CHAPTER 12 – ATOM

Very short answer type questions (1 mark)

Q 1. What is Bohr's quantization condition for the angular momentum of an electron in the n^{th} orbit?

Answer : $mvr = nh/2\pi$, where n= 1,2,3,…….

m is mass of electron, v is velocity of electron, r is radius of orbit , h is planks constant

Q 2. **When is Hα line of the Balmer series in the emission spectrum of hydrogen atom obtained?**

Answer : Hα line of Balmer series is obtained when an electron jumps from 2^{nd} orbit to 3^{rd} orbit of hydrogen atom.

Q 3. The ground state energy of hydrogen atom is -13.6 eV. What are P.E. and K.E. of electron in this state?

Answer : Total energy E = -13.6 eV

Kinetic energy T = - E = 13.6 eV

Potential energy V = -2T = - 2 × 13.6 = - 27.2 eV

Q 4. What is the ionization potential of hydrogen atom?

Answer : 13.6 eV

Q 5. Define scattering angle.

Answer : The angle between the direction of approach of the alpha particle and the direction of scattered alpha particle is called scattering angle.

Assertion-Reason type MCQs (1 mark each)

Directions : For question numbers 6,7 and 8, two statements are given-one labeled Assertion(A) and the other labeled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

a) Both A and R are true and R is the correct explanation of A
b) Both A and R are true but R is NOT the correct explanation of A
c) A is true but R is false
d) A is false and R is also false

Q6. **Assertion (A)** - Balmer series lies visible region of electromagnetic spectrum.
Reason (R) - Balmer means visible, hence series lies in visible region.
Answer : (c), explanation:- Balmer series found invisible region and Balmer is a

name of scientist.

Q7. **Assertion (A)** – Electrons revolve around the nucleus in a circular orbit.
Reason (R) – Nucleus has positive charge.
Answer: (b)

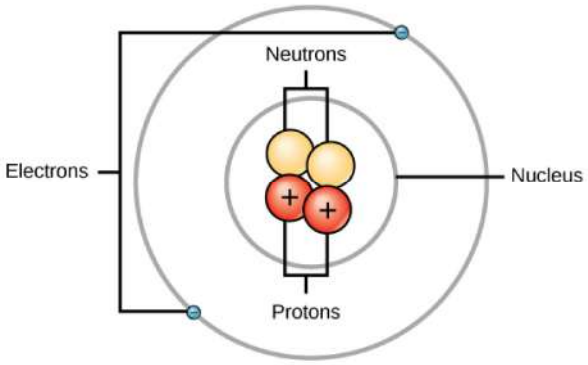
Q 8. **Assertion (A)** - An electron absorbs energy when it jumps from higher energy level to lower energy level.
Reason (R) – Ionization potential is zero for lowest energy level in an atom.
Answer : (d)

Case study based

Direction: question 9, 10, 11 and 12 are the multiple choice questions each of 1 mark based on the following paragraph. Select correct answers of these MCQs.

Atomic Particles

Atoms consist of three basic particles: protons, electrons, and neutrons. The nucleus (center) of the atom contains the protons (positively charged) and the neutrons (no charge). The outermost regions of the atom are called electron shells and contain the electrons (negatively charged). Atoms have different properties based on the arrangement and number of their basic particles.



The hydrogen atom (H) contains only one proton, one electron, and no neutrons. This can be determined using the atomic number and the mass number of the element. Thus hydrogen atom is electrically neutral. If a hydrogen atom loses one electron then it becomes H^+ ion. Now H^+ ion has only one proton and one neutron.

Q 9. The nature of charge of outermost region of the atom is

a) Positive
b) Negative
c) Neutral
d) None of above

Answer: b

Q 10. Nucleus of an atom is positive due to

a) Charge on electrons
b) Charge on protons
c) Charge on neutrons
d) None of above

Answer: b

Q 11. A hydrogen atom becomes H^+ ion when it

a) loses one electron
b) gains one electron
c) loses one proton
d) loses one neutron

Answer: a

Q 12: A nucleus contains

a) electron and proton
b) electron and neutron
c) proton and neutron
d) only neutron

Answer: c

Short answer type questions (2 marks)

Q 13. An α-particle moving with initial kinetic energy K towards a nucleus of atomic number z approaches a distance 'd' at which it reverses its direction. Obtain the expression for the distance of closest approach 'd' in terms of the kinetic energy of α -particle K.

Answer:

At the distance d, the K.E. (K) gets converted into P.E. (P) of the system.

$$\therefore \quad \text{P.E. at distance } (d) = \frac{1}{4\pi\varepsilon_0}\frac{2e \times Ze}{d}$$

$$\therefore \quad \frac{1}{4\pi\varepsilon_0}\frac{2Ze^2}{d} = K$$

$$\therefore \quad d = \frac{1}{4\pi\varepsilon_0}\frac{2Ze^2}{K}$$

Q 14. Find out the wavelength of the electron orbiting in the ground state of the

hydrogen atom?

Answer: $E_n = -13.6/n^2$ eV

$E_1 = -13.6$ eV $= -13.6 \times 1.6 \times 10^{-19}$ J

$E = hc/\lambda$

$\lambda = hc/E = (6.6 \times 10^{-34} \times 3 \times 10^{8}) / (13.6 \times 1.6 \times 10^{-19}) = 91.2$ nm

Q 15. Define ionization energy. How would ionization energy change when electron in hydrogen atom is replaced by a particle 200 times heavier than electron, but having same charge?

Answer: Ionization energy is the minimum energy required to knock out an electron from an atom. When an electron in hydrogen atom is replaced by a particle 200 times heavier than electrons, but having the same charge, ionization energy will not change, as it depends only on charge and not on mass of the particle.

Short answer type questions (3 marks)

Q 16. a) Write two limitations of Rutherford nuclear model of atom.

b) How these were explained in Bohr's model of hydrogen atom ?

Answer: **a) Limitations:**

(i) Electron moving in a circular orbit around the nucleus would get accelerated. Therefore it loses its energy and hence it would spiral into nucleus.

(ii) Due to continuously changing radii of orbits, electron will emit em waves of all frequencies. Hence atom should emit continuous spectrum.

b) Explanation: according to Bohr's model of hydrogen atom:

i) Electron in an atom can revolve in certain stable orbits without the emission of radiant energy , in which angular momentum

$mvr = nh/2$ $\quad$ $n = 1,2,3,\ldots$

ii) Energy is released/absorbed only, when an electron jumps from one stable orbit to another stable orbit. This result in a discrete spectrum.