

# Orbital Diagrams

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YALE UNIVERSITY  
CHEMISTRY 161  
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s-block												p-block					
1																	8
H																	He
←1s→	2											3	4	5	6	7	←1s→
Li	Be											B	C	N	O	F	Ne
←2s→												←2p→					
Na	Mg											Al	Si	P	S	Cl	Ar
←3s→		d-block										←3p→					
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
←4s→		←3d→										←4p→					
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
←5s→		←4d→										←5p→					
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
←6s→		←5d→										←6p→					
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og
←7s→		←6d→										←7p→					

## ELECTRON CONFIGURATION

*Fill from left to right!*

### Examples

N:  $1s^2 2s^2 2p^3$

Na:  $1s^2 2s^2 2p^6 3s^1$

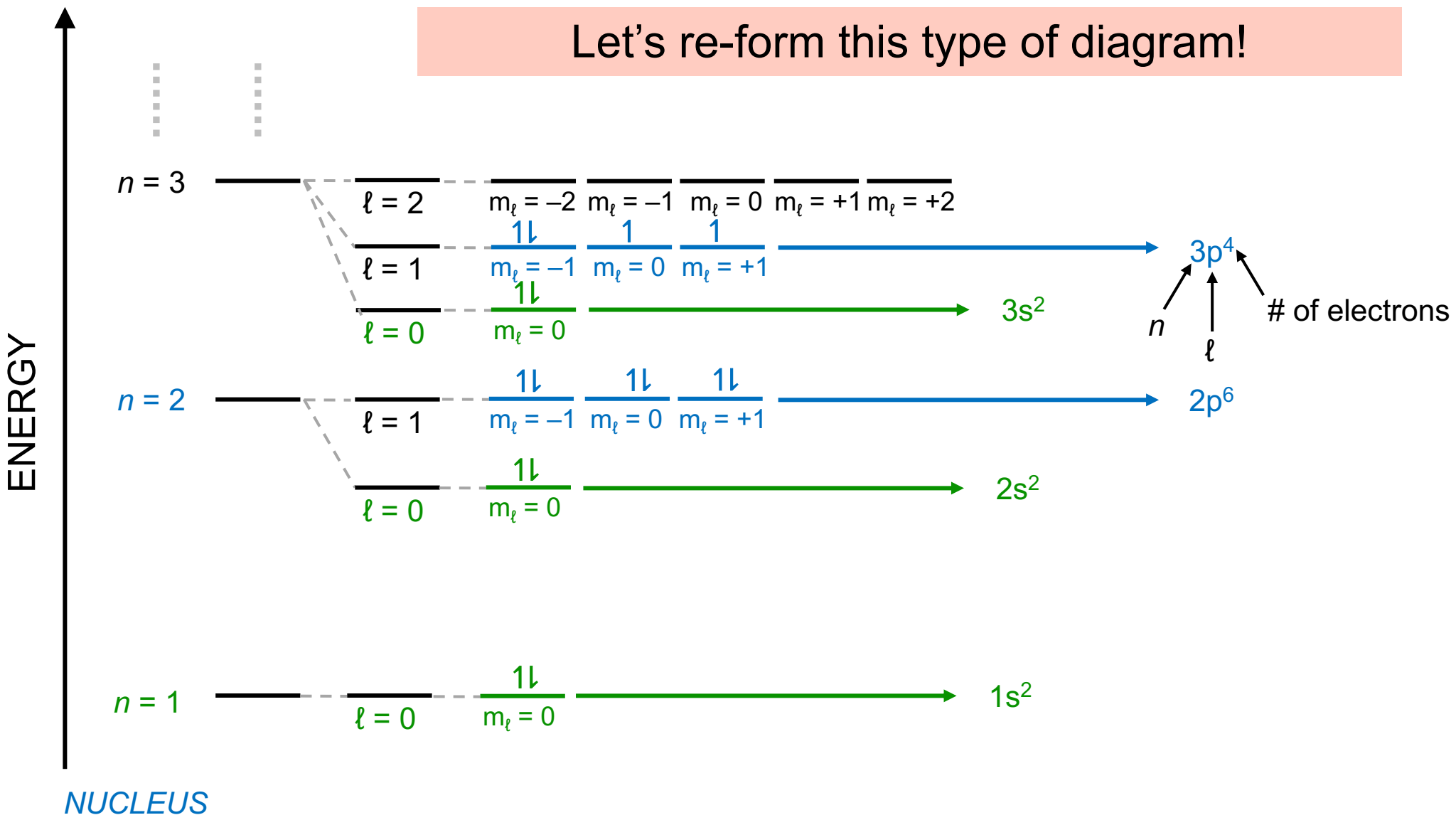
Fe:  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

f-block													
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
←4f→													
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
←5f→													

While this form is condensed, it loses information about the distribution and energy of the electrons we had in an earlier representation...

# Orbital Diagram

Let's re-form this type of diagram!

