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JEST

ATOMIC & MOLECULAR PHYSICS

PREVIOUS YEAR QUESTIONS WITH ANSWER (CHAPTER-WISE)

- ATOMIC
- MOLECULAR
- LASER PHYSICS

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ATOMIC

1. The binding energy of the hydrogen atom (electron bound to proton) is 13.6 eV. The binding energy of positronium (electron bound to positron) is. **[JEST 2012]**

(a) 13.6 / 2 eV (b) 13.6 / 1810 eV
(c) 13.6 × 1810 eV (d) 13.6 × 2 eV

2. A sodium atom in the first excited 3P states has a lifetime of 16ns for decaying to the ground 3S state. The wavelength of the emitted photon is 589 nm. The corresponding line width of the transition (in frequency units) is about. **[JEST 2013]**

(a) $1.7 \times 10^6 Hz$ (b) $1 \times 10^7 Hz$
(c) $6.3 \times 10^7 Hz$ (a) $5 \times 10^{14} Hz$

3. If a proton were ten times, the ground state energy of the electron in a hydrogen atom would be. **[JEST 2013]**

(a) Less (b) More
(c) The same
(d) Less, more or equal depending on the electron mass

4. The value of elastic constant for copper is about 100 Nm^{-1} and the atomic spacing is 0.256nm . What is the amplitude of the vibration of the Cu atoms at 300 K as a percentage of the equilibrium separation? **[JEST 2014]**

(a) 4.55 % (b) 3.55 % (c) 2.55 % (d) 1.55 %

5. Which functional form of potential best describes the interaction between a neutral atom and an ion at large distances (i.e. much larger than their diameters). **[JEST 2014]**

(a) $V \propto -1/r^2$ (b) $V \propto -1/r$
(c) $V \propto -e^{-r/a}/r$ (d) $V \propto -1/r^3$

6. If a proton were ten times lighter, then the ground state energy of the electron in a hydrogen atom would have been. **[JEST 2014]**

(a) Less (b) More
(c) The same (d) Depends on the electron mass

7. If hydrogen atom is bombarded by energetic electrons, it will emit. **[JEST 2014]**

(a) K_α X- rays (b) β-rays
(c) Neutrons (d) none of the above

8. A hydrogen atom in its ground state is collided with an electron of kinetic energy 13.377 eV. The maximum factor by which the radius of the atom would increase is. **[JEST 2014]**

(a) 7 (b) 8 (c) 49 (d) 64

9. The energy difference between the $3p$ and $3s$ levels in Na is 2.1 eV . Spin-orbit coupling splits the $3p$ level, resulting in two emission lines differing by 6Å. The splitting of the 3p level is approximately, **[JEST 2015]**

(a) 2eV (b) 0.2eV (c) 0.02eV (d) 2meV

10. Which of the following excited states of a hydrogen atom has the highest lifetime? **[JEST 2015]**

(a) 2p (b) 2s (c) 3s (d) 3p

11. Which of the following statements is true for the energies of the terms of the carbon atom in the ground state electronic configuration $1s^2 2s^2 2p^2$? **[JEST 2015]**

(a) $^3P < {}^1D < {}^1S$ (b) $^3P < {}^1S < {}^1D$

(c) $^3P < {}^1F < {}^1S$ (d) $^3P < {}^1F < {}^1D$

12. If the Rydberg constant of an atom of finite nuclear mass is αR_∞, where R_∞ the Rydberg constant corresponding to an infinite nuclear mass, the ratio of the electronic to nuclear mass of the atom is. **[JEST 2016]**

(a) $\frac{(1-\alpha)}{\alpha}$ (b) $\frac{(\alpha-1)}{\alpha}$ (c) $(1-\alpha)$ (d) $\frac{1}{\alpha}$

13. What is the difference between the maximum and the minimum eigenvalues of a system of two electrons whose Hamiltonian is $H = J\vec{S}_1.\vec{S}_2$, where $\vec{S}_1$ and $\vec{S}_2$ are the corresponding spin angular momentum operators of the two electrons? **[JEST 2018]**

(a) $\frac{J}{4}$ (b) $\frac{J}{2}$ (c) $\frac{3J}{4}$ (d) J

14. Consider a hypothetical world in which the electron has spin 3/2 instead of 1/2. What will be the electronic configuration for an element with atomic number Z = 5? **[JEST 2019]**

(a) $1s^4, 2s^1$ (b) $1s^4, 2s^2, 2p^1$ (c) $1s^5$ (b) $1s^3, 2s^1, 2p^1$

MOLECULAR

15. The H_2 molecule has a reduced mass $M = 8.35 \times 10^{-28} kg$ and an equilibrium internuclear distance $M = 0.742 \times 10^{-10} m$. The rotational energy in terms of the rotational quantum number J is . **[JEST 2016]**

(a) E_{rot} (J) = 7J (J-1) meV

(b) E_{rot} (J) = $\frac{5}{2}$ J (J+1) meV

(c) E_{rot} (J) = 7J (J+1) meV

(d) E_{rot} (J) = $\frac{5}{2}$ J (J-1) meV

ANSWER KEY

1.	A	2.	C	3.	B	4.	B	5.	A	6.	B
7.	D	8.	C	9.	D	10.	B	11.	A	12.	A
13.	D	14.	A	15.	C						