PHYSICS

BOOKS - NCERT PHYSICS (HINGLISH)

ATOMS

Atoms

1. Taking the Bohr radius $a_0 = 53$ pm, the radius of Li^{++} ion in its gnround state, on the basis of Bohr's model, will be about.

A. 53 pm

B. 27 pm

C. 18 pm

D. 13 pm

Answer: C

Watch Video Solution

2. The binding energy of a H-atom considering an electron moving around a fixed nuclei (proton), is

$$B = -\frac{me^4}{8n^2\varepsilon_0^2h^2}$$ (m= electron mass)

If one decides to work in a frame of refrence where the electron is at rest, the proton would be movig around it. By similar arguments, the binding energy would be :

$$B = -\frac{me^4}{8n^2\varepsilon_0^2h^2}$$ (M = proton mass)

This last expression is not correct, because

A. n would not be integral

B. Bohr-quantisation applies only two electron

C. the frame in which the electron is at rest is not initial

D. the motion of the proton would notbe in circular orbits, even approximately

Answer: C

Watch Video Solution

3. The simple Bohr model cannot be directly applied to calculate the energy level of an atom with many electrons . This is because.

A. of the electron not being subject to a central force

B. of the electron colliding with each other

C. of scrrening effects

D. the force between the nucleus and an electron will no longer be given by Coulomb's law

Answer: A

Watch Video Solution

4. For he ground state , the electron int eh H-atom has an angular momentum $= h$, according to the simple Bohr model. Angular momentum is a vector ans hence there will be infi-nitely many orbits with the vector pointing in alll possible direction . In actuality , this is not true,

A. because Bohr model gives incorrect values of angular momentum

B. because only one of these would have a minimum energy

C. angular momentum must be in the direction of spin of electron

D. because electrons go around only in horizontal orbits

Answer: A

Watch Video Solution

5. O_2 molecules consists of two oxygen atoms. In the molecules , nuclear force between the nuclei of the two atoms

A. is not important because nuelear forces are short-ranged

B. is not important as electrostaic force for binding the two atoms

C. cancels the replusive electrosatatic force between the nuclei

D. is not important because oxygen nucleus have euqal number of netrons and protons

Answer: A

Watch Video Solution

6. Two H atoms in the ground state collide in elastically. The maximum amount by which their combined kinetic energy is reduced is

A. $10.20eV$

B. $20.40eV$

C. $13.6eV$

D. $27.2eV$

Answer: A

Watch Video Solution

7. A set of atom in an excited state decays

A. in general to any of the states with lower energy

B. into a lower state only when excited by an external by an external electric field

C. all together simultaneously into a lower state

D. to emit photons only when they collide

Answer: A

Watch Video Solution

8. An ionised H-molecules consists of an electron and wo protons. The protons are seperated by a small distance of the order of angstrom. In the ground state,

A. the electrons would not move iin circular orbits

B. the energy would be $(2)^4$ times that of a H-atom

C. the electrons, orbits would go around the protons

D. the molecule will soon decay in a proton and a H-atom

Answer: A::C

Watch Video Solution

9. Consider aimimg a beam of free electrons to wards free atoms . When they scatter, an electron and a protons cannot combine be produced a H-atom,

A. Because of energy conservation

B. Without simultaneously releasing energy in the form of radiation

C. Because of momentum conservation

D. Because of angular momentum conservation

Answer: A::B

Watch Video Solution

10. The bhor model for the spectra of H-atom

A. will not be applicable to hydrogen in the molecular from

B. will not be applicable as it is for a He-atom

C. is valid only at room temperature

D. predicts continuous as well as discrete spectral atoms.

Answer: A::B

Watch Video Solution

11. The balmer series for the H-atom can be observed

A. if we measure the frequencies of light emitted when an excited atom falls to the ground state

B. if we measure the frequencies of light emitted due to transitions between excited states and the first excited state

C. in any transition in a H-atom

D. as a sequence of frequencies with the higher frequencies getting closely packed

Answer: B::D

Watch Video Solution

12. Let $E = \frac{-1me^4}{8\varepsilon_0^2 n^2 h^2}$ be the energy of the n^{th} level of H-atom state and radiation of frequency $(E_2 - E_1)/h$ falls on it ,

A. it will not be absored at all

B. some of atoms will move to the first excited state

C. all atoms wil be excited to the $n = 2$ state

D. no atoms will make a transition to the

$n = 3$ state

Answer: B::D

Watch Video Solution

13. The simple Bohr model is not applicable to He^4 atom because

A. He^4 is an inert gas

B. He^4 has neutrons in the nucleus

C. He^4 has one more electrons

D. electrons are not subject to central forces

Answer: C::D

Watch Video Solution

14. The mass of a H-atom is less than the sum of the masses of a proton and electron. Why is this?

Watch Video Solution

15. Imagine removing one electron from He^4 and He^3. Their energy levels, as worked out on the basis of Bohr model will be very close. Explain why ?