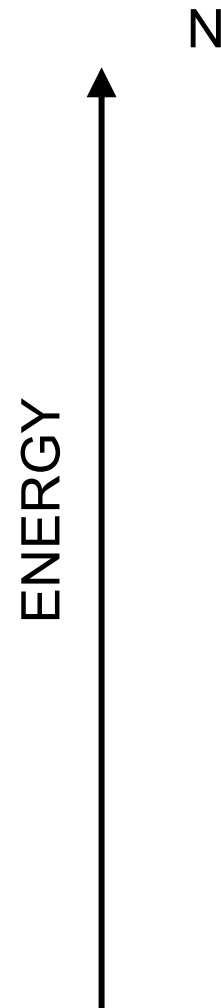


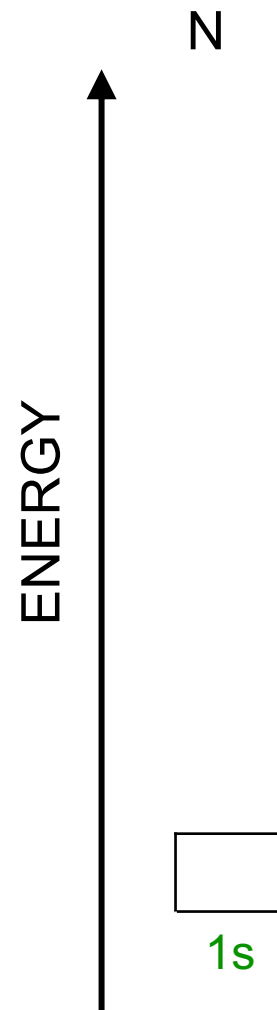
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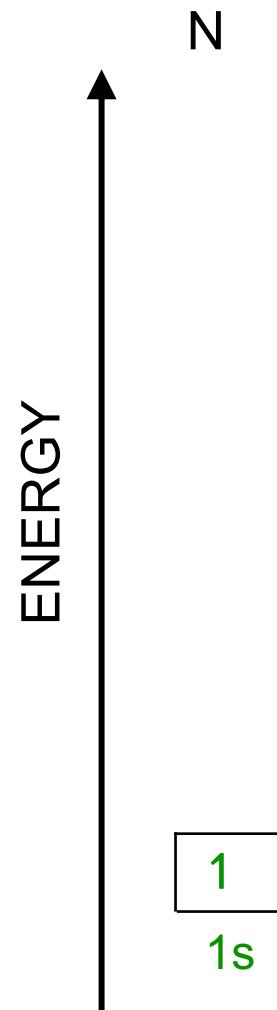
Fe:  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

ORBITAL DIAGRAM

ELECTRON CONFIGURATIONN:  $1s^2 2s^2 2p^3$ Na:  $1s^2 2s^2 2p^6 3s^1$ Fe:  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$ ORBITAL DIAGRAM

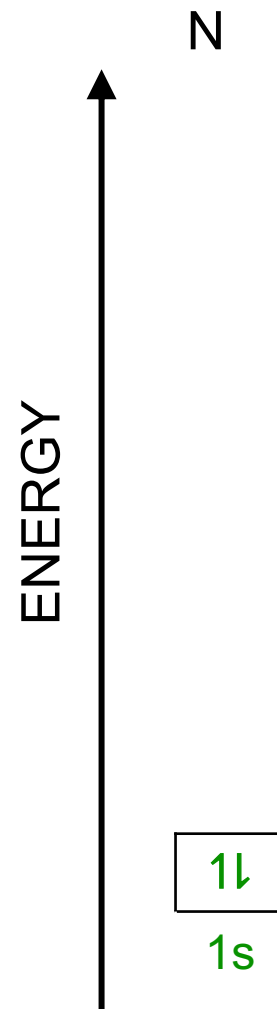
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Fill orbitals with “up” before  
“down” to maximize number  
of unpaired electrons.

ORBITAL DIAGRAM

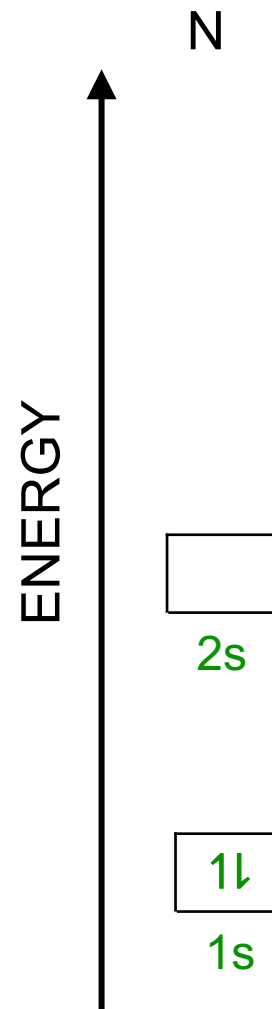
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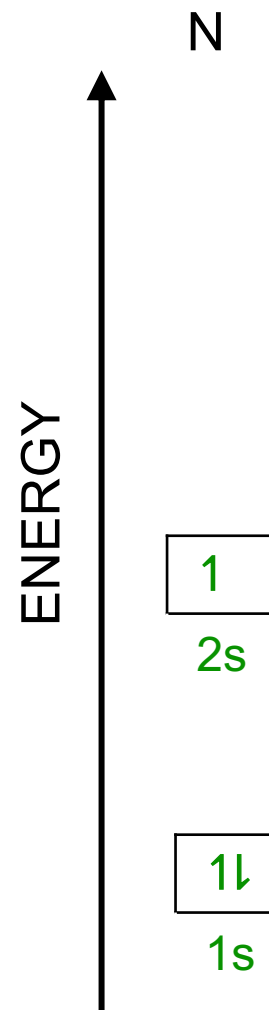
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ORBITAL DIAGRAM



