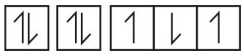
Date Planned : __ / __ / __	Daily Tutorial Sheet - 4	Expected Duration : 90 Min
Actual Date of Attempt : __ / __ / __	JEE Advanced (Archive)	Exact Duration :_____

***46.** Ground state electronic configuration of nitrogen atom can be represented by **(1999)**

(A)  **(B)** 

(C)  **(D)** 

47. **Statement I :** The first ionisation energy of Be is greater than that of B. **(2000)**

Statement II : 2p-orbital is lower in energy than 2s.

(A) Both Statement I and Statement II are correct; Statement II is the correct explanation of Statement I

(B) Both Statement I and Statement II are correct; Statement II is not the correct explanation of Statement I

(C) Statement I is correct; Statement II is the incorrect

(D) Statement I is incorrect; Statement II is the correct

48. The number of nodal planes in a p_x orbital is : **(2000)**

(A) one **(B)** two **(C)** three **(D)** zero

49. The electronic configuration of an element is $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5, 4s^1$. This represents its : **(2000)**

(A) excited state **(B)** ground state **(C)** cationic form **(D)** anionic form

50. The wavelength associated with a golf ball weighing 200 g and moving at a speed of 5 m / h is of the order : **(2001)**

(A) 10^{-10}m **(B)** 10^{-20}m **(C)** 10^{-30}m **(D)** 10^{-40}m

51. The quantum numbers $+1/2$ and $-1/2$ for the electron spin represent : **(2001)**

(A) rotation of the electron in clockwise and anticlockwise directions respectively

(B) rotation of the electron in anticlockwise and clockwise directions respectively

(C) magnetic moment of the electron pointing up and down respectively

(D) two quantum mechanical spin states which have no classical analogue

52. Rutherford's experiment, which established the model of the atom, used a beam of : **(2002)**

(A) β-particle, which impinged on a metal foil and got absorbed

(B) γ-rays, which impinged on a metal foil and got scattered

(C) helium atoms, which impinged on a metal foil and got scattered

(D) helium nuclei, which impinged on a metal foil and got scattered

53. If the nitrogen atom has electronic configuration $1s^7$, it would have energy lower than that of the normal ground state configuration $1s^2 2s^2 3p^3$, because the electrons would be closer to the nucleus. Yet $1s^7$ is not observed because it violates. **(2002)**

(A) Heisenberg uncertainty principle **(B)** Hund's rule

(C) Pauli exclusion principle **(D)** Bohr postulate of stationary orbits

54. The radius of which of the following orbit is the same as that of the first Bohr's orbit of hydrogen atom?

(A) $He^+(n=2)$ **(B)** $Li^{2+}(n=2)$ **(C)** $Li^{2+}(n=3)$ **(D)** $Be^{3+}(n=2)$ **(2004)**

55. The numbers of radial nodes of 3s and 2p orbitals are respectively: **(2005)**

(A) 2, 0 **(B)** 0, 2 **(C)** 1, 2 **(D)** 2, 1

56. According to Bohr's theory E_n = Total energy, K_n = Kinetic energy, V_n = Potential energy R_n = Radius of nth orbit : **(2006)**

Column I		Column II	
(A)	V_n / K_n = ?	**(P)**	0
(B)	If radius of n^{th} orbit $\propto E_n^x$, x = ?	**(Q)**	-1
(C)	Angular momentum in lowest orbital	**(R)**	-2
(D)	$\frac{1}{r^n} \propto Z^y$, y = ?	**(S)**	1

57. Match the entries in column I with the correctly related quantum number(s) in column II. **(2008)**

Column I		Column II	
(A)	Orbital angular momentum of the electron in a hydrogen like atomic orbital	**(P)**	Principal quantum number
(B)	A hydrogen-like one electron wave function obeying Pauli's principle	**(Q)**	Azimuthal quantum number
(C)	Shape, size and orientation of hydrogen-like atomic orbitals	**(R)**	Magnetic quantum number
(D)	Probability density of electron at the nucleus in hydrogen like atom	**(S)**	Electron spin quantum number

Paragraph for Question No. 58 – 60 **(2010)**

The hydrogen-like species Li^{2+} is in a spherically symmetric state S_1 with one radial node. Upon absorbing light the ion undergoes transition to a state S_2. The state S_2 has one radial node and its energy is equal to the ground state energy of the hydrogen atom.

