Rutherford:

Rutherford was the 1st scientist who stated the concept of the atomic structure.

1-The Atom:

Although it has very small size but it has a complicated structure that resembles the solar system in which electrons revolve around the central nucleus in orbits as planets revolve around the sun.

2-<u>The Nucleus:</u>

Is much smaller than the atom. Located in the centre of the atom with (+ve) charge. There is a big space between the nucleus and orbits of electrons, so most of the atom is a space. Most mass of the atom is concentrated in the nucleus as mass of e is very small and can be neglected.

3-Electrons:

- 1-Have negligible mass compared to that of the pectors. 2-No of electrons (-ve) equals not 2-No of electrons (-ve) equals no of scons (+ve) so the atom is electrically neutral.
- electrically neutral. 3-Electrons revolve around the nucleus in a fixed orbit as electrons are affected by two forces equation strength but in opposite direction, which are :

a- Force of attraction of the nucleus to electrons.

b- Centrifugal force due to velocity of electron around the nucleus.

Give reason: Electrons are not attracted to the nucleus.

Explain: Structure of the atom in the view of Rutherford.

Bohr's Atomic Model

Bohr's postulates:

- 1- A positively charged nucleus exists in the center of the atom.
- 2- Atom is electrically neutral as no of p^+ s equals to no of e's.
- 3- Electrons revolve around the nucleus in orbits due to centrifugal and attraction forces.
- 4- Electrons orbit the nucleus in a rapid movement without gaining or losing energy.
- 5- Electrons orbit the nucleus only in definite allowed energy levels, so they can't be found at intermediate distance.



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- 6- Each electron in the atom has a definite amount of energy depending on the distance between is E.L and nucleus. This energy increases as its radius increases.
- 7- It was found that the maximum no of energy levels in the heaviest known atoms in their ground state (unexcited) is only seven (K, L, M, N, O, P, Q). Each level has energy expressed by a completely no called principle Q. No.
- **<u>Ex</u>**: The 1st E. Level K its principle Q. no = 1 The 2nd E. level L its principle Q. no = 2
 - 8- If when atom is excited by heating (Quantum) or by electric discharge the electron will transfer to a higher E. level agrees with the absorbed quantum. The excited electron in the higher E. level is then unstable, so it returns to its original level losing the same quantum of energy, which it gained during excitation in the form of radiation have definite wavelength and frequency.

* <u>Remarks:</u>

- 1- The quantum: Is the amount of energy gained people when an electron jumps from one E. level to another.
- 2- The difference in energy between leves (Q) is not equal i.e. the difference in this energy decreases further from the nucleus. This means that the quantum of energy required to transfer an electron from one energy level to another is not equal.
- **3-** The electron does not move from its level to another unless the energy absorbed or emitted is equal to the difference in energy between 2 levels i.e. one quantum.

(There is no half quantum for instance). Q can't be divided or doubled

Give reason: It is wrong to say that e' to be transferred from E.L (K) to E.L (M) needs amount of <u>energy equals 2 quantum</u>.

Excited Atom:

- It is an atom that acquired an amount of energy (Q) sufficient to transfer its e's from their original E.L to higher ones.

- ✤ It is possible to determine the allowed energy levels of the electron and define the region of space around the nucleus where it is most probable to find the electron in each energy level.
- The electronic motion around nucleus has wave properties therefore the position to use the term electron cloud to describe any orbital.

<u>Electron Cloud</u>: (used to describe any orbital)

"Area of space around the nucleus where there is a great probability for finding electrons in all direction and all positions."

The difference between the orbit and orbital concepts according to both Bohr and the wave mechanics theories:



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1- S – block consists of two groups because the S – sublevel consists of one orbital which is filled with two electrons only.

2- P – block consists of (6) groups because the P – sublevel consists of three orbitals which filled with six electrons.

3-d – block consists of (10) groups because the d – sublevel consists of five orbitals which are filled with ten electrons.

4- f block are separated from the table so that the table is not too wide (long)

5- The first period contains two elements because it consists of elements of the sublevel 1S = 2 electrons.

6- The second period contains eight elements because it consists of the sublevel (2S + 2P) = 8 electrons.

7- The third period contains eight elements because it consists picement of

sublevel (3S + 3P) = (2 + 6) = 8 electrons.
8- The fourth period contains eighten elements because it consists of elements of the sublevels (45 - Qd + 4P) - 2 - 10 + 6 = 18 electrons.

9- The first period contail (3) elements because it consists of elements of the sublevels (5S + 4d + 5P) = 2 + 10 + 6 = 18 electrons.

10- The six period contains (32) elements because it consists of elements of the sublevels (6S + 4P + 5d + 6P) = 2 + 14 + 10 + 6 = 32 electrons.

How can you find the location and the type of element in the periodic table?

1- Write the electronic configuration of element in quantum levels.