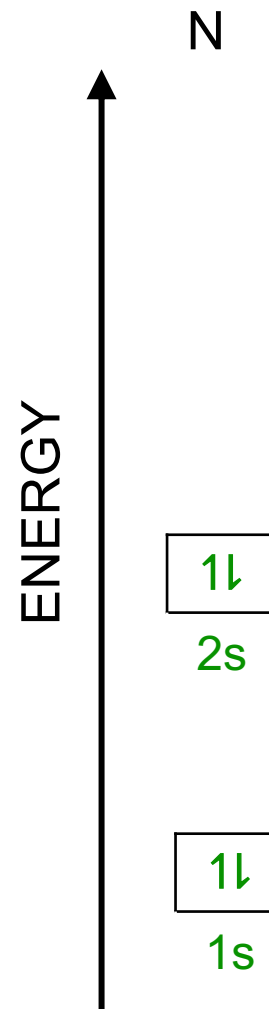
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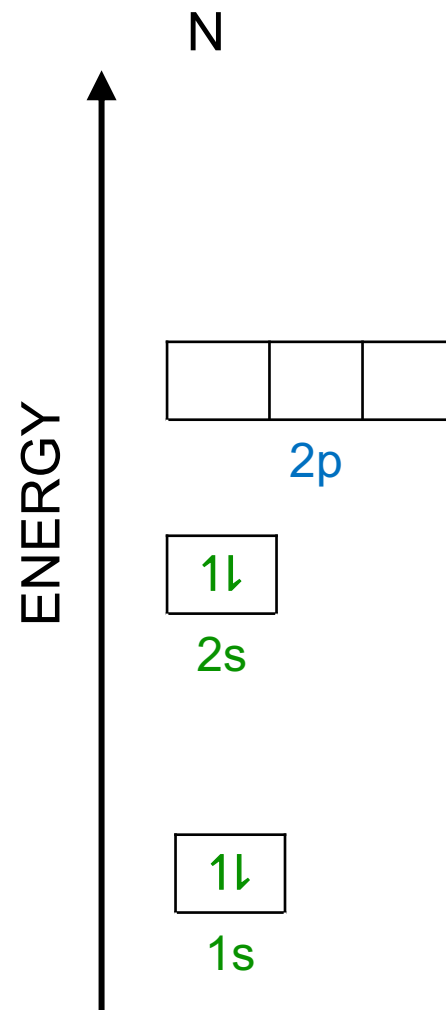
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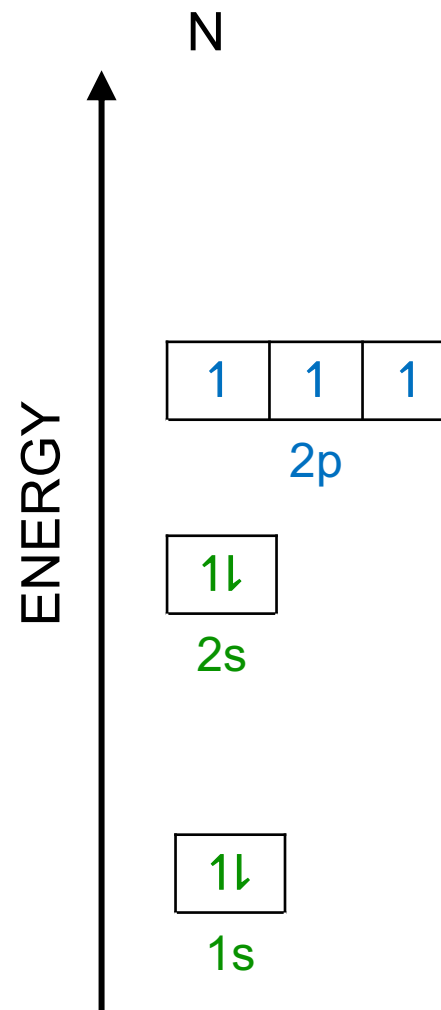
