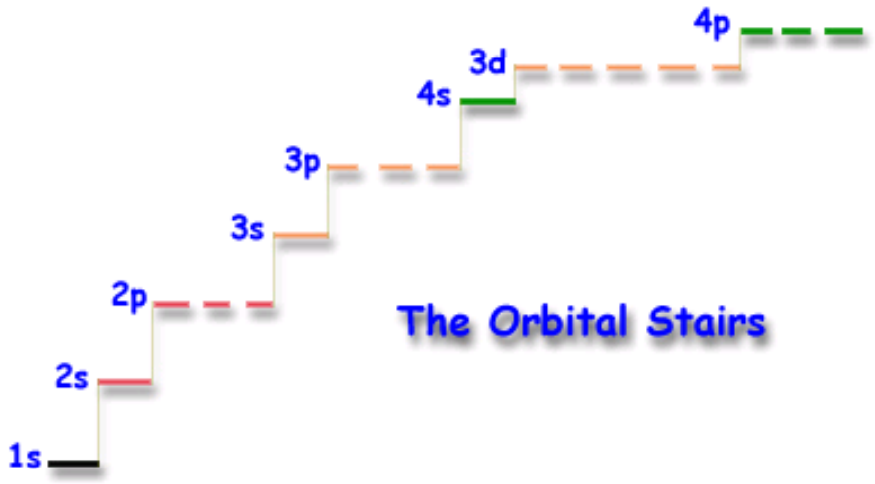
Announcements – Lecture X – Wednesday, June 5th

4th Lab: Tue, Jun 11th, 1:30-4:30

Quiz 7

Last Name: _____



1. Give the electronic configuration for **chlorine**.

$1s^2 2s^2 2p^6 3s^2 3p^5$

2. Give the valence configuration for **Krypton (Kr)**

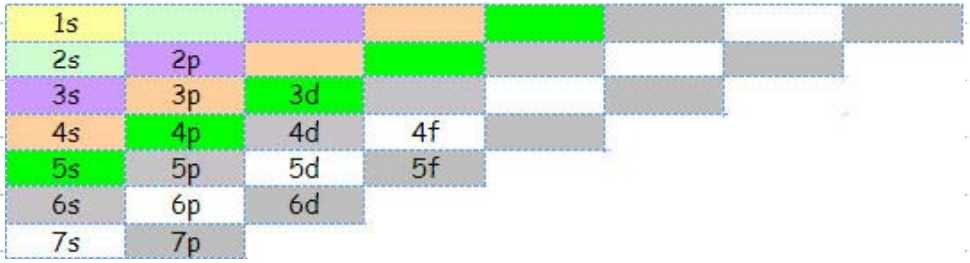
$[Ar]\,4s^2 3d^{10} 4p^6$

3. An element has a valence configuration of **$[Kr]5s^2 4d^{10} 5p^4$** – what group does this element belong to? (ie 1A, 1B, 2A … etc)

VIA (6A)

7.3 Electron Configurations of the Elements

D: Electron Configurations and Magnetism – Orbital Box Notation



Paramagnetic : Any element or molecule that has at least one unpaired electron.

Diamagnetic : Any element or molecule that has no unpaired electrons.

Label the following as either paramagnet (P) or diamagnetic (D)

Li :

Be :

B :

C :

N :

O :

F :

Ne :

7.3 Electron Configuration of the Elements

D: Electron Configurations and Magnetism – Orbital Box Notation

Hund's Rule:

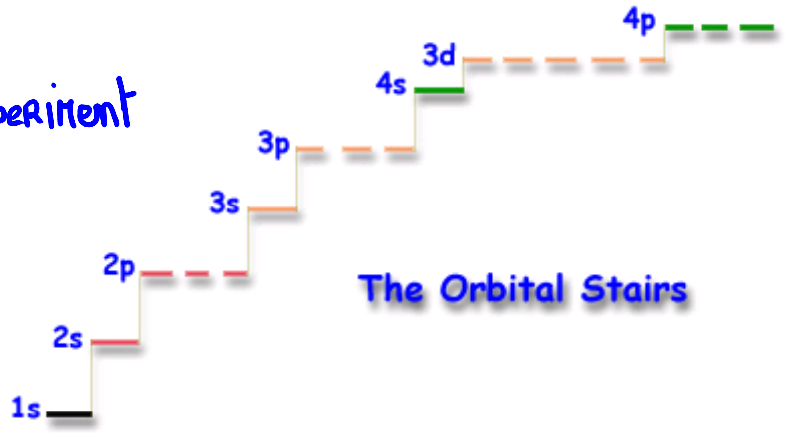
The most stable arrangement of electrons is that with the maximum allowed number of unpaired electrons, all with the same spin direction.