58. The state S_1 is :

(A) 1s **(B)** 2s **(C)** 2p **(D)** 3s

59. Energy of the state S_1 in units of the hydrogen atom ground state energy is :

(A) 0.75 **(B)** 1.50 **(C)** 2.25 **(D)** 4.50

60. The orbital angular momentum quantum number of the state S_2 is :

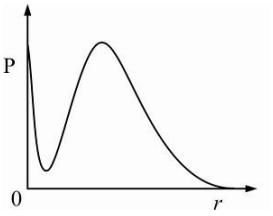
(A) 0 **(B)** 1 **(C)** 2 **(D)** 3

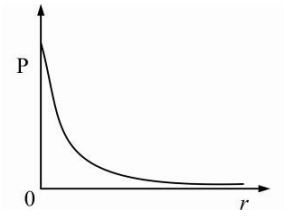
61. The kinetic energy of an electron in the second Bohr orbit of a hydrogen atom is [a_0 is Bohr radius] : **(2012)**

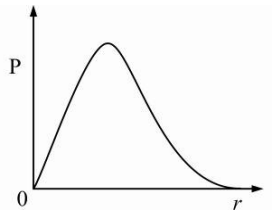
(A) $\frac{h^2}{4\pi^2 m a_0^2}$ **(B)** $\frac{h^2}{16\pi^2 m a_0^2}$

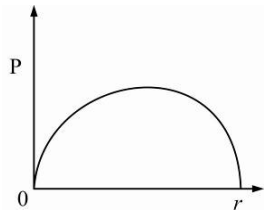
(C) $\frac{h^2}{32\pi^2 m a_0^2}$ **(D)** $\frac{h^2}{64\pi^2 m a_0^2}$

62. *P* is the probability of finding the 1s electron of hydrogen atom in a spherical shell of infinitesimal thickness, *dr*, at a distance *r* from the nucleus. The volume of this shell is $4\pi r^2 dr$. The qualitative sketch of the dependence of *P* on *r* is: **(2016)**

(A) 

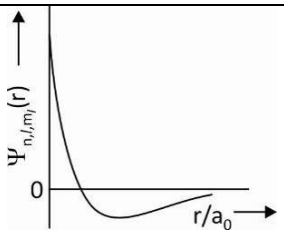
(B) 

(C) 

(D) 

Paragraph for Question No. 63 – 65 **(2017)**

The wave function, $\psi_{n,\,l,\,m_l}$ is a mathematical function whose value depends upon spherical polar coordinates (r, θ, ϕ) of the electron and characterized by the quantum numbers n, l and m_l. Here r is distance from nucleus, θ is colatitude and ϕ is azimuth. In the mathematical functions given in the Table, Z is atomic number and a_0 is Bohr radius.

Column 1		Column 2		Column 3	
(I)	1s orbital	**(i)**	$\psi_{n,l,m_l} \propto \left(\frac{Z}{a_0}\right)^{3/2} e^{-\left(\frac{Zr}{a_0}\right)}$	**(P)**	
(II)	2s orbital	**(ii)**	One radial node	**(Q)**	Probability density at nucleus $\propto \frac{1}{a_0^3}$
(III)	$2p_z$ orbital	**(iii)**	$\psi_{n,l,m_l} \propto \left(\frac{Z}{a_0}\right)^{\frac{5}{2}} re^{-\left(\frac{Zr}{2a_0}\right)} \cos\theta$	**(R)**	Probability density is maximum at nucleus
(IV)	$3d_z^2$ orbital	**(iv)**	xy-plane is a nodal plane	**(S)**	Energy needed to excite electron from n = 2 state to n = 4 state is 27/32 times the energy needed to excite electron from n = 2 state to n = 6 state

63. For He^+ ion, the only **INCORRECT** combination is:

(A) (I) (iii) (R) **(B)** (II) (ii) (Q) **(C)** (I) (i) (R) **(D)** (I) (i) (S)

64. For hydrogen atom, the only CORRECT combination is:

(A) (II) (i) (Q) **(B)** (I) (i) (P) **(C)** (I) (iv) (R) **(D)** (I) (i) (S)

65. For the given orbital in Column 1, the only CORRECT combination for any hydrogen-like species is:

(A) (I) (ii) (S) **(B)** (IV) (iv) (R) **(C)** (II) (ii) (P) **(D)** (III) (iii) (P)

66. Consider the Bohr's model of a one-electron atom where the electron moves around the nucleus. In the following, List-I contains some quantities for the n^{th} orbit of the atom and List-II contains options showing how they depend on n. **(2019)**

	List-I		**List-II**
(I)	Radius of the n^{th} orbit	**(P)**	$\propto n^{-2}$
(II)	Angular momentum of the electron in the n^{th} orbit	**(Q)**	$\propto n^{-1}$
(III)	Kinetic energy of the electron in the n^{th} orbit	**(R)**	$\propto n^{0}$
(IV)	Potential energy of the electron in the n^{th} orbit	**(S)**	$\propto n^{1}$
		(T)	$\propto n^{2}$
		(U)	$\propto n^{1/2}$

Which of the following options has the correct combination considering List-I and List-II?

(A) (IV), (U) **(B)** (IV), (Q) **(C)** (III), (P) **(D)** (III), (S)

***67.** The ground state energy of hydrogen atom is –13.6 eV. Consider an electronic state ψ of He^+ whose energy, azimuthal quantum number and magnetic quantum number are –3.4 eV, 2 and 0, respectively. Which of the following statement(s) is(are) true for the state ψ? **(2019)**

(A) It has 3 radial nodes

(B) It has 2 angular nodes

(C) The nuclear charge experienced by the electron in this state is less than 2e, where e is the magnitude of the electronic charge

(D) It is a 4d state