards**, we can get the graph of **Second I.E** from the respective **first I.E. graph**.

→ In terms of magnitude, the n^{th} I.E. should be ordered as n > n-1 > … >2 > 1 st I.E.

(**WHY**? It is more difficult to remove electron(s) which is _____ charged from a p_____ charged ion than from a neutral atom.)

→ But, please don't try to remember any graphs. Instead, you should be able to contruct it by yourself.

Exercise 3

Explain why a) the first I.E. of oxygen is greater that that of sulphur.

b) the first I.E. of oxygen is smaller than that of fluorine.

(Hint = Please try to write precisely and write all the **key words**) (2 M)