PYQ [IIT-JAM]
[Chapter 1 Bohr Sommerfeld theory and Hydrogen atom]

Q1. If M_e, M_p *and* M_H are the rest masses of electron, proton and hydrogen atom in the ground state (with energy $-13.6\,eV$), respectively, which of the following is exactly true? (c is the speed of light in free space)

(a) $M_H = M_p + M_e$

(b) $M_H = M_p + M_e - \frac{13.6\,eV}{c^2}$

(c) $M_H = M_p + M_e + \frac{13.6\,eV}{c^2}$

(d) $M_H = M_p + M_e + K$, where $K \neq \pm\frac{13.6\ eV}{c^2}$ or zero

IIT-JAM 2005

Q2. In the hydrogen atom spectrum. The ratio of the longest wavelength in the Lyman series (final state $n=1$) to that in the Balmer series (final State $n=2$) is______________

IIT-JAM 2015

Q3. Consider Rydberg (hydrogen-like) atoms in a highly excited state with n around 300. The wavelength of radiation coming out of these atoms for transitions to the adjacent states lies in the range:

(a) Gamma rays $(\lambda \sim pm)$ (b) $UV\,(\lambda \sim nm)$

(c) Infrared $(\lambda \sim \mu m)$ (d) $RF\,(\lambda \sim m)$

IIT-JAM 2017

Q4. Let T_g and T_e be the kinetic energies of the electron in the ground and the third excited states of a hydrogen atom, respectively. According to the Bohr model, the ratio $\frac{T_g}{T_e}$ is

(a) 3 (b) 4 (c) 9 (d) 16

IIT-JAM 2018

PYQ [GATE]

Q1. The wavefunction of which orbital is spherically symmetric:

(a) p_x (b) p_y (c) s (d) d_{xy}

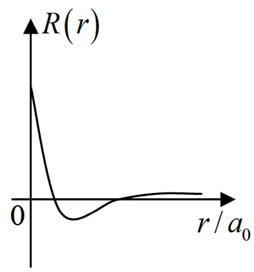
GATE-2017

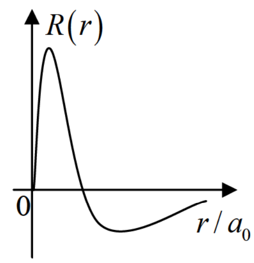
Q2. The intrinsic/permanent electric dipole moment in the ground state of hydrogen atom is (a_0 is the Bohr radius)

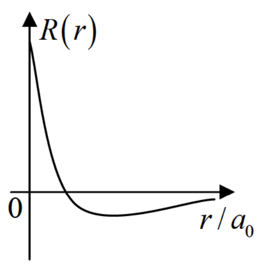
(a) $-3ea_0$ (b) zero (c) ea_0 (d) $3ea_0$

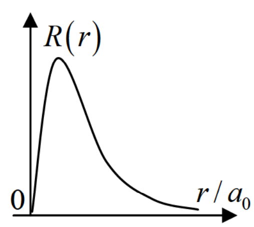
GATE-2018

Q3. Which one of the following represents the $3p$ radial wave function of hydrogen atom? (a_0 is the Bohr radius)

(a)


(b)


(c)


(d)


GATE-2018

Q4. Positronium is an atom made of an electron and a positron. Given the Bohr radius for the ground state of the Hydrogen atom to be 0.53 Angstroms, the Bohr radius for the ground state of positronium is_____________Angstroms. (up to two decimal places).

GATE-2017

Q5. Consider a gas of hydrogen atoms in the atmosphere of the Sun where the temperature is $5800\,K$. If a sample from this atmosphere contains 6.023×10^{23} of hydrogen atoms in the ground state, the number of hydrogen atoms in the first excited state is approximately 8×10^{n}, where n is an integer. The value of n is ___________.

(Boltzmann constant: $8.617\times10^{-5}\,eV/K$)

GATE- 2020

PYQ [NET-JRF]

Q1. Given that the ground state energy of the hydrogen atom is $-13.6\ eV$, the ground state energy of positronium (which is a bound state of an electron and a positron) is

(a) $+6.8\ eV$ (b) $-6.8\ eV$ (c) $-13.6\ eV$ (d) $-27.2\ eV$

NET/JRF (DEC-2011)

Q2. A muon (μ^-) from cosmic rays is trapped by a proton to form a hydrogen-like atom. Given that a muon is approximately 200 times heavier than an electron, the longest wavelength of the spectral line (in the analogue of the Lyman series) of such an atom will be

(a) $5.62\ \mathring{A}$ (b) $6.67\ \mathring{A}$ (c) $3.75\ \mathring{A}$ (d) $13.3\ \mathring{A}$

NET/JRF (JUNE-2013)

Q3. A negative muon, which has a mass nearly 200 times that of an electron, replaces an electron in a Li atom. The lowest ionization energy for the muonic Li atom is approximately

(a) The same as that of He (b) The same as that of normal Li

(c) 200 times larger than that of normal Li (d) The same as that of normal Be

NET/JRF–(DEC-2019)

Q4. If the binding energies of the electron in the K and L shells of silver atom are $25.4\,keV$ and $3.34\,keV$, respectively, then the kinetic energy of the Auger electron will be approximately

(a) $22\,keV$ (b) $9.3\,keV$ (c) $10.5\,keV$ (d) $18.7\,keV$

NET/JRF (JUNE-2017)

Q5. A photon of energy $115.62\ keV$ ionizes a K-shell electron of a Be atom. One L-shell electron jumps to the K-shell to fill this vacancy and emits a photon of energy $109.2\ keV$ in the process. If the ionization potential for the L-shell is $6.4\ keV$, the kinetic energy of the ionized electron is

(a) $6.42\,\text{keV}$ (b) $12.82\,\text{keV}$ (c) $20\,\text{eV}$ (d) $32\,\text{eV}$

NET/JRF (JUNE-2018)

Q6. The first ionization potential of K is $4.34\ eV$, the electron affinity of Cl is $3.82\ eV$ and the equilibrium separation of KCl is $0.3\ nm$. Then energy required to dissociate a KCl molecule into a K and a Cl atom is

(a) $8.62\ eV$ (b) $8.16\ eV$ (c) $4.28\ eV$ (d) $4.14\ eV$

NET/JRF (DEC-2015)

Q7. An atom of mass M can be excited to a state of mass $(M+\Delta)$ by photon capture. The frequency of a photon which can cause this transition is

(a) $\frac{\Delta c^2}{2h}$ (b) $\frac{\Delta c^2}{h}$ (c) $\frac{\Delta^2 c^2}{2Mh}$ (d) $\frac{\Delta c^2}{2Mh}(\Delta+2M)$

NET/JRF (DEC-2011)

Q8. The wavelength of the first Balmer line of hydrogen is $656\,nm$. The wavelength of the corresponding line for a hydrogenic atom with $Z=6$ and nuclear mass of $19.92\times10^{-27}\,kg$ is

(a) $18.2\,nm$ (b) $109.3\,nm$ (c) $143.5\,nm$ (d) $393.6\,nm$

NET/JRF (JUNE-2020)