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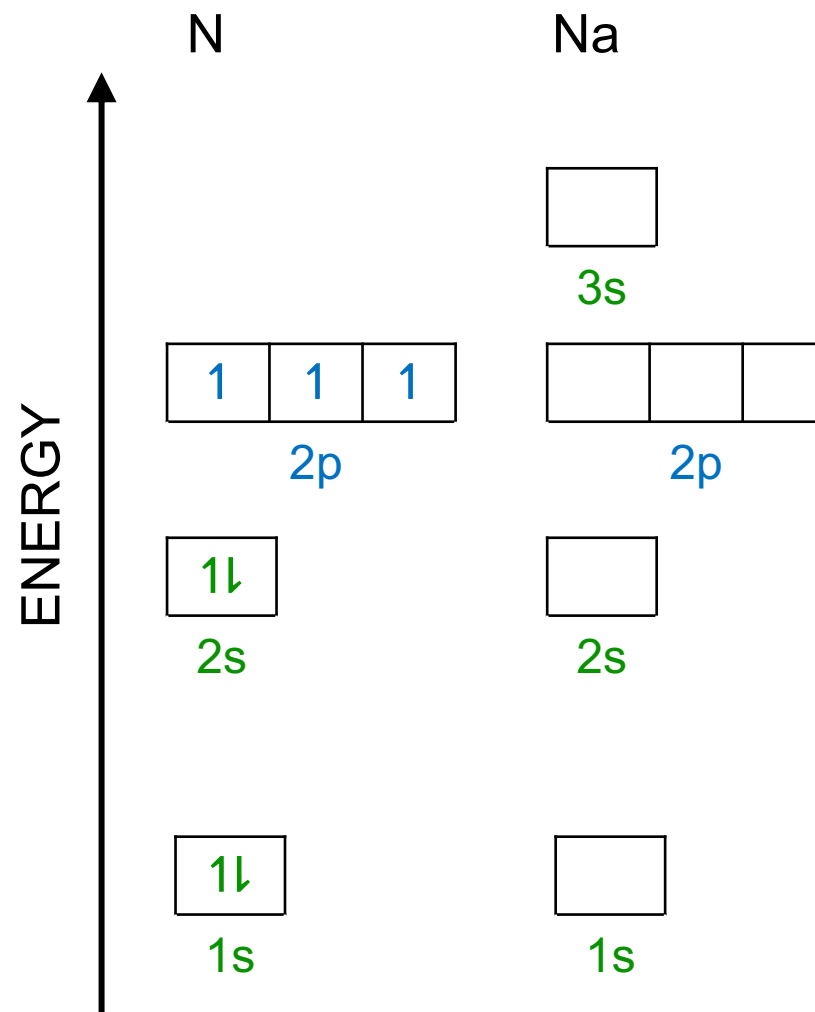
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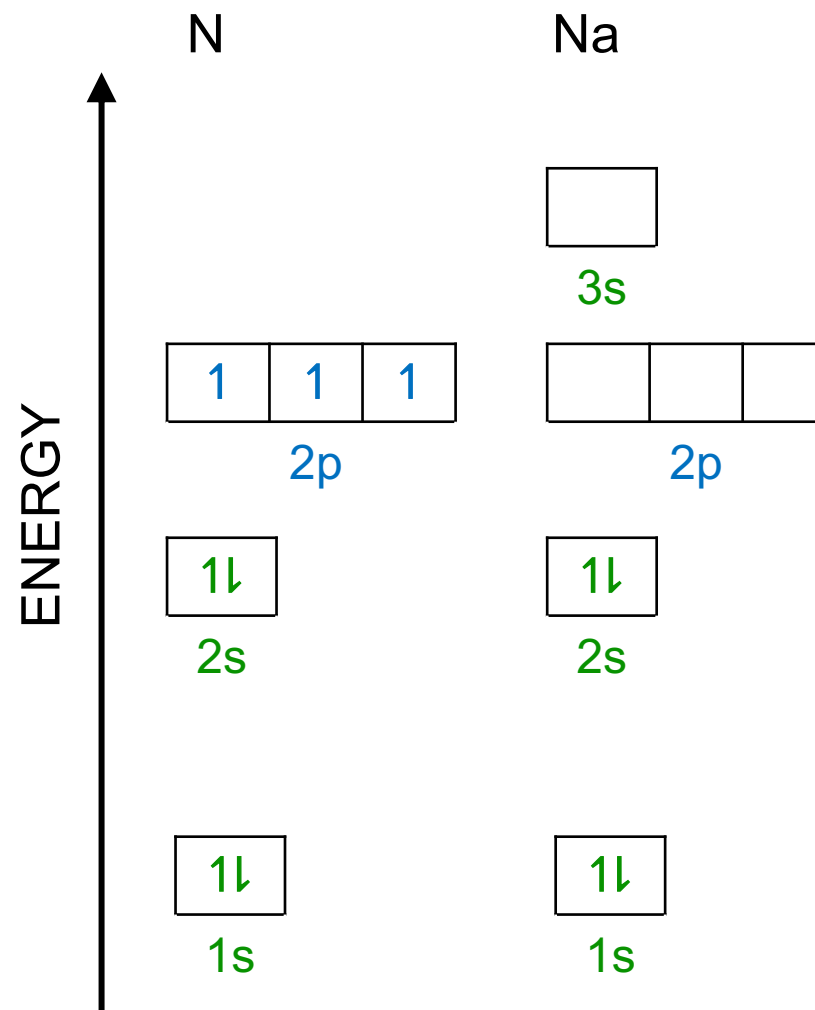
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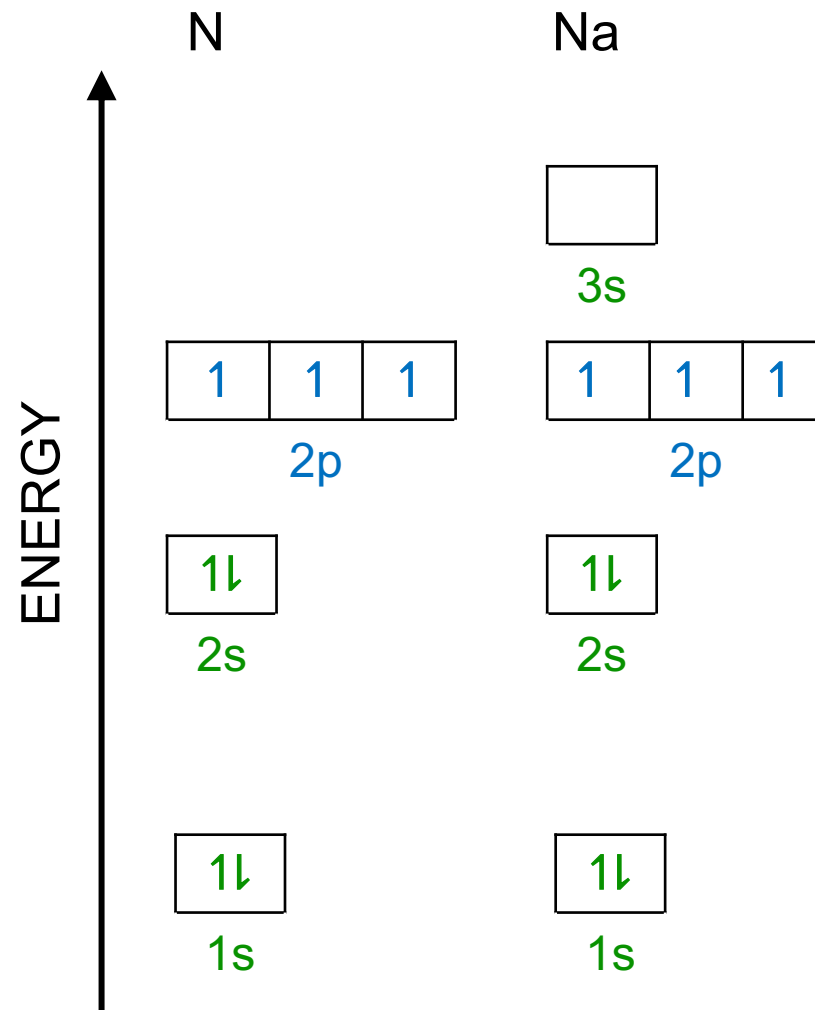
