Answers to exercises in the textbook

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1. identical 2. cathode 3. negatively 4. 1.673×10^{-27} kg
5. neutron

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1. *F* 2. *T* 3. *T* 4. *F* 5. *F*

Check Your Knowledge

A. 1. a) 2. c) 3. b) 4. b) 5. d)

B. 1. three 2. negative plate 3. zero 4. empty
5. energy 6. K

C. 1. *T* 2. *F* 3. *F* 4. *F* 5. *T*
6. *T*

D. 1. Cathode 2. Proton 3. J. J. Thomson 4. Oxygen
5. Valence electrons

E. 1. When a high voltage was applied to a gas in the discharge tube at low pressure, a glow was observed inside the tube. This suggested that an electrical discharge has occurred through the gas. The flow of current occurred due to rays coming from the cathode. In this way, the presence of cathode rays was determined.

2. In 1886, Eugen Goldstein, carried out discharge tube experiments using modified cathode ray tubes. The tubes had a perforated cathode. These experiments resulted in the discovery of canal rays. Unlike cathode rays, canal rays are attracted towards the negative plate under the influence of an external electric field. While cathode rays consist of negatively charged particles, canal rays consist of positively charged particles.
3. The features of Bohr's model of an atom are as follows:
   - The electrons move around the nucleus only in certain fixed orbits or energy levels.
   - As long as an electron revolves in a particular orbit, it does not lose or gain energy.
4. Rutherford's model could not explain the stability of an atom. As the electron is a charged particle, it should lose energy on revolving around the nucleus and should finally fall into the nucleus. Thus as per this model, an atom should be very unstable.
5. An atom consists of two parts—nucleus and extranuclear part. The nucleus is a small, dense body that contains the protons and neutrons. The extranuclear part of an atom is the part excluding the nucleus. It contains the electrons. The electrons revolve around the nucleus in different energy levels, or shells.
6. The number of protons present in an atom of an element is known as the atomic number of the element. On the other hand, the total number of protons and neutrons present in an atom of an element is called its mass number.

F. 1. The postulates of Dalton's Atomic Theory are as follows:
   - All matter is composed of very small, indivisible particles called atoms.
   - Atoms can neither be created nor be destroyed. They are only rearranged during chemical reactions.
   - All atoms of an element show identical properties.
   - Atoms of different elements show different properties.
   - Atoms of different elements combine with each other in fixed whole number ratios to form molecules of compounds.
2. The comparison of properties of electrons, protons, and neutrons is as follows:

Property	**Electron**	**Proton**	**Neutron**
Electrical charge	Negative	Positive	Neutral
Relative charge	–1	+1	0
Mass	9.1×10^{-31} kg	1.673×10^{-27} kg	1.675×10^{-27} kg

3. The features of the plum pudding model of an atom are as follows:
   - An atom consists of a sphere in which the positive charge is uniformly distributed.
   - The electrons are embedded in the sphere just like plums or raisins are distributed in a pudding.

- The negative charge is equal in magnitude to the positive charge, making the atom electrically neutral.

4. From the gold foil experiment, Rutherford made the following conclusions regarding the structure of an atom.
   - Most of the alpha particles passed undeflected through the gold foil. This suggests that most of the space in an atom is empty.
   - Some of the alpha particles were deflected by small angles. This must be due to a repulsive force, indicating that the positive charge is present in a very small space in an atom.
   - Very few alpha particles bounced back, suggesting that the positive charge and the mass of the atom are concentrated in a very small volume at the centre of the atom.
5. The rules of the Bohr-Bury scheme for writing the electric configuration of elements are as follows:
   - The maximum number of electrons that can be accommodated in a shell is given by the formula $2n^2$, where n is the number of the shell.

     For K shell, $n = 1$, so $2n^2 = 2 \times (1)^2 = 2$.

     For L shell, $n = 2$, so $2n^2 = 2 \times (2)^2 = 8$.

     For M shell, $n = 3$, so $2n^2 = 2 \times (3)^2 = 18$.

     For N shell, $n = 4$, so $2n^2 = 2 \times (4)^2 = 32$.
   - Electrons are filled in the shells in a stepwise manner. A given shell is not filled unless the inner shells are completely occupied by electrons.
   - The outermost shell in an atom is known as the valence shell. It can accommodate a maximum of eight electrons.
6. The electronic configuration helps in determining the valency of an element.
   - The elements that have eight electrons in their valence shell are said to possess a completely filled outermost shell. They are unreactive and show a valency of zero.
   - For atoms that contain four or less valence electrons, the valency is the same as the number of valence electrons.
   - For atoms that contain more than four valence electrons, the valency is obtained by subtracting the number of valence electrons from 8.

   Let us understand this with the help of two examples.
   - The electronic configuration of sodium is 2, 8, 1. Thus the number of valence electrons in sodium is one, and its valency is also one.
   - The electronic configuration of chlorine is 2, 8, 7. Thus the number of valence electrons in chlorine is seven, and its valency is $8 - 7 = 1$.