Element	#e-	Valence Configuration	Orbital Box	Magnetism
Li	3	$[He]2s^1$	[He] ↑	P
Be	4	$[He]2s^2$	[He] ↑↓	D
B	5	$[He]2s^2 2p^1$	[He] ↑↓ ↑ _ _	P
C	6	$[He]2s^2 2p^2$	[He] ↑↓ ↑ ↑ _	P
N	7	$[He]2s^2 2p^3$	[He] ↑↓ ↑ ↑ ↑	P
O	8	$[He]2s^2 2p^4$	[He] ↑↓ ↑↓ ↑ ↑	P
F	9	$[He]2s^2 2p^5$	[He] ↑↓ ↑↓ ↑↓ ↑	P
Ne	10	$[He]2s^2 2p^6$	[He] ↑↓ ↑↓ ↑↓ ↑↓	D

7.3 Electron Configuration of the Elements

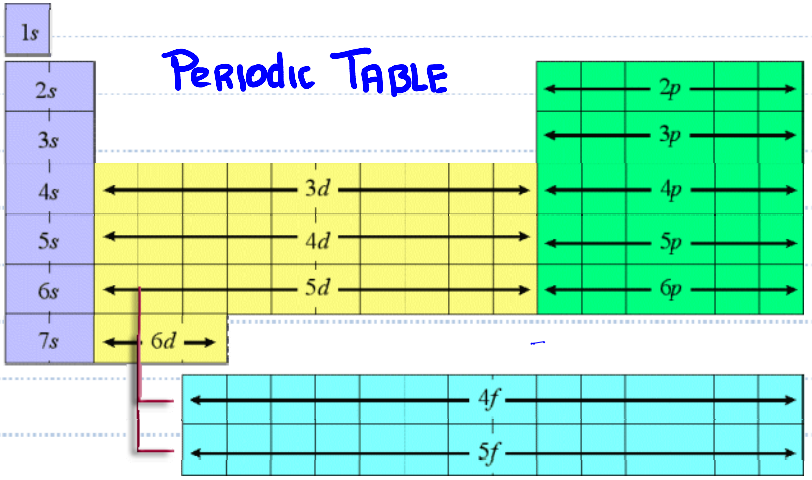
Cheats to Remember the Order of Filling

Experiment



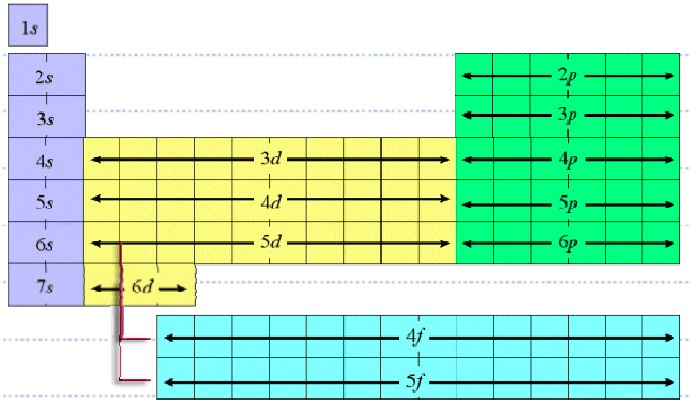
Diagonal method

1s							
2s	2p						
3s	3p	3d					
4s	4p	4d	4f				
5s	5p	5d	5f				
6s	6p	6d					
7s	7p						



7.3 Electron Configurations of the Elements

Transition Metals

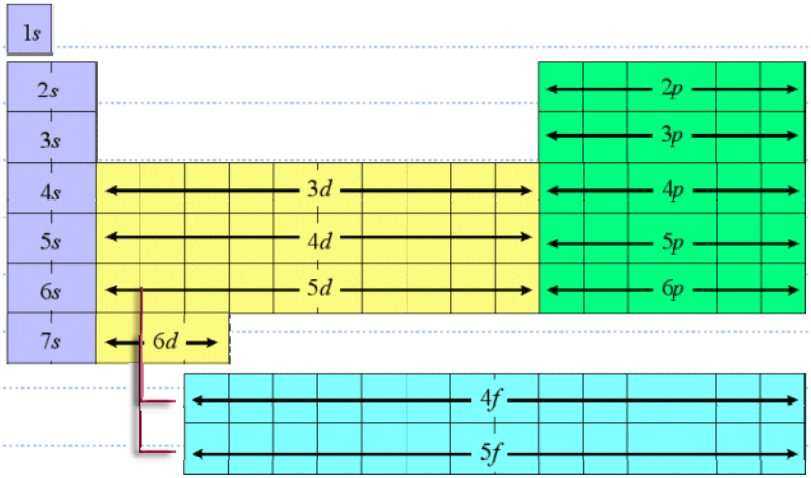


Valence Configuration

Element	#e-	Predicted Configuration		Actual Configuration
Sc	21	$[Ar]\,4s^2 3d^1$		✓
Ti	22	$[Ar]\,4s^2 3d^2$		✓
V	23	$[Ar]\,4s^2 3d^3$		✓
Cr	24	$[Ar]\,4s^2 3d^4$	X	$[Ar]\,4s^1 3d^5$
Mn	25	$[Ar]\,4s^2 3d^5$		✓
Fe	26	$[Ar]\,4s^2 3d^6$		✓
Co	27	$[Ar]\,4s^2 3d^7$		✓
Ni	28	$[Ar]\,4s^2 3d^8$		✓
Cu	29	$[Ar]\,4s^2 3d^9$	X	$[Ar]\,4s^1 3d^{10}$
Zn	30	$[Ar]\,4s^2 3d^{10}$		✓

