CHEMISTRY

BOOKS - IIT-JEE PREVIOUS YEAR (CHEMISTRY)

ATOMIC STRUCTURE

Jee Main And Advanced

1. A stream of electrons from a heated filament was passed between two charged plates kept at a potential difference V esu. If c and m are charge and mass of an electron repectively, then the value of h/λ (where λ is wavelength associated with electron wave) is given by :

A. $2meV$

B. $\sqrt{meV}$

C. $\sqrt{2meV}$

D. meV

Answer: C

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2. Rutherford's scattering experiment, which established the nuclear model of the atom, used a beam of

A. β-particles, which impinged on a metal foil and got absorbed

B. γ-rays, which impinged on a metal foil and got scatted

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

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

Answer: D

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3. Rutherford's α particle scattering experiment eventually led to the conclusion that

A. mass and energy are related

B. electrons occupy space around the nucleas

C. neutrons are burried deep in the nucleas

D. the point of impact with matter can be precisely determined

Answer: B

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4. The radius of an atomic nucleus is of the order of

A. $10^{-10}cm$

B. $10^{-13}cm$

C. $10^{-15}cm$

D. $10^{-0}cm$

Answer: B

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5. Bohr's model can explain

A. the spectrum of hydrogen atom only

B. spectrum of an atom or ion containing one electron only

C. the spectrum of hydrogen molecule

D. the solar spectrum

Answer: B

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6. The increasing order (lowest first) for the values of e/m (charge//mass) for electron (e), proton (p), neutron (n), and alpha particle (α) is

A. e, p, n, α

B. n, p, e, α

C. n, p, α, e

D. n, α, p, e

Answer: D

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7. Rutherford's scattering experiment is related to the size of the

A. nucleus

B. atom

C. electron

D. neutron

Answer: A

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8. Rutherford's experiment on the scattering of α particle showed for the first time that the atom has

A. electrons

B. protons

C. nucleus

D. neutron

Answer: C

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9. The energy of an electron in the first Bohr orbit of H atom is $-13.6eV$ The potential energy value (s) of excited state(s) for the electron in the Bohr orbit of hydrogen is(are)

A. $-3.4eV$

B. $-4.2eV$

C. $-6.8eV$

D. $+6.8eV$

Answer: A

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10. The atomic nucleus contains

A. protons

B. neutrons

C. electrons

D. photons

Answer: A::B

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11. The sum of the number of neutrons and proton in the isotope of hydrogen is

A. 6

B. 5

C. 4

D. 3

Answer: D

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12. When alpha particle are sent through a thin metal foil ,most of them go straight through the foil because

A. alpha particles are much heavier than electrons

B. alpha particles are positively charged

C. most part of the atom in empty space

D. alpha particles move with high velocity

Answer: A::C

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13. Many elements have non-integral atomic masses because

A. they have isotopes

B. their isotopes have non-integral masses

C. their isotopes have different masses

D. the constituentsm neutrons, protons and electrons, combine to given fractional masses

Answer: A::C

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14. Given in hydrogen atom r_n, V_n, E, K_n stand for radius, potential energy, total energy and kinetic energy in n^{th} orbit. Find the value of U,v,x,y.

(A)	$u = \frac{V_n}{K_n}$	(P)	1
(B)	$\frac{1}{r_n} \propto E^x$	(Q)	-2
(C)	$r_n \propto Z^y$ $(Z = \text{Atomic number})$	(R)	-1
(D)	$v = (\text{Orbital angular momentum of electron})$ $(\text{in its lowest energy})$	(S)	0

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15. The light radiations with discrete quantities of energy are called .....

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16. The mass of a hydrogen is .....kg.

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17. Isotopes of an element differ in the number of .....in their nuclei

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18. Elements of the same mass number but of different atomic number are known as .....

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19. With what velocity should an alpha (α)- particle travel towards the nucleus of a copper atom arrive at a distance of $10^{-13}m$ from the nucleus of the copper atom ?

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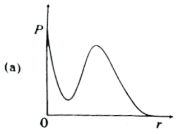
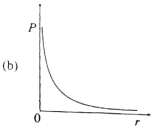
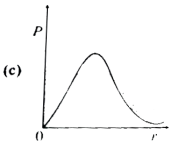
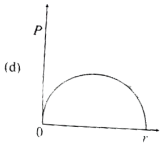
20. P is the probability of finding the Is electron of hydrogen atom in a spherical shell of infitesimal thickness, dr, at a distance r from the

nucleus. The volume of this shell is $4\pi r^2 dr$. The qualitative sketch of the dependence of P on r is

A. 

