Quantum Numbers and Atomic Orbitals

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1. quantum Number - number which helps describe where an ⓔ will most likely be found

atomic orbital - region of space where the probability of finding an ⓔ is high.

→ need 3 atomic numbers to specify a single atomic orbital.

n → principle quantum #

ℓ → secondary quantum #

m_ℓ → ~~sp~~ magnetic number

2. n → principle quantum #
→ average distance from nucleus and energy level } Energy level shell

ℓ → secondary quantum #
→ an orbital's shape → shape of region ⓔ will be found in. } sub shell

m_ℓ → magnetic quantum #
→ orientation of ~~s~~ shape in 3D space } orbital

m_s → spin quantum #
→ recognizes that electrons spin on their axis

3. ⓔ in a 3p orbital

$n = 3$ $\ell = 1$ $m_\ell = +1, 0, -1$ $m_s = +1/2, -1/2$

↑

one of these 3 values

one of these 2 values

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	# e	reason
4. a) $n = 3$	18	3^{rd} energy level can hold 2 ⓔ in s 8 e in p 10 e in d
b) $n = 3$ $\ell = \underline{1}$	6	ℓ value of 1 relates to a p orbital which has 3 orientations each which can hold 2 e
c) $n = 3$ $\ell = \underline{1}$ $m_\ell = 1$	2	$m_\ell = 1$ → looking at the orientation of 1 orbital
d) $n = 3$ $\ell = 1$ $m_\ell = 1$ $m_s = 1/2$	$\underline{1}$	ms value of ½ relates to a particular ⓔ
e) $n = 3$ $\ell = 2$	10	ℓ value of $\underline{2}$ indicates d orbital which has $\underline{5}$ orientations
f) $n = 3$ $\ell = 2$ $m_\ell = \underline{1}$	2.	m_ℓ value of 1 indicates 1 orientation of the $\ell = 2$ (d) orbital
g) $n = 3$ ~~$\ell = 2$~~ $\ell = 1$ $m_\ell = 1$	2	
h) $n = 3$ $\ell = 2$ $m_\ell = 0$ $m_s = 1/2$	$\underline{1}$	

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5.

	Subshell	n	ℓ
a)	1s	1	0
b)	4s	4	0
c)	3p	3	1
d)	3d	3	2
e)	4f	4	3

6.

	subshell	m_ℓ values
a)	3d	-2, -1, 0, 1, 2
b)	1s	0
c)	3p	-1, 0, 1

7.

	quantum #	# orbitals	reason
a)	4p	3	p has 3 orientations
b)	3p	3	p has 3 orientation.
c)	$3p_x$	1	p_x is 1 orientation of p orbital
d)	n = 5	25	has spdfg w total of 50 e
e)	6d	5	d has 5 orientations
f)	5d	5	d has 5 orientations.
g)	5f	7	f has 7 orientations
h)	7s	1	s has 1 orientation

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8. a) 1, 0, 0, +½, +½

$\underbrace{n=1 \quad l=0, \quad m_l=0}_{or}$ m_s is +½ or −½ not 2 +½

b) 2, 2, 1, ± ½

$n=2$ $l=2$ $m_l=1$ $m_s=\pm\frac{1}{2}$

↑ ↑ ↑ ↑

ok wrong ok talks about both ⓔ's in the orbital

$l=0 \ldots n-1$

$\therefore l=1$ or 0 for $n=2$

c) 3, 2, 3, ± ½

$n=3$ $l=2$ $m_l=3$ $n=\pm\frac{1}{2}$

↑ ↑ ↑ ↑

ok ok wrong ok

$m_l=-l \ldots +l$

for $l=2$ $m_l=-2 \ldots +2$

$m_l=2$

d) 3, 1, 2, + ½

$n=3$ $l=1$ $m_l=2$ $m_s=+\frac{1}{2}$

↑ ↑ ↑ ↑

ok ok wrong ok

$m_l=-l \ldots +l$

$m_l=1$

e) 2, 1, −1, 0

$n=2$ $l=1$ $m_l=-1$ $m_s=0$

↑ ↑ ↑ ↑

ok ok ok wrong m_s values are $+\frac{1}{2}$ or $-\frac{1}{2}$ only

f) 3, 0, −1, −½

$n=3$ $l=0$ $m_l=-1$, $m_s=-\frac{1}{2}$

↑ $m_l=-l \ldots +l$

$m_l=0$

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	orbital	simularity	difference
9. a)	1s /2s	- have the same shape.	- 2s is larger than 1s → ⓔ in 2s are on average further from nucleus than ⓔ in 1s
b)	2px/2py	- same shape - same "size"	- orientations in 3D space