2- Number of period = the maximum value of principle energy level (quantum number).

Example:

Find the number of period and group for each of the following element: Na: The atomic number = 11Cl : The atomic number = 17

Elements of the fifth group (N7, P₁₅) have a lower value of electron affinity

Because the outer most energy sublevel (nP) has three electrons and it is half filled with electrons it gives the atom some extra stability ($N_7 : 1S^2$, $2S^2$, $2P^{2}$).

Noble gases have not (small) electron affinity

Because all energy sublevels are completely filled with electrons which gives the atoms great stability.

Electron affinity of Fluorine (F_9) is less than that of chlorine (Cl_{17})?

Because the atomic radius (size) of fluorine atom is smaller than that of chlorine atom and when fluorine atom gains electron it is affected by a great repulsion force bigger than that in chlorine atom and fluorine atom is very small size.

Electro negativity

le.co.uk The tendency of an atom to attract to testions of chemical bond to itself.

gy, electron affinity and electro Compa egativity

Ionization energy	Electron affinity	Electro negativity		
It is the amount of energy needed to remove the least connected electron bond in a single atom	It is the amount of energy released when an extra electron is added to a neutral single atom to form an ion	It is tendency of an atom to attract the electrons of chemical bond to itself		
It refers to the atom in its single state	It refers to the atom in its single state	It refers to the atoms which linked together in the molecule		
It is inversely proportional to the atomic radius	It is inversely proportional to the atomic radius	It is inversely proportional to the atomic radius		



In the case of hydride

- The oxidation number of element (metal) of 1st and 3rd groups in their compounds agrees with group number (it takes positive oxidation number to which they belong)

- Most elements in the middle of the table have variable oxidation number in different compounds.

The oxidation number of the elements in groups from IV to VII = the group number = - value because the elements gain electrons to complete a full shell.

Group	Ι	II	III	I V	V	VI	V II
Element	Li	Be	В	С	Ν	0	F
Hydride	LiH	BeH ₂	BH ₃	CH ₄	NH ₃	H ₂ O	HF
Oxidation							
Number	1 +	+ 2	+ 3	+ 4	- 3	- 2	- 1

The oxidation number of noble gases of (group zero) is zero because they do not combine to form compounds.

2nd secondary



• The valency Bond Theory: (V.B.T.)

- Electrons has wave property so the formation of covalent bond as a result of overlapping of an atomic orbital of an atom with an unpaired electron, with another orbital in another orbital in another atom has an unpaired electron to form a molecular orbital contains a pair of electrons.

1- <u>H₂ Molecule:</u>

 $H\bar{2}$ molecule is formed as a result of overlapping of the e' of 1s orbital of each atom



2- HF molecule: 1H 1S

HF molecule is formed as a result of overlapping of 1S atomic of H atom with 2P atomic orbital of F atom.



• NH₃ is formed as a result of overlapping of

 P_x , p_y , p_z Orbitals of (N) atom with 3(1S) orbitals of hydrogen atoms.

<u>Q</u>: How does the valence bond theory explain the structure of methane?

- There are 2 single electrons in carbon atom, but in methane molecule, the carbon atom forms 4 covalent bonds. So, the carbon atom must have 4 single electrons. How?? By exciting one electron from 2S to the vacant orbital 2P.
- Now, the carbon atoms has 4 single electrons, but they aren't equivalent in energy as one electron is located in 2S orbital which is lower in energy than 2P orbital. Then they must be = in energy. How?? By hybridization

2nd secondary





• <u>Hybridization:</u>

"It is the process of the overlapping between two different orbitals or more of the same atom to produce a number of new orbitals called hybridized orbitals."

• **<u>Properties of hybridization:</u>**

- (1)Hybridization occurs between orbitals of close energy, for the same atom.
- (2)Hybridization occurs after excitation 105
- (3) Number of hybridized orbitals equal number of pure orbitals taking part in hybridization.

Example: eview

Hybridization of 15 with 1P gives 2SP orbitals. Hybridization of 1S with 2P gives 3SP² orbitals. Hybridization of 1S with 3P gives 4SP³ orbitals.

- (4) Hybridized orbitals are equal in shape and energy; also angles between them are equal.
- (5) The shape of the hybridized molecular orbitals differ from these of the pure atomic orbitals forming them. The hybridized molecular orbitals must protrude to the outside to be more capable of overlapping than the pure atomic orbitals.

