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28/04/21

ASSIGNMENT - 1b

ATOMIC THEORY

The atomic theory is a scientific theory that states that every matter is composed of extremely small particles called atoms. This theory traces its origins to an ancient philosophical tradition known as atomism. According to this idea, if one were to take a lump of matter and cut it into small pieces, one would eventually reach a point where the pieces could not be further cut into small pieces. These are called 'atomos'.

In the early 1800s century, John Dalton proposed the atomic theory. According to his theory, each chemical element is composed of extremely small particles that are indivisible and cannot be seen by the naked eye, called atoms. Atoms can neither be created, nor destroyed. All atoms of an element are alike in mass and other properties, but atoms of one element differ from all other elements. For each compound, different different elements combine in a simple numerical ratio. However Dalton's theory has not proven to be correct at all circumstances.

Discovery of Electrons:

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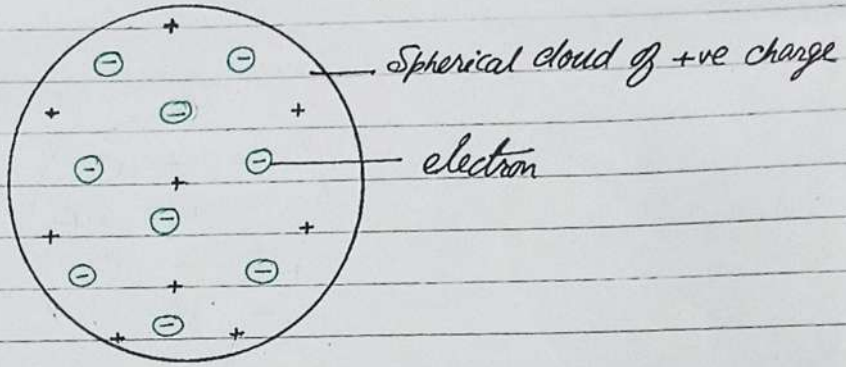
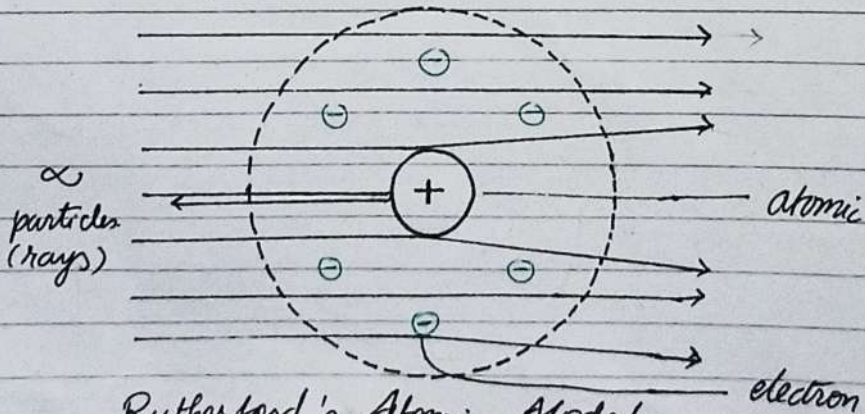


JJ Thompson's Plum Pudding Model

Discovery of Proton:

In 1909, Ernest Rutherford performed the Gold Foil experiment from which he concluded that most of the mass and the positive charge of an atom is concentrated in a very small fraction of its volume, which he assumed to be at the very centre of it.



Rutherford's Atomic Model.

Discovery of neutrons :

In 1933, James Chadwick discovered a new type of radiation that consisted of neutral particles. It was discovered that these neutral particles come from the nucleus of the atoms. He named these particles as neutrons. The last discovery completed the atomic model.

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HEISENBERG's UNCERTAINTY PRINCIPLE

Heisenberg's uncertainty principle states that, it is impossible to calculate simultaneously and exactly both the position and momentum of a moving particle. This principle is based on wave particle duality of matter. Although this principle can be ignored in macroscopic world, (∵ the uncertainty in the position & momentum of objects with relatively large masses are negligible.) it holds significant values in the microscopic world. Since atoms and subatomic particles have very small masses, any increase in the accuracy of their position will be accompanied by an increase in uncertainty in the accuracy of their velocities. Another implication of Heisenberg's uncertainty principle is that it is impossible to calculate accurately the energy of a system in some finite amount of time.

If Δx is the error in position measurement and Δp is the error in the measurement of momentum, then

$$\Delta x \times \Delta p \geq h/4\pi$$

Since momentum $p = mv$, it can be alternatively written as ;

$$\Delta x \times \Delta mv \geq h/4\pi$$

$$\Rightarrow \Delta x \times \Delta m \times \Delta v \geq h/4\pi$$

where Δv is the error in the measurement of velocity and assuming mass remaining constant during the experiment,

$$\Delta x \times \Delta v \geq \frac{h}{4\pi m}$$

Heisenberg's uncertainty principle applies to only dual natured microscopic particle whose wave nature is very small.

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