B. 

C. 

D. 

Answer: C

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21. Which of the following is the energy of a possible excited state of hydrogen?

A. $+13.6eV$

B. $-6.8eV$

C. $+3.4eV$

D. $+6.8ev$

Answer: C

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22. The correct set of four quantum number for the valence (outermost) electron of radiation $(Z = 37)$ is

A. $5, 0, 0, +\frac{1}{2}$

B. $5, 1, 0, +\frac{1}{2}$

C. $5, 1, 1, +\frac{1}{2}$

D. $5, 0, 1, +\frac{1}{2}$

Answer: A

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23. Energy of an electron is givem by $E = -2.178 \times 10^{-18} J\left(\frac{Z^2}{n^2}\right)$. Wavelength of light required to excited an electron in an hydrogen atom from level $n = 1$ to $n = 2$ will be $(h = 6.62 \times 10^{-34} Js$ and $c = 3.0 \times 10^8 ms^{-1})$.

A. $1.214 \times 10^{-7} m$

B. $2.816 \times 10^{-7} m$

C. $6.500 \times 10^{-7} m$

D. $8.500 \times 10^{-7} m$

Answer: A

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24. The kinetic energy of an electron in the second Bohr orbit of a hydrogen atom is [a_0 is Bohr radius] :

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. $\frac{h^2}{64\pi^2 m a_0^2}$

Answer: C

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25. The number of radial nodes of $3s$ and $2p$ orbital are, respectively

A. 2 and 0

B. 0 and 2

C. 1 and 2

D. 2 and 1

Answer: A

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26. Which hydrogen -like species will have the same r adius as that of Bohr orbit of hydrogen atom ?

A. $n = 2, Li^{2+}$

B. $n = 2, Be^{3+}$

C. $n = 2, He^{+}$

D. $n = 3, Li^{2+}$

Answer: B

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27. If nitrogen atoms had el,ectonic configuration is ? It would have energy lower than that of the nornal ground state configuration $1s^2 2s^2 2p^3$ because the electrons would be clear to the nucleus yet $1s^2$ is not oberved because it violates ?

A. Heisenberg uncertainty principle

B. Hund's rule

C. Pauli exclusion principle

D. Bohr postulate of stationary orbits

Answer: C

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28. The quatum numbers $+\frac{1}{2}$ and $-\frac{1}{2}$ for the electron spin represent

A. rotation of the electron in clockwise and anti-clockwise direction respectively

B. rotation of the electron in anti-clockwise and clockwise direction respectively

C. magnetic moment of the electrn pointing up and down respectively

D. two quantum mechanical spin states which have no classical analogue

Answer: D

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29. The wavelength associated with a golf ball weighing 100g and moving at a speed of $5m/h$ is of the order

A. $10^{-10}m$

B. $10^{-20}m$

C. $10^{-30}m$

D. $10^{-40}m$

Answer: C

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30. The number of nodal planes in a p_x orbital is :

A. one

B. two

C. three

D. zero

Answer: A

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31. The electronic configuration of an element is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$ .This represents its

A. excited state

B. ground state

C. cationic form

D. anionic from

Answer: B

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32. The electronic, identified by quantum numbers n and l, (i) $n = 4, l = 1$, (ii) $n = 4, l = 0$, (iii) $n = 3, l = 2$, (iv) $n = 3, l = 1$ can be placed in order of increasing energy, from the lowest to highest, as

A. $(iv) < (ii) < (iii) < (i)$

B. $(ii) < (iv) < (i) < (iii)$

C. $(i) < (iii) < (ii) < (iv)$

D. $(iii) < (i) < (iv) < (ii)$

Answer: A

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33. The energy of an electron in the first Bohr orbit of H atom is $-13.6eV$ The potential energy value (s) of excited state(s) for the electron in the Bohr orbit of hydrogen is(are)

A. $-3.4eV$

B. $-4.2eV$

C. $-6.8eV$

D. $+6.8eV$

Answer: A

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34. For d electron, the orbital angular momentum is

A. $\sqrt{6}\left(\frac{h}{2\pi}\right)$

B. $\sqrt{2}\left(\frac{h}{2\pi}\right)$

C. $\left(\frac{h}{2\pi}\right)$

D. $2\left(\frac{h}{2\pi}\right)$

Answer: A

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35. The first use of quantum theory to explain the structure of atom was made by

A. Heisenberg

B. Bohr

C. Planck

D. Einstein

Answer: B

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36. Which of the following has the maximum number of unpaired electrons ?

