QUANTUM NUMBERS

*Problem-Solved Example 27*

Why (a) for atomic orbital, $np$, $n \neq 1$ ?

(b) for atomic orbital, $nd$, $n \neq 1$ or $n \neq 2$ ?

(c) for atomic orbital, $nf$; $n \neq 1$, $n \neq 2$, $n \neq 3$ ?

## *Solution*

Solution:

> For $n = n$
> $l = 0, 1, 2 \ldots (n-1)$

a) For p-orbital : $l = 1$

$n = 1$ ; $l = 0$ (1s) ; $l = 1$ not possible

$n = 2$ ; $l = 0$ (s) : 2s

$l = 1$ (p) : 2p

Thus, only when $n = 2$, there are p-orbital
(So 1p orbital does not exist)

b) For d-orbital : $l = 2$

$n = 3$ ; $l = 0$ (3s)

$l = 1$ (3p)

$l = 2$ (3d)

$n = 1$ ; $l = 0$ (1s) : $l \neq 1$ & $l \neq 2$ } (1p, 1d) p

$n = 2$ ; $l = 0$ (2s)

$l = 1$ (2p)

$l \neq 2$ (2d not possible)

Thus, only when $n = 3$, there are d-orbital ($l = 2$)
(So 1d and 2d doesnot exist)

c) For f-orbital : $l = 3$

$n = 1$ ; $l = 0$ (1s) : $l \neq 1$, $l \neq 2$, $l \neq 3$ (no 1f orbital)

$n = 2$ ; $l = 0$ (2s) ; $l = 1$ (2p) : $l \neq 2$, $l \neq 3$ (no 2f orbital)

$n = 3$ ; $l = 0$ (3s) ; $l = 1$ (3p) ; $l = 2$ (3d) : $l \neq 3$ (no 3f orbital)

$n = 4$ ; $l = 0$ (4s) ; $l = 1$ (4p) ; $l = 2$ (4d) ; $l = 3$ (4f)

Thus, only when $n = 4$, there are f-orbital ($l = 3$)
So 1f, 2f, 3f does not exist.

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