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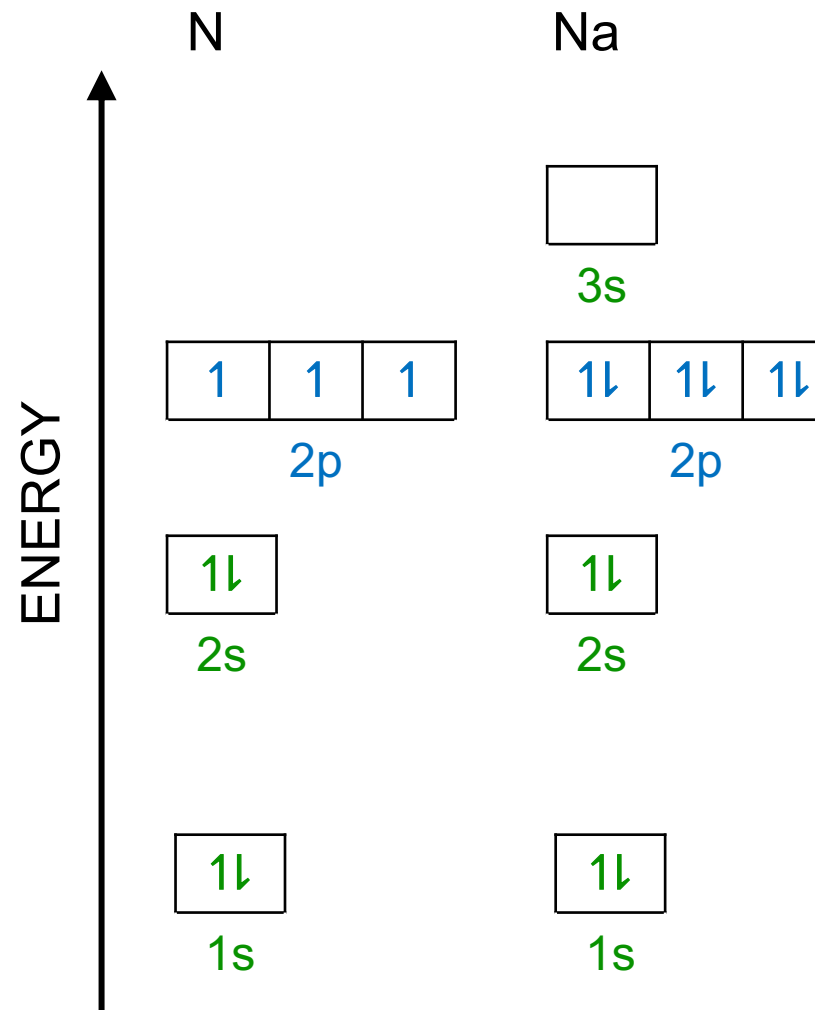
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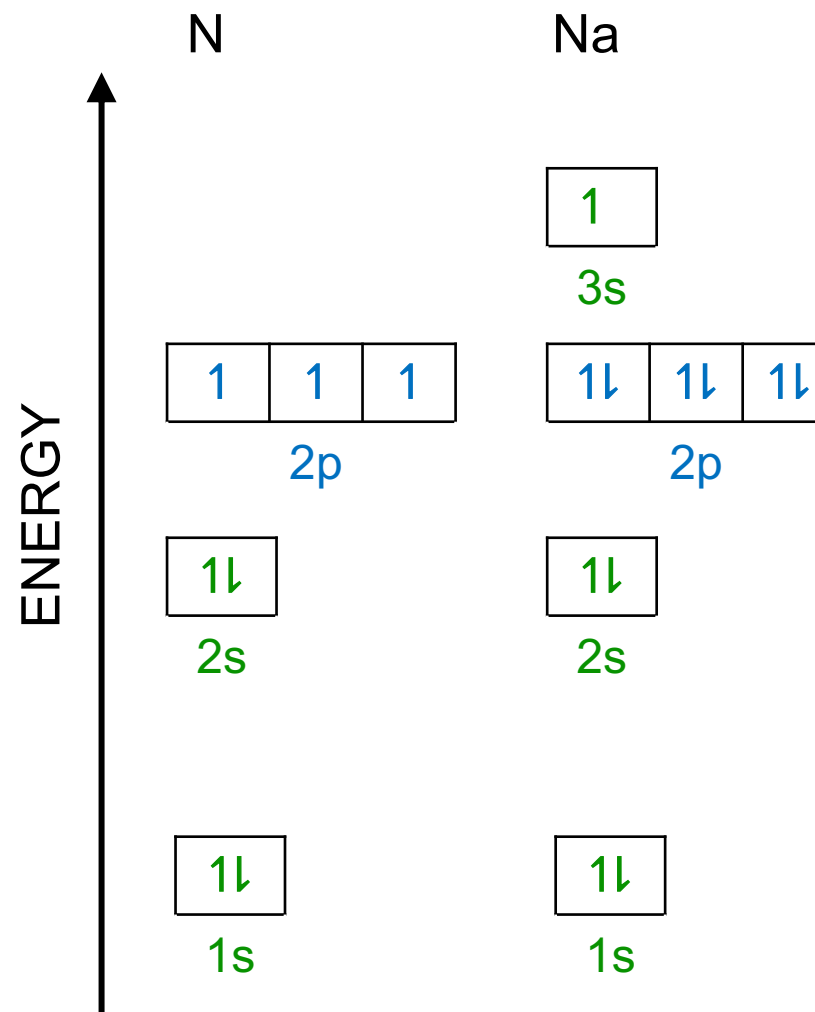
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ORBITAL DIAGRAM