A. Mg^{2+}

B. Ti^{3+}

C. V^{3+}

D. Fe^{2+}

Answer: D

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37. The orbital angular momentum of an electron in $2s$-orbital is

A. $+\frac{1}{2}.\frac{h}{2\pi}$

B. zero

C. $\frac{h}{2\pi}$

D. $\sqrt{2}.\frac{h}{2\pi}$

Answer: B

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38. Which of the following best explains light both as a stream of particles and wave motion ?

A. Interference

B. $E = mc^2$

C. Diffraction

D. $E = hv$

Answer: D

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39. Which of the following does not characteristic X -rays ?

A. The radiation can ionise gases

B. It causes ZnS to fluoresce

C. Deflected by electric and magnetic fields

D. Have wavelengths shorter than ultraviolet rays

Answer: C

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40. The correct set of quantum numbers for the unpaired electron of chlorine atom is

A. $\begin{matrix} n & l & m \\ 2 & 1 & 0 \end{matrix}$

B. $\begin{matrix} m & l & m \\ 2 & 1 & 1 \end{matrix}$

C. $\begin{matrix} n & l & m \\ 3 & 1 & 1 \end{matrix}$

D. $\begin{matrix} n & l & m \\ 3 & 0 & 0 \end{matrix}$

Answer: C

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41. The correct ground state electronic configuration of chromium atom(Z=24) is :

A. $[Ar]3d^5 4s^1$

B. $[Ar]3d^{4_4 s^2}$

C. $[Ar]3d^6 4s^0$

D. $[ar]4d^5 4s^1$

Answer: A

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42. Outermost electronic comfiguration of the highest electronegative atom is .....

A. $ns^2 np^3$

B. ns^2np^4

C. ns^2np^5

D. ns^2np^6

Answer: C

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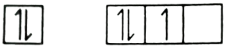
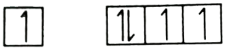
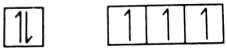
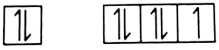
43. The orbital diagram in which the Aufbau principle is violated

A. (a) 

B. (b) 

C. (c) 

D. (d) 

Answer: B

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44. The wavelngth fo a spectrl line for an electronic transition is inversely related to :

A. the number of electrons undergoing the transition

B. the nuclear charge of the atom

C. the difference in the energy of the energy levels involved in the transition

D. the velocity of the electron undergoing the transition

Answer: C

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45. The ratio of the energy of a photon of 200Å wavelengths radiation to that of 4000Å radiation is

A. $\frac{1}{4}$

B. 4

C. $\frac{1}{2}$

D. 2

Answer: D

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46. Which of the following sets of quantum numbers represents an impossible arrangement ?

A.

n	l	m	s
3	2	-2	$1/2$

B.

n	l	m	s
4	0	0	$1/2$

C.

n	l	m	s
3	2	-3	$\frac{1}{2}$

D.

n	l	m	s
5	3	0	$-\frac{1}{2}$

Answer: C

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47. Electromagnetic radiation with maximum wavelengths is :

A. ultraviolet

B. radio wave

C. X-ray

D. infrared

Answer: B

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48. Which electronic level would allow the hydrogen atom to absorbs a photon but not to emit a photon

A. $3s$

B. $2p$

C. $2s$

D. $1s$

Answer: D

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49. Correct set of four quantum numbers for the valence (outermost) electron of rubidium $(Z = 37)$ is

A. $5, 0, 0, +\frac{1}{2}$

B. $5, 1, 0, +\frac{1}{2}$

C. $5, 1, 1, +\frac{1}{2}$

D. $6, 0, 0, +\frac{1}{2}$

Answer: A

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50. The principal quantum number of an atom is related in the

A. size of the orbital

B. spin angular momentum

C. orientation of the orbital in space

D. orbital angular momentum

Answer: A

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51. Any p arbital can accommodate up to