Watch Video Solution

16. When an electron falls from a higher energy to a lower energy level, the difference in the energies appears in the forms of electromagnetic radiation. Why cannot it be emitted as other forms of energy?

Watch Video Solution

17. Would the Bohr formula for the H-atom remain unchanged if proton had a charge $(+4/3)e$ and electron a charge $(-3/4)e$, where $e = 1.6 \times 10^{-19} C$. Given reasons for you answer.

Watch Video Solution

18. Consider two different hydrogen atoms. The electron in each atom is in an excited state. Is it possible for the electrons to have different energies but the same orbital angular momentum according to the Bohr model ?

Watch Video Solution

19. Positronium is just like a H-atom with the proton replaced by the positively charged anti-particle of the electron (called the positron which is as massive as the electron). What would be the ground state energy of positronium ?

Watch Video Solution

20. Assume that their is no repulsive force be - tween the electrons in an atom but the force between positive and negative charges is given by Coulomb's law as usual . Under such circumtences, calculate the ground state energy of a He-atom.

Watch Video Solution

21. Using Bohr model, calculate the electric current created by the electron when the H-atom is in the ground state.

Watch Video Solution

22. Show that the first few frequencies of light that are emitted when electrons falls to the nth level form levels higher than n, are approximate harmonics (i.e., in the ratio 1 : 2: 3...) when $n > > 1$.

Watch Video Solution

23. What is the minimum energy that must be given to a H atom in ground state so that it can emit an $H\gamma$ line in Balmer series. If the angular momentum of the system is conserved, what would be the angular momentum of such $H\gamma$ photon ?

Watch Video Solution

24. The first four spectral lines in the Lyman series of a H-atom are $\lambda = 1218 Å, 1028 Å, 974.3 Å$ and $951.4 Å$. If instead of Hydrogen, we consider Deuterium, calculate the shift in the wavelength of these lines.

Watch Video Solution

25. Deutrium was discovered in 1932 by Harold Urey by measuring the small change in wavelength for a particular transition in $.^1H$ and $.^2H$. This is because, the wavelength of transition depend to a certain extent on the nuclear mass. If nuclear motion is taken into account, then the electrons and nucleus revolve around their common centre of mass. Such a system is equivalent to a single particle with a reduced mass μ, revolving around the nucleus at a distance equal to the electron - nucleus separation. Here $\mu = m_e M / (m_e + M)$, where M is the nuclear mass and m_e is the electronic mass. Estimate the percentage difference in wavelength for the $1st$ line of the Lyman series in $.^1H$ and $.^2H$. (mass of $.^1H$ nucleus is 1.6725×10^{-27} kg, mass of $.^2H$ nucleus is 3.3374×10^{-27} kg, Mass of electron $= 9.109 \times 10^{-31} kg.$)

Watch Video Solution

26. If a proton had a radius R and the charge was uniformaly fistributed , Calculate using bohr theory, the ground state energy of a H-atom When $R = 10\text{Å}$

27. In the Angular process as atom makes a transition to a lower state without emitting a photon. The excess energy is transferred to an outer electron which may be ejected by the atom. (this is called an Augar elecrons) . Assuming the nuclesu to be massive , calculate the kinetic energy of an $n=4$ Augar electron emitted by chromium by absorbing the energy from a $n=2$ to $n=1$ transition .

28. The inverse sequare law in electrostatic is $|F| = \frac{e^2}{(4\pi\varepsilon_0)r^2}$ for the force between an electron and a proton. The $\left(\frac{1}{r}\right)$ dependence of $|F|$ can be understood in quantum theo ry as being due to the fact that the particle of light (photon) is massless. If photons had a mass m_p, force would be modified to

$$|F| = \frac{e^2}{(4\pi\varepsilon_0)\pi^2}\left[\frac{1}{r^2} + \frac{\lambda}{r}\right] \quad .\exp(-\lambda r)$$

where $\lambda = \frac{m_p c}{h}$ and $h = \frac{h}{2\pi}$. Estimate the change in the gound state energy of a H-atom if m_p were 10^{-6} times the mass of the electron.

Watch Video Solution

29. The Bohr model for the H-atom relies on the Coulomb's law of electrostatics . Coulomb's law has not directly been varified for very short distances of the order of angstroms. Suppos-ing Coulomb's law between two oppsite charge $+q_1, -q_2$ is modified to $\left|\overrightarrow{F}\right| = \frac{q_1 q_2}{(4\pi\varepsilon_0)r^2}\frac{1}{r^2}, r \geq R_0$

$$= \frac{q_1 q_2}{(4\pi\varepsilon_0) r^2} \frac{1}{R_0^2} \left(\frac{R_0}{r}\right)^{\varepsilon}, r \leq R_0$$

Calculate in such a case , the ground state enenergy of H-atom , if $\varepsilon = 0.1, R_0 = 1 \text{Å}$

Watch Video Solution