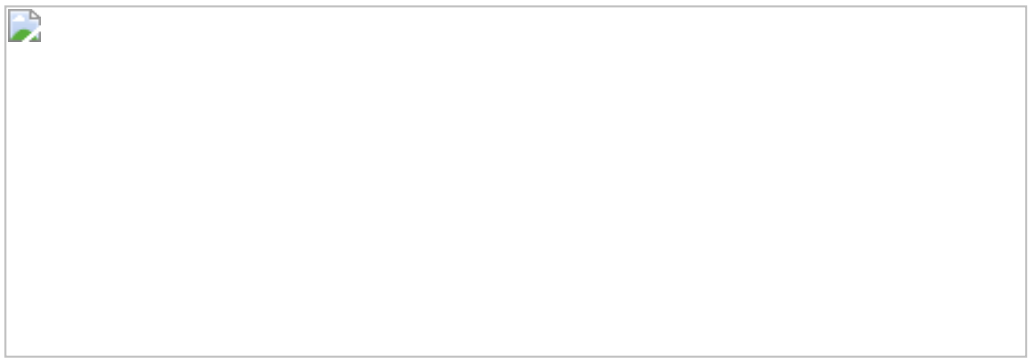
Chemistry Class 11 NCERT Solutions: Chapter 2 Structure of Atom Part 9

Q: 25. An electron is in one of the 3d orbitals. Give the possible values of n, l and m_l for this electron.



Answer:

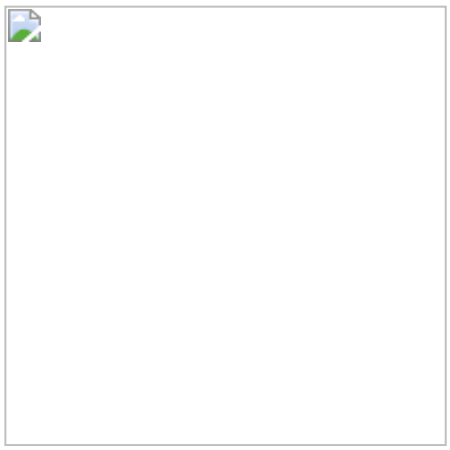
For the $3d$ orbital:

Principal quantum number $(n) = 3$

Azimuthal quantum number $(l) = 2$

Magnetic quantum number $(m_l) = -2, -1, 0, 1, 2$

Q: 26. An atom of an element contains 29 electrons and 35 neutrons. Deduce (i) the number of protons and (ii) the electronic configuration of the element.



Answer:

(i) For an atom to be neutral, the number of protons is equal to the number of electrons.

$\therefore$ Number of protons in the atom of the given element $= 29$

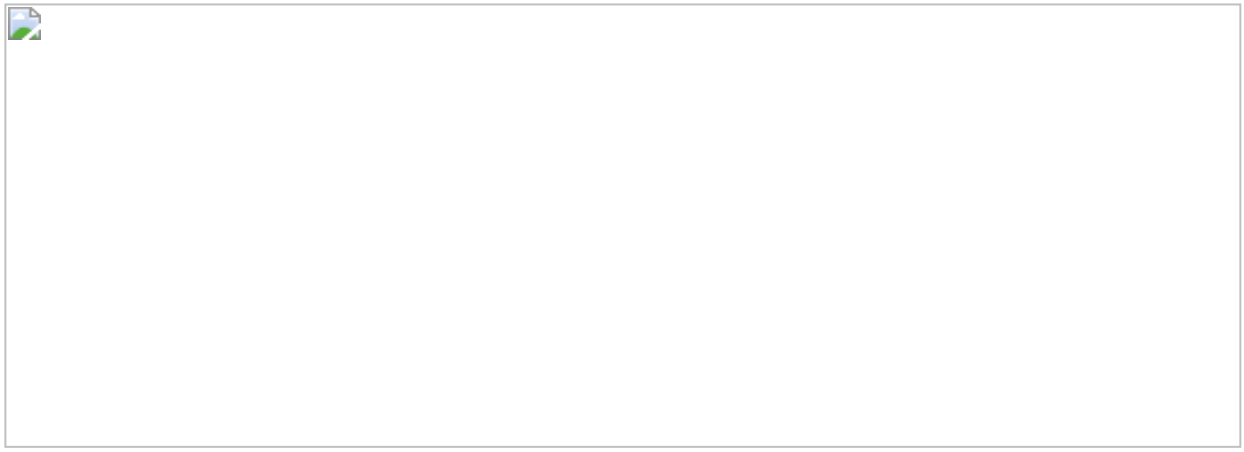
(ii) The electronic configuration of the atom is

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$.