A. four electrons

B. six electrons

C. two electrons with parallel spins

D. two electrons with opposite spins

Answer: D

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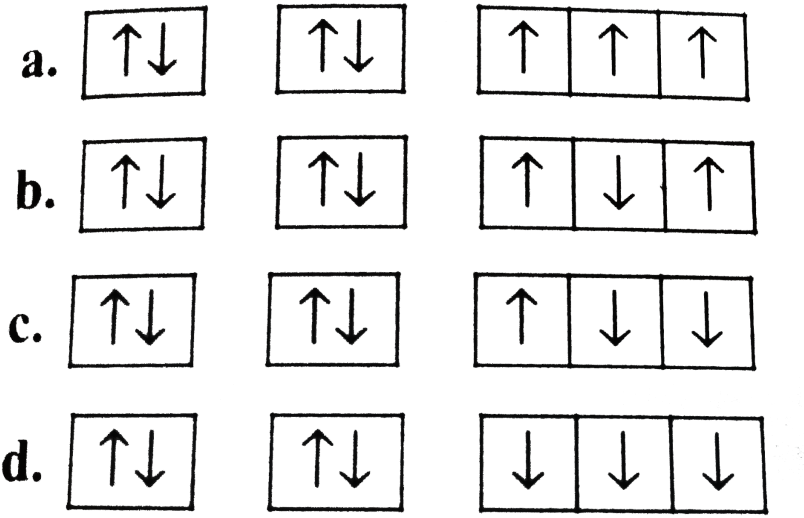
52. The less ground state electronic configeration of nitrogen atom can be represented by



A.

B.

C.

D.

Answer: A::D

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53. Which of the following statement (s) is (are) correct ?

A. The electronic configuration of Cr is $[Ar]3d^5 4s^1$ (atomic number of $Cr = 24$)

B. The magnetic quantum number may have a negative value

C. In silver atom, 23 electrons have a spin of one type and 24 of the opposite type. (atomic number of $Ag = 47$)

D. The oxidation state of nitrogen in HN_3 is -3

Answer: A::B::C

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54. An isotone of $._{32}^{76}Ge$ is-

(a) $._{32}^{77}Ge$

(b). $._{33}^{77}As$

(c). ${}^{77}_{34}Se$

(d). ${}^{78}_{34}Se$

A. ${}^{77}_{32}Ge$

B. ${}^{77}_{33}As$

C. ${}^{77}_{43}Se$

D. ${}^{78}_{34}Se$

Answer: B::D

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55. Assertion: The first ionisation energy of Be is greater than that of B.

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

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 incorrect

D. Statement I is incorrect, Statement II is correct

Answer: C

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56. The hydrogen -like species Li^{2+} is in a spherically symmetric state S_1 with one 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 is to the ground state energy of the hydrogen atom.

The orbital angular momentum quantum number of the state S_2 is

A. 1s

B. 2s

C. 2p

D. 3s

Answer: B

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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

Answer: C

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58. The hydrogen -like species Li^{2+} is in a spherically symmetric state S_1 with one 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 is to the ground state energy of the hydrogen atom.

The orbital angular momentum quantum number of the state S_2 is

A. 0

B. 1

C. 2

D. 3

Answer: B

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59. The outermost electrinic configuration of Cr is _____

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60. $8g$ each of oxygen and hydrogen at $27^\circ C$ will have the total kinetic energy in the ratio of .....

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61. The uncertainty principle and the concept of wave nature of matter were proposed by.....and .....respectively.

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62. Wave functions of electrons in atoms and molecules are called .....

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63. The $2p_x$, $2p_y$ and $2p_z$ orbitals of atom have identical shapes but differ in their .....

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64. When there are two electron is the same orbitals , they have ..... spins.

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65. Assertion (A) : $\beta -$ particles are deflected more than $\alpha -$ particles in a given electric field.

Reason (R) : Charge on $\alpha -$ particles is larger than on $\beta -$ particles. a)If both (A) and (R) are correct , and (R) is the correct explanation of (A) b)If both (A) and (R) are correct, but (R) is not the correct explanation of (A) c)If (A) is correct, but (R) is incorrect. d)If (A) is incorrect, but (R) is correct.

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66. The electron density in the xy-plane in $3d_{x^2-y^2}$ orbital is zero.