Molecular Orbital Theory: (M.O.T)

- Considers the molecule as one unit (or a big atom with multi nuclei) in which some of atomic orbitals of the combined atoms overlap forming molecular orbitals.
- The molecular orbitals have symbols sigma (δ) & pi (Π)

2 nd secondary					
Monthly Exam.					
<u>(First question):</u> A- <u>Define the following:</u>					
1- Ionization potential 2- Octet	t rule.				
B- <u>Give reasons:</u>	B- Give reasons:				
1- Zinc oxide is from amphoteric oxides.	1- Zinc oxide is from amphoteric oxides.				
2- The angle value between covalent bonds in ammonia molecule is less than that in methane molecule.					
(Second question) (A) Write the scientific term for each of the following:					
1- A bond formed as a result of overlap of two atomic orbitals by here to head. ()					
2- An ion is formed from the combination of water or dische with a positive hydrogen ion.					
3- A bond is formed when hydrogen atom respetiven two atoms of high electromera Pily					
B- Show the oxidation and reduction in this reaction :					
$2\text{FeCl}_3 \longrightarrow 2\text{FeCl}_2 + \text{Cl}_2$					
<u>(Third question):</u> Compare between ethylene & acetylene.					
1- The type of hybridization, the value of angles & Stereo structure.					
B- What is meant by? 1. Atomic radius	2- Metallic bond				
(Fourth question)					
what is the atomic number for element in period 2, group 6A?					

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- **3-** They are very strong reducing agent because they have a large atomic radius (or volume) and small ionization energy so they lose the electrons from their outer most energy level easily.
- 4- They are most (soft) metals with low melting and boiling points due to the decreasing in the strength of the metallic bond between atoms since they have only one electron in the outer most energy level.
- 5- They have a large atomic radius because each element occupied the beginning of its period.
- 6- Elements of group (1A) are considered of the highest electropositive metals because they can easily lose the valency electron.
- 7- Potassium and Cesium are used in photoelectric cells because the atoms of these elements have a large atomic radius and small ionization energy so when they are exposed to light the lose the electrons from their outer most energy level easily.
- 6- They have characteristic colors when the atom gains an amount of energy which is sufficient to transfer electrons to higher energy levels they give a characteristic colors dry test

Element	Color	
Lithium	Crimson	
Sodium	Golden yellow	
Potassium	Pale violet	
Calcium	Bluish violet	

7- They are kept under liquid hydrocarbons.

Sodium is kept under kerosene because it is a very active metal which can react with air and water so it is stored under kerosene.

8- Action of atmospheric air:

All elements lose their metallic luster because they reacts easily with air to form metal oxide.



G.R.F: Ammonia is considered anhydride base?

Preparation of ammonia gas in industry (Haber's method)

From nitrogen and hydrogen in presence of catalyst (Fe, Mo) at 500°C under 200 atmospheric pressure. $N_2 + 3H_2 \longrightarrow$ $2NH_3$

- 2- Nitric acid HNO₃
- 1- Preparation of nitric acid in lab

 $2KNO_3 + H_2SO_4 \xrightarrow{\Delta} K_2SO_4 + 2HNO_3$



stopper because the vapors of pitcic Qid damage the organic materials as rubber. 🚩

The temperature of exp. dose not exceed more than 100°C because the acid is decomposed thermally.

Properties of acid:

1- Action of heat:

It decomposed by heat giving nitrogen dioxide (NO₂), oxygen and water

 $4NO_2 + O_2 + 2H_2O$ 4HNO₃ Δ .

- 2- Nitric acid is an oxidizing agent because it is reduced in to different product depends on:
 - a- The activity of reducing agent (the metal).
 - b- The presence of some impurities in the metal.
 - c- Concentration of the acid.

d- Temperature of reaction:



Questions

Show by symbolic equations only:

- 1. The reaction between nitrogen and lithium, then adding water.
- 2. Passing of CO2 gas on a hot solution of NaOH.
- 3. Adding dilute cold sulphuric acid on sodium peroxide.
- 4. Exposing a piece of sodium in air for a long time.
- 5. Reaction between lithium and hydrogen, then adding water.

How can you get each of the following?

- 1. Oxygen from sodium nitrate.
- 2. Ammonia gas from lithium.
- 3. Oxygen from potassium.
- 4. Nitrogen dioxide from conc. Nitric acid.
- 5. Ammonia gas from nitrogen.

Give reason for:

- 1. The Chemical reactivity of the alkali metals.
- 2. Potassium superoxide is used submarines and high altitude aero plants.

- Cesium metal is used in photoelectric cells.
 The weak strength of the metallicit 5. The weak strength of the metallic horry of tween atoms of 1st group metals.
- 6. Ammonium ion is more bari (thus phosphonium ion.
- 7. There are various or tion numbers for outrogen.
- 8. A co-min & covalent body on monium ion is formed.
- 9. Calcium Cyanamid is used as a fertilizer.
- 10. Sodium is kept under kerosene.

How to differentiate between:

- 1-Copper sulphate and aluminum sulphate
- 2-Conc. And dilute H N O 3

Give one use for:

- 1-Cs
- 2-Potassium Nitrate
- **3-Phosphorus**
- 4-Caustic soda
- 5-Washing soda