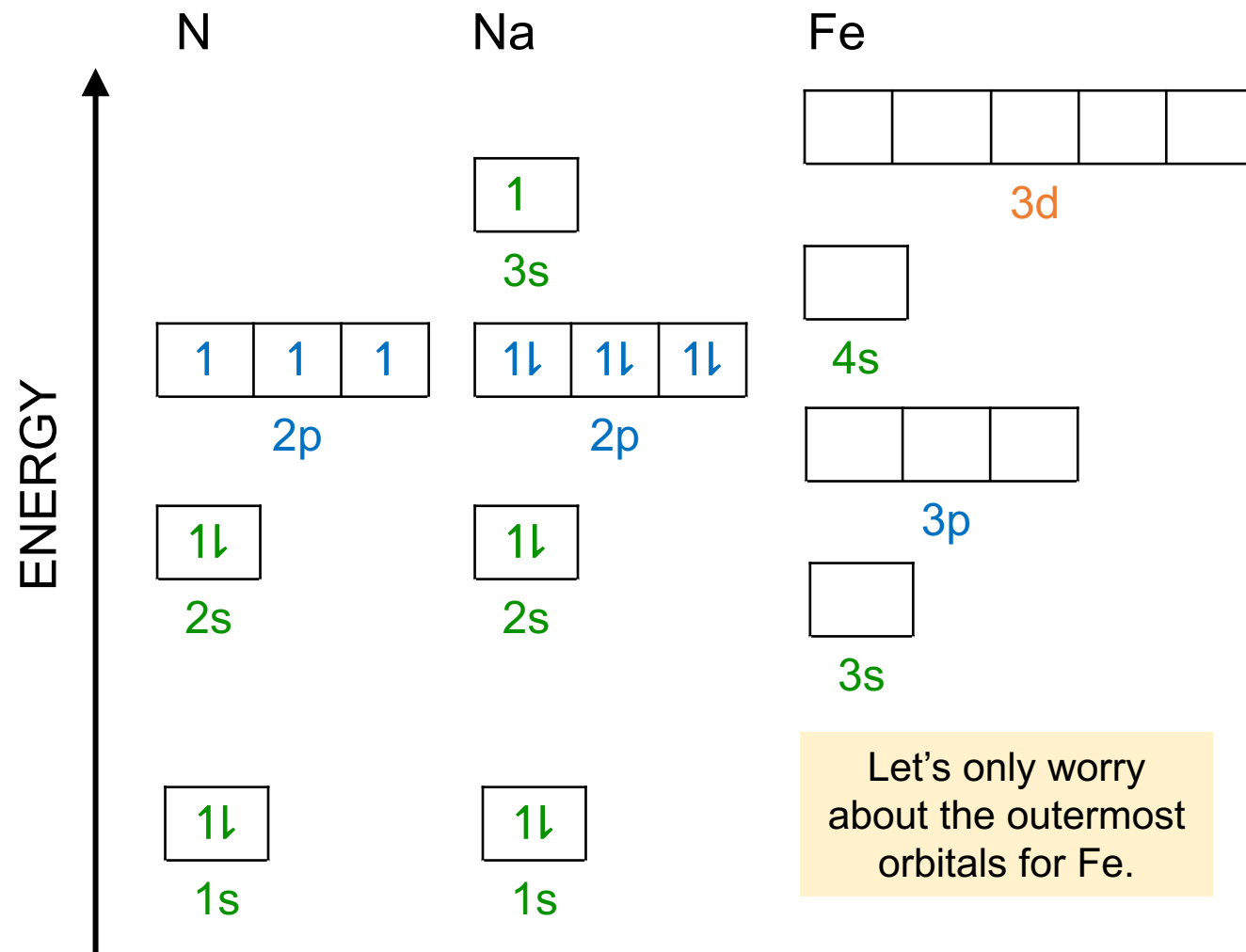
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ORBITAL DIAGRAM