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67. The energy level of 4s-orbital is less than 3d- orbital because :

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68. γ -rays are electromagnetic radiation of wavelength of 10^{-6} to $10^{-5}cm$

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69. The correct ground state electronic configuration of chromium atom(Z=24) is :

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70. Not considering the electron spin, the degeneracy of second excited state is 9, while the degeneracy of then first excited state of H^- is :

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71. In an atom, the total number of electrons having quantum numbers $n = 4$, $|m_l| = 1$ and $m_s = -\frac{1}{2}$ is

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72. The atomic masses of He and Ne are 4 and 20 amu respectively . The value of the de Broglie wavelength of He gas at $-73.^\circ C$ is "M" times that of the de Broglie wavelength of Ne at $727.^\circ C$. M is

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73. The work function (ϕ) of some metals is listed below. The number of metals which will show photoelectric effect when light of 300 nm wavelength falls on the metal is

$$\begin{pmatrix} Metal & Li & Na & K & Mg & Cu & Ag & Fe & Pt & W \\ \phi(eV) & 2.4 & 2.3 & 2.2 & 3.7 & 4.8 & 4.3 & 4.7 & 6.3 & 4.75 \end{pmatrix}$$

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74. The maximum number of electrons can have principal quantum number $n = 3$ and spin quantum number $m_s = 1/2$ is

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75. a.Calculate the velocity of an electron in the first Bohr's orbit of hydrogen atom (given $r = a_0$).

b. Find de Broglie's wavelength of the electron in the first Bohr's orbit.

c. Find the orbital angular momentum of $2p$ orbital in terms of $h/2\pi$ units.

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76. a.The schrodinger wave equation for hydrogen atom is $\psi_{2s} = \frac{1}{4\sqrt{2\pi}}\left(\frac{1}{a_0}\right)^{\frac{3}{2}}\left(2 - \frac{r_0}{a_0}\right)e^{\left(-\frac{r}{a}\right)}$

When a_0 is Bohr's radius. Let the radial node in $2s$ be at r_0 .Then find r_0 in terms of a_0 .

b. A base ball having mass $100g$ moves with velocity $100ms^{-1}$.Find the value of the wavelength of the base ball.

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77. Wavelength of high enrgy trabsition fo H-atoms is $91.2nm$. Calculate the corresponding wavelength of He^{+}.

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78. Calculated the energy required to excite one litre of hydrogen gas at $1atm$ and $298K$ to the first excited state of atomic hydorgen. The enegry

for the dissociation of $H-H$ bond is $436 kJ mol^{-1}$.

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79. An electron beam can undergo defraction by crystals .Through what potential should a beam of electrons be accelerated so that its wavelength becomes equal to $1.54 Å$

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80. Consider the hydrogen atom to be a proton embedded in a cavity of radius a_0 (Bohr radius) whose charge is neutralised by the addition of an electron to the cavity in a vacuum, infinitiely slowly .Estimate the average total energy of an electron in its ground state in a hydrogen atom as the work done in the above neutralisation process .Also if the magnitude of the average kinetic energy is half the magnitude of the average potential energy, find the average potential energy.

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81. Calculate the wave number for the shortest wavelength transition in the Balmer series of atomic hydrogen.

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82. An iodine molecule dissociates into atom after absorbing light of wavelength 4500Å. If quantum of radiation is absorbed by each molecule calculate the kinetic energy of iodine (Bond energy of I_2 is $240kJmol^{-1}$)

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83. Find out the number of waves made by a Bohr's electron in one complete revolution in its $3rd$ orbit.

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84. What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition $n = 4$ to $n = 2$ of $He^{\oplus}$ spectrum?

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85. Estimate the difference in energy between the first and second Bohr's orbit for a hydrogen atom. At what minimum atomic number , a transition from $n = 2$ to $n = 1$ energy level would result in the emission of X -rays with $\lambda = 3.0 \times 10^{-8} m$? Which hydogen -like species does this atomic number correspond to ?

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86. According to Bohr's theory , the electronic energy of hydrogen atom in the n^{th} Bohr's orbit is given by

$$E_n = \frac{-21.76 \times 10^{-19}}{n^2} J$$

Calculate the longest wavelength of electron from the third Bohr's orbit of the $He^{\oplus}$ ion

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87. What is the maximum number of electron that may be present in all the atomic orbitals with principal quantum number 3 and azimuthal quantum number2?

