paragraph for questions 1 to 3 :- 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 S_2 has one radial node and its energy is equal to the ground state energy of the hydrogen atom.

① The state S_1 is

1) 1S
2) 2S
3) 2P
4) 3S

Solution: (2) $S_1 = 2S$ $S_2 = 3P$

② Energy of the state S_1 in units of the hydrogen atom ground state energy

1) 0.75
2) 1.50
3) 2.25
4) 4.50

Solution: $E = 13.6 \times \frac{3}{4}$

$E = 2.25$

So, option (3) is the answer

③ The orbital angular momentum quantum number of state S_2 is

1) 0
2) 1
3) $\sqrt{2}\frac{h}{2\pi}$
4) 3

Solution: Since S_1 is spherically symmetric it means it is s orbital. Also, it is given that the no. of radial nodes = 1

No. of radial nodes is given by :- $n-l-1$; where n = principal quantum number, l = angular quantum number. Here $n-l-1 = 1$, for s orbital $l=0$, Thus $n=2$

S_1 is 2S orbital, so S_2 will be the orbital next to 2S i.e 2P.

The orbital angular momentum is given by $\sqrt{l(l+1)} \times \frac{h}{2\pi}$

Here, for 2P orbital $l = 1$

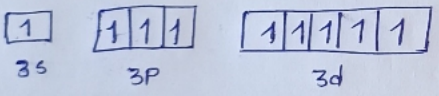
orbital angular momentum will be $\sqrt{1(1+1)} \times \frac{h}{2\pi}$ i.e $\sqrt{2} \times \frac{h}{2\pi}$

∴ So, option (3) is the answer.

(4) The maximum number of electrons that can have principal quantum number $n=3$ and spin quantum number $m_s = -1/2$ is

1) 3
2) 9
3) 12
4) 18

Solution: since $n=3 \Rightarrow$ 3S, 3P, 3d and it was given that $m_s = -1/2 \Rightarrow$ only one direction

$\Rightarrow$ 

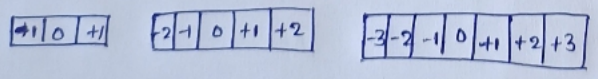
∴ The number of electrons = 9

So, option (2) is the correct answer.

(5) In an atom, the total number of electrons having numbers $n=4$, $|m_l| = 1$ & $m_s = -\frac{1}{2}$ is

1) 2, 2) 4, 3) 16, 4) 6

Solution: for $n=4$, orbitals are



Total number of orbitals having $\{|m_l| = 1\} = 6$

Total number of electrons having $\{|m_l| = 1\}$ and $\{m_s = -\frac{1}{2}\} = 6$

So option (4) is the answer.

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