Q: 27. Give the number of electrons in the species $H_2^+, H_2 \text{and} O_2^+$

Answer:

H_2^+ :



Number of electrons present in hydrogen molecule $(H_2) = 1 + 1 + = 2$

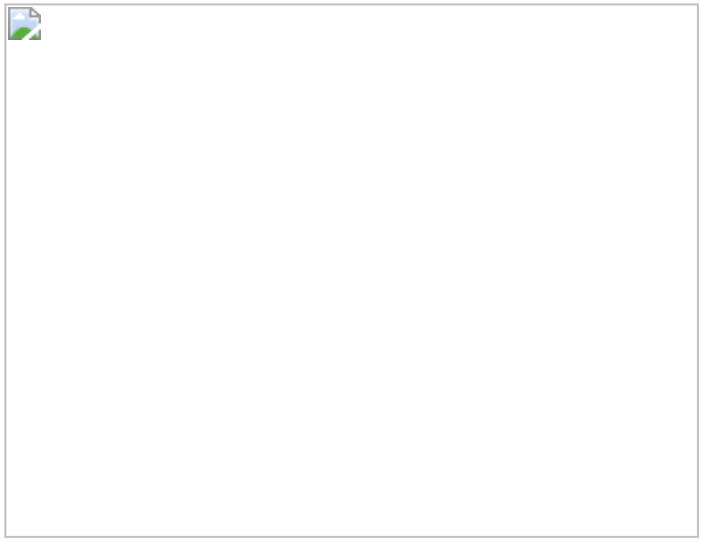
$\therefore$ Number of electrons in $H_2^+ = 2 - 1 = 1$

O_2^+ :

Number of electrons present in oxygen molecule $(O_2) = 8 + 8 = 16$

$\therefore$ Number of electrons in $O_2^+ = 16 - 1 = 15$

Q: 28 (i) An atomic orbital has $n = 3.$ what are the possible values of l and m_1 ?



(ii) List the quantum numbers m_1 and l of electrons for 3d orbital.

(iii) Which of the following orbitals are possible?

$1p, 2s, 2p \text{and} 3f$

Answer:

$(i)\ n = 3$ (Given)

For a given value of n, l can have values from 0 to $(n-1)$

$\therefore$ For $n = 3$

$l = 0, 1, 2$

For a given value of l, m_l can have $\begin{pmatrix} 2 \\ +1 \end{pmatrix}$ values.

For $l = 0, m = 0$

$l = 1, m = -1, 0, 1$

$l = 2, m = -2, -1, 0, 1, 2$

$\therefore$ For $n = 3$

$l = 0, 1, 2$

$m_0 = 0$

$m_1 = -1, 0, 1$

$m_2 = -2, -1, 0, 1, 2.$

(ii) For 3d orbital, $l = 2$

For a given value of l, m_1 can have $(2l+1)$ values i.e.. , 5values

$\therefore$ For$l = 2$

$m_2 = -2, -1, 0, 1, 2$

(iii) Among the given orbitals only 2 s and 2p are possible. 1p and 3 f cannot exist.

For p-orbital , $l = 1$.

For a given value of n, l can have values from zero to $(n-1)$.

$\therefore$ For$l$is equal to1, the minimum value of$n$is2.

Similarly,

For f-orbital, $l = 4$

For $l = 4$, the minimum value of n is $_5$.

Hence, 1p and 3 f do not exist.

Q: 29. Using s, p, d notations, describe the orbital with the following quantum numbers.

(a) $n = 1, l = 0;$

$(b)\, n = 3; l = 1$

$(c)\, n = 4; l = 2;$

$(d)\, n = 4; l = 3.$

Answer:

(a) $n = 1, l = 0$ (Given)

The orbital is$1s$

(b) For $n = 3$ and $l = 1$

The orbital is $_{3p}$.

(c) For $n = 4$and$l = 2$

The orbital is $_{4d}$.

(d) For $n = 4$and$l = 3$

The orbital is $_{4f}$.

Q: 30. Explain giving reasons, which of the following sets of quantum numbers are not possible.

a	$n = 0$	$l = 0$	$m_l = 0$	$m_s = +\frac{1}{2}$
b	$n = 1$	$l = 0$	$m_l = 0$	$m_s = -\frac{1}{2}$
c	$n = 1$	$l = 1$	$m_l = 0$	$m_s = +\frac{1}{2}$
d	$n = 2$	$l = 1$	$m_l = 0$	$m_s = -\frac{1}{2}$
e	$n = 3$	$l = 3$	$m_l = -3$	$m_s = +\frac{1}{2}$
f	$n = 3$	$l = 1$	$m_l = 0$	$m_s = +\frac{1}{2}$

Answer:

(a) The given set of quantum numbers is not possible because the value of the principal quantum number (n) cannot be zero.

(b) The given set of quantum number is possible.

(c) The given set of quantum numbers is not possible.

For a given value of n, 'l' can have values from zero to (n-1) .

For $n = 1, l = 0 \text{and not} 1$.

(d) The given set of quantum numbers is possible.

(e) The given set of quantum numbers is not possible.

For n = 3

l = 0 to (3 - 1)

l = 0 to 2 i.e.. , 0,1, 2

(f) The given set of quantum numbers is possible.