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88. Give reason for why the ground state outermost electronic configuration of silicon is

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89. The electron energy in hydrogen atom is given by $E_n = \left(-21.7 \times \frac{10^{-12}}{n^2} \right) erg$. Calculate the energy required to remove

an electron completely from the $n = 2$ orbit.What is the longest wavelength (in cm) of light can be used to cause this transition ?

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90. Calculate the wavelength in Angstroms of the photon that is emitted when an electron in the Bohr's orbit $n = 2$, returns to the orbit $n = 1$, in the hydrogen atom .The ionisation potential of the ground state hydrogen atom is 2.17×10^{-11} ergs per atom

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91. The energy of the electron in the second and third Bohr's orbitals of the hydrogen atom is $-5.42 \times 10^{-12} erg$ and $-2.42 \times 10^{-12} erg$ respectively ,Calculate the wavelength of the emitted radiation when the electron drops from the third to the second orbit.

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Topic 2

1. The radius of the second Bohr orbit for hydrogen atom is (Planck's constant $(h) - 6.6262 \times 10^{-34} Js$, mass of electron $= 9.1091 \times 10^{-31} kg$, charge of electron $(e) = 1.60210 \times 10^{-19} C$, permitivity of vacuum $(\in_0) = 8.854185 \times 10^{-12} kg^{-1} m^{-3} A^2)$

A. $1.65 Å$

B. $4.76 Å$

C. $0.529 Å$

D. $2.12 Å$

Answer: C

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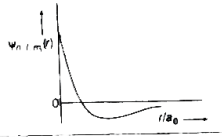
Match The Columns

1. The wave function, ψ_n, l, m_l is a mathematical function whose value depends upon spherical polar coordinates (r, θ, ϕ) of the electron and characterised by the quantum number 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) $\psi_{n,l,m_l} \propto \left(\frac{Z}{a_0}\right)^{\frac{3}{2}} e^{-\left(\frac{Zr}{a_0}\right)}$	(P) 
(II) 2s-orbital	(ii) One radial node	(Q) Probability density at nucleus $\propto \frac{1}{a_0^3}$
(III) $2p_z$-orbital	(iii) $\psi_{n,l,m_l} \propto \left(\frac{Z}{a_0}\right)^{\frac{5}{2}} re^{-\left(\frac{Zr}{a_0}\right)} \cos\theta$	(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 $\frac{27}{32}$ times the energy needed to excite electron from $n = 2$ state to $n = 6$ state

For He^+ ion, the only INCORRECT combination is

A. (I) (i)(S)

B. (II)(ii) (Q)

C. (I)(iii)(R)

D. (I)(i)(R)

Answer: C

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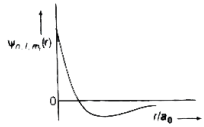
2. The wave function, ψ_n, l, m_l is a mathematical function whose value depends upon spherical polar coordinates (r, θ, ϕ) of the electron and characterised by the quantum number n, l and m_l. Here r is distance from nucleus, θ is colatitude and ϕ is azimuth. In the mathematical functions given in the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

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

For the given orbital in Column I, the Only CORRECT combination for any hydrogen-like species is

A. (II)(ii)(P)

B. (I)(ii)(S)

C. (IV)(iv)(R)

D. (III)(iii)(P)

Answer: A

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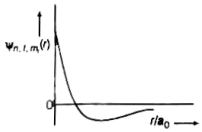
3. The wave function, ψ_n, l, m_l is a mathematical function whose value depends upon spherical polar coordinates (r, θ, ϕ) of the electron and characterised by the quantum number n, l and m_l. Here r is distance from nucleus, θ is colatitude and ϕ is azimuth. In the mathematical functions given in the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

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

For hydrogen atom, the only CORRECT combination is

A. (I) (i)(P)

B. (I)(iv)(R)

C. (II)(i)(Q)

D. (I)(i)(S)

Answer: D

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4. Match the entires in Column I with the correctly related quantum number(s) in Column II.

ColumnI

Orbital angular momentum of the electron in a hydrogen-like atomic orbita

A hydrogen-like one-electron wave function obeying Pauli's principle

Shape size and orientation of hydrogen-like atomic orbitals

Probability density of electron at the nucleus in hydrogen-like atom

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