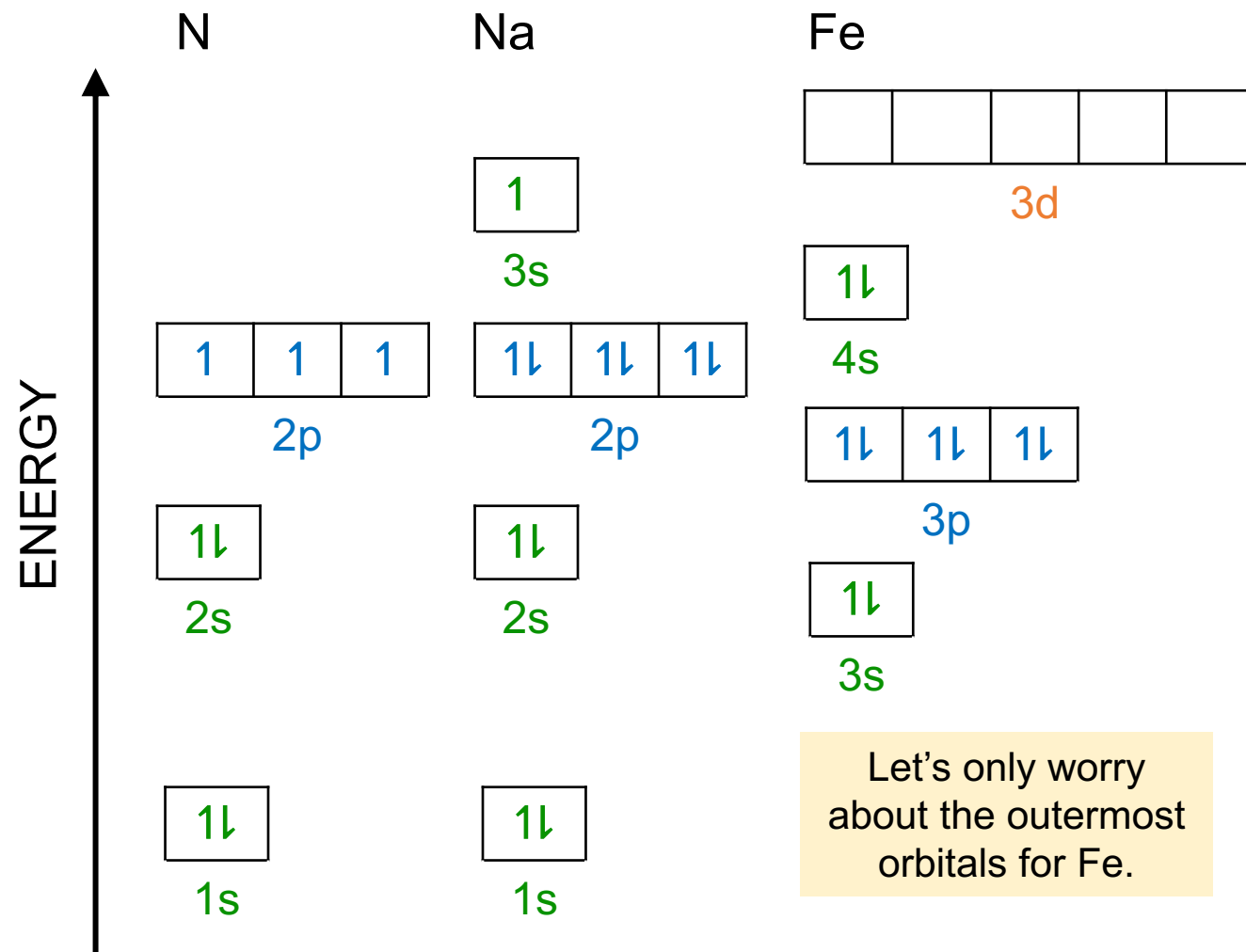
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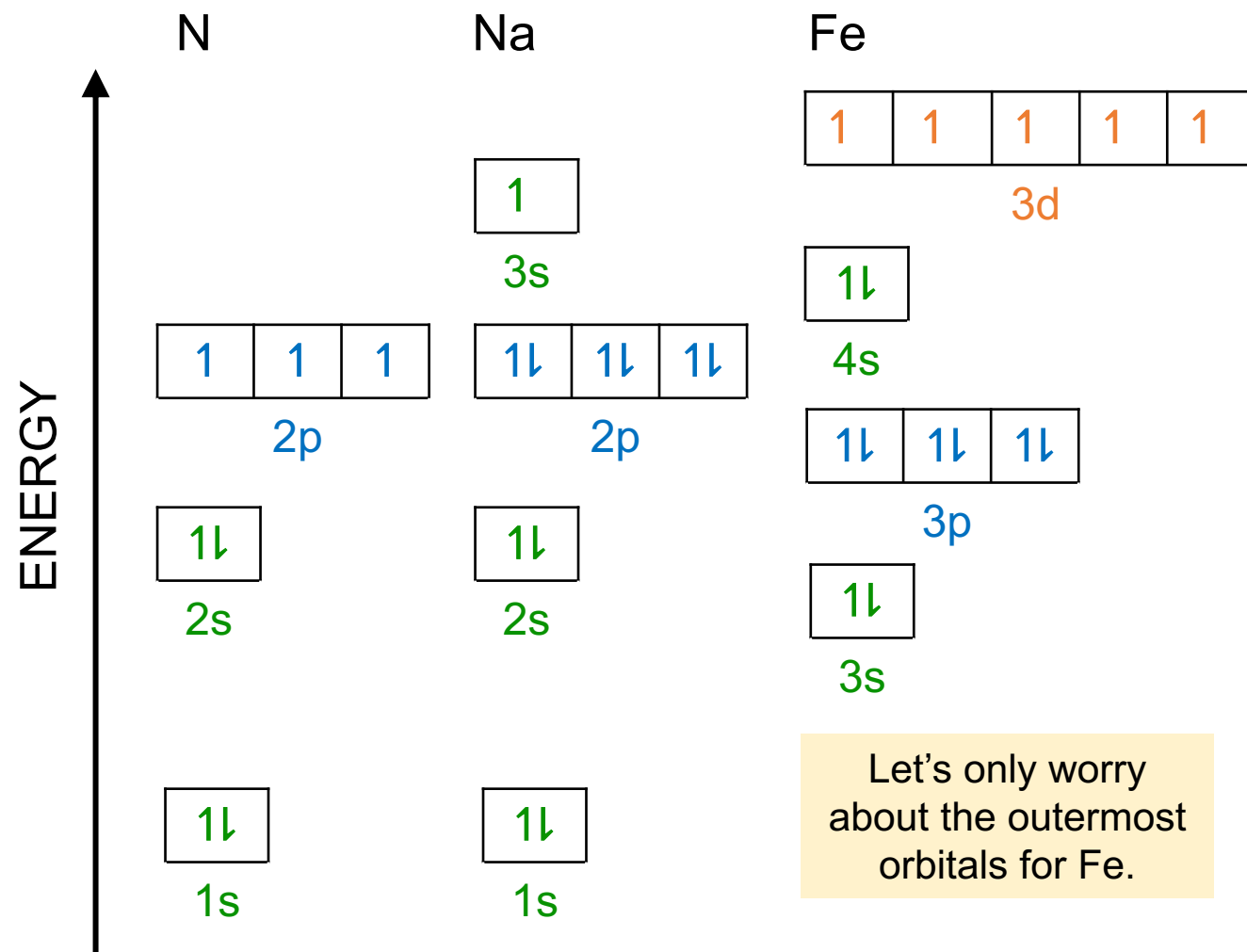
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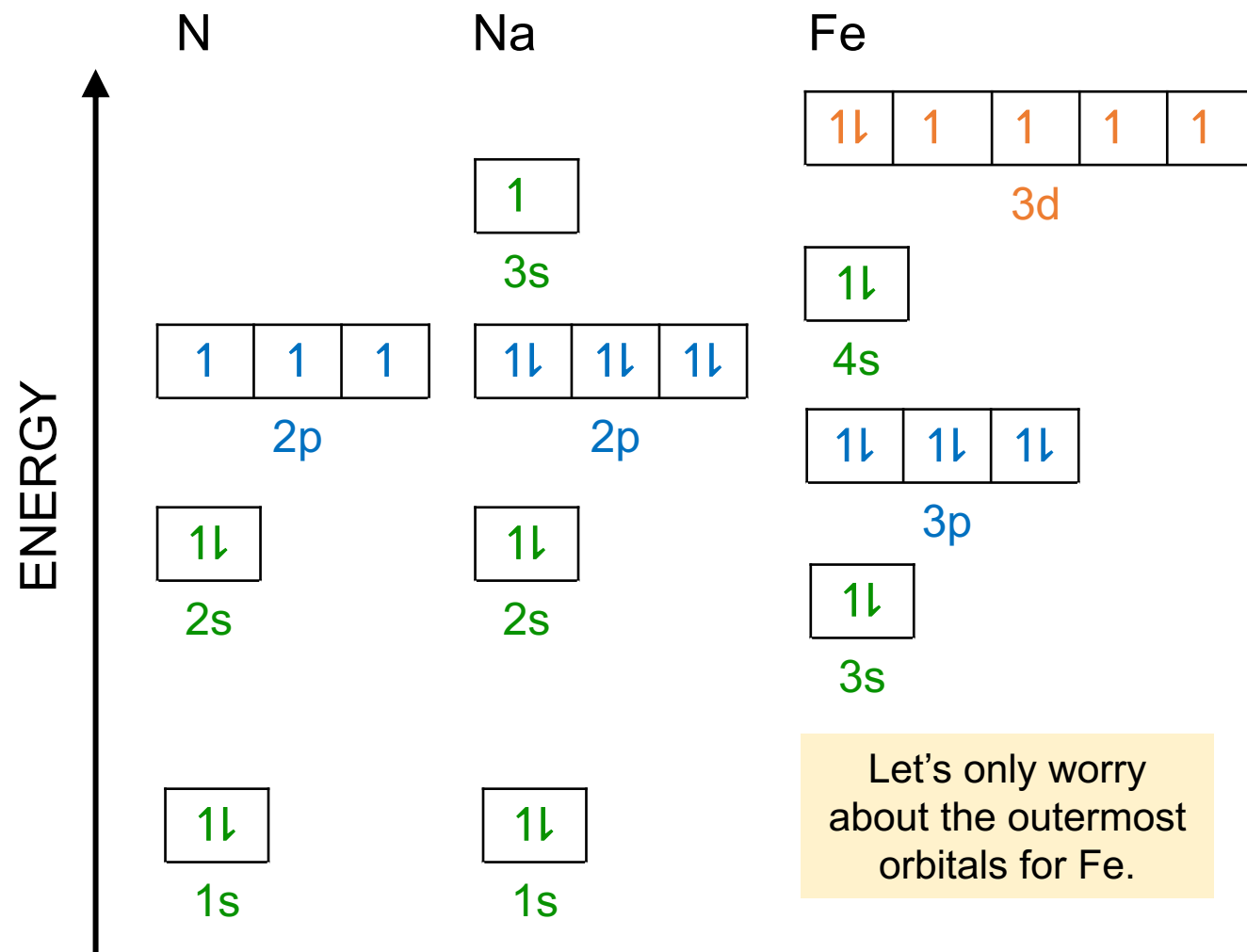
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ORBITAL DIAGRAM

