Term Symbols Example   C atom

Carbon atom e^- config is $1s^2 2s^2 2p^2$

(1) Apply rule 1: $1s^2, 2s^2$ don't matter. We're left w/ $2p^2$.

(2) Consider what possible Slater determinants could be formed. For a p orbital, $\ell = 1$, so $m_\ell = +1, 0, -1$.

Det #	Det ($2p$; $m_\ell = +1$, 0, -1)	M_L	M_S
①	↑↓ — —	2	0
②	↑ ↑ —	1	1
③	↑ ↓ —	1	0
④	↑ — ↑	0	1
⑤	↑ — ↓	0	0
⑥	↓ ↑ —	1	0
⑦	↓ — ↑	0	0
⑧	— ↑↓ —	0	0
⋮	⋮		

there are more w/ $M_L, M_S < 0$... usually suffices to work w/ + ones, keep − in mind

(3) Use the Rules to Figure out which term symbols arise from this config.

Use corollary of Rule 3: The highest $M_L = 2$. ∴ Can't have $L > 2$. The highest $M_S = 1$. ∴ Can't have $S > 1$.

This gives us the following possible term symbols at this stage: $S = 0, 1$ $(2S+1 = 1 \text{ or } 3)$

$L = 0, 1, 2$

$\Rightarrow$ ^1S, ^3S, ^1P, ^3P, ^1D, ^3D.

<u>But</u> not all these are really possible. For example,

^3D: Corollary says it must be possible to construct a slater det. w/ $M_L = 2$, $M_S = 1$. But there's no such determinant! (Would require 2 α spins in same orb). ∴ <u>No</u> ^3D. Others still ok, for now...

Since we can make $\uparrow\downarrow$ — — $M_L = 2, M_S = 0$, there must be an L-S eigenfunction w/ $L \geq 2, S \geq 0$.

But also we know $L < 3, S < 2$. The only term symbol in our list fitting this is ^1D.

∴ This Slater det <u>must</u> belong to ^1D.

Now: other Slater dets <u>also</u> belong to this term symbol (because it's degenerate) — see Rule 2. We need to figure out which ones & mark them out.

$M_L = -L, -L+1, \ldots L-1, L$ or here $M_L = -2, -1, 0, 1, 2$.

Likewise, $M_S = 0$. ^1D accts for the following determinants: $(M_L, M_S) = \underbrace{(2,0), (1,0), (0,0), (-1,0), (-2,0)}_{\text{5 choices}}$

$5 = (2L+1)(2S+1)$

∴ Remove ①, ③, ⑤ (& the − ones not drawn in Slater det list).

· Remaining dets:

		(M_L, M_S)
②	↑ ↑ —	(1, 1)
④	↑ — ↑	(0, 1)
⑥	↓ ↑ —	(1, 0)
⑦	↓ — ↑	(0, 0)
⑧	— ↑↓ —	(0, 0)

Now go to the determinant w/ highest (M_L, M_S) left, which is ②, (1,1). Apply Rule 3:

Must be an L-S state w/ $L \geq 1$, $S \geq 1$. Out of our list of remaining term symbols,

(^1S, ^3S, ^1P, ^3P, ~~^1D~~ → did, ~~^3D~~ → impossible),

we have to use only ^3P for this ($L=1, S=1$).

For ^3P, $M_L = -1, 0, 1$; $M_S = -1, 0, 1$. Therefore ^3P accts for 9 Slater dets.

^3P accts for Slater dets w/ $(M_L, M_S) =$

$(1,1), (1,0), (1,-1), (0,1), (0,0), (0,-1), (-1,1), (-1,0),$

$(-1,-1)$.

Cross off ②, ④, ⑥, ⑦, (and the unwritten (−) ones). What Slater dets does this leave? Only (0,0) ⑧ is left!

For remaining (0,0) det ⑧, must have an L-S state w/ $L=0$, $S=0$. What term symbols are left in our list?

^1S, ^3S, ^1P. It can't be ^3S or ^1P, because either of those take 3 dets, and we only have one left. ∴ It must be

^1S $(L=0, S=0)$.

Result: C atom $1s^2 2s^2 2p^2$ gives rise to term symbols ^1D, ^3P, ^1S.