ELECTRON CONFIGURATION

Fill orbitals with “up” before  
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ORBITAL DIAGRAM

NEUTRAL ATOMS

IONS

N

Na

Fe

$N^{3-}$

$Na^+$

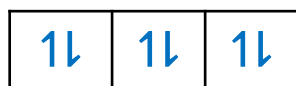
$Fe^{2+}$



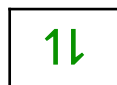
2p



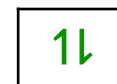
3s



2p



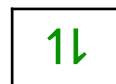
2s



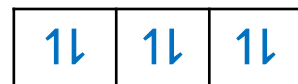
1s



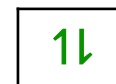
3d



4s



3p



3s

Let's only worry about the outermost orbitals for Fe.

## NEUTRAL ATOMS

## IONS

N

Na

Fe

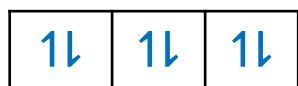
$N^{3-}$

$Na^+$

$Fe^{2+}$



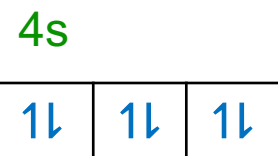
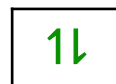
2p



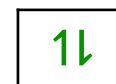
2p



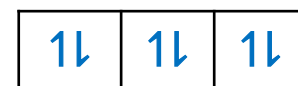
3d



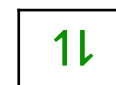
3p



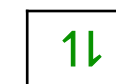
3s



2p



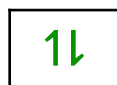
2s



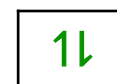
1s



3s



2s

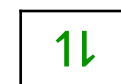


1s

Let's only worry about the outermost orbitals for Fe.



2s



1s

NEUTRAL ATOMSIONS

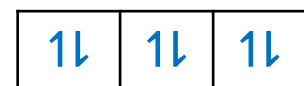
N

Na

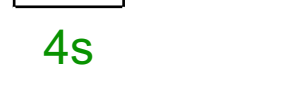
Fe

N<sup>3-</sup>Na<sup>+</sup>Fe<sup>2+</sup>

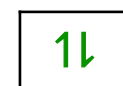
2p



2p



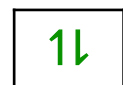
3p



3s



3d



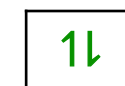
4s



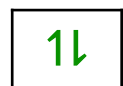
3s



2s



1s

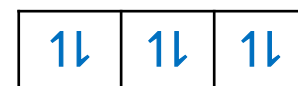


2s

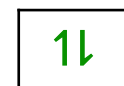


1s

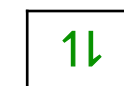
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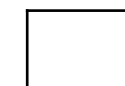
2p



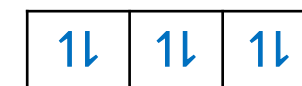
2s



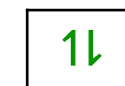
1s



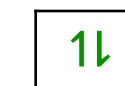
3s



2p



2s

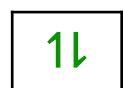


1s



NEUTRAL ATOMSIONS

N



2s

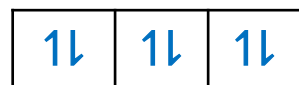


2p

Na



2s

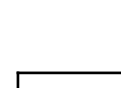


2p

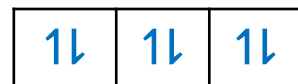


3s

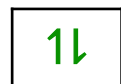
Fe



3s



3p

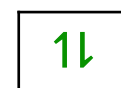


4s



3d

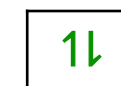
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N<sup>3-</sup>

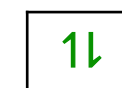
2s



2p



1s

Na<sup>+</sup>

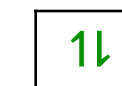
2s



2p



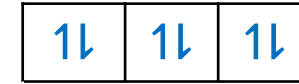
3s



1s

Fe<sup>2+</sup>

3s



3p



4s



3d

For transition metal  
cations, remove from  
s orbitals first!