7.5 Electron Configuration of Ions

B: Anions



Add up the electrons and fill the orbitals based on the filling order given above.

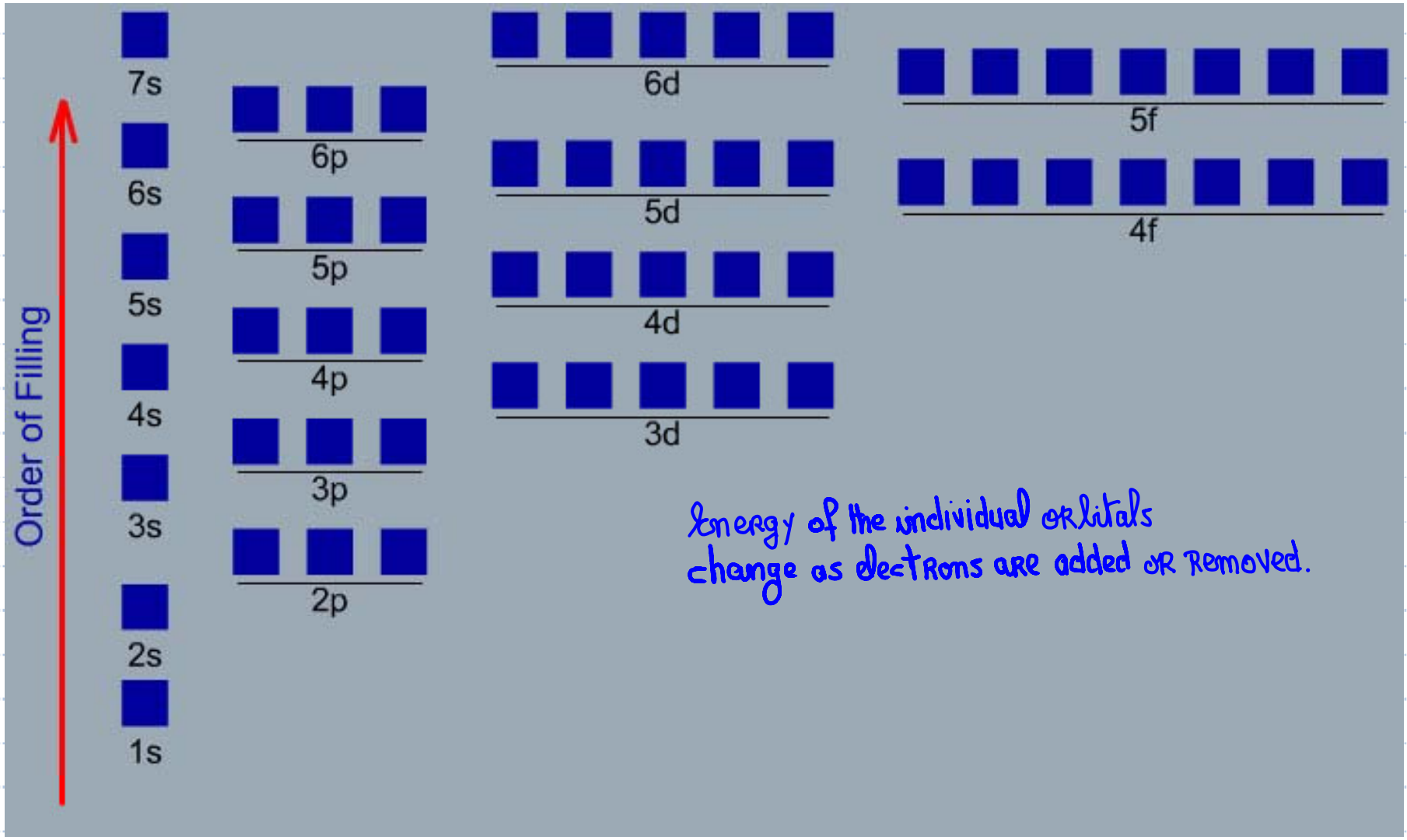
O^{2-} : 8+2 = 10 $1s^2 2s^2 2p^6$

N^{3-} : 7+3 = 10 $1s^2 2s^2 2p^6$

Cl^- : 17+1 = 18 $1s^2 2s^2 2p^6 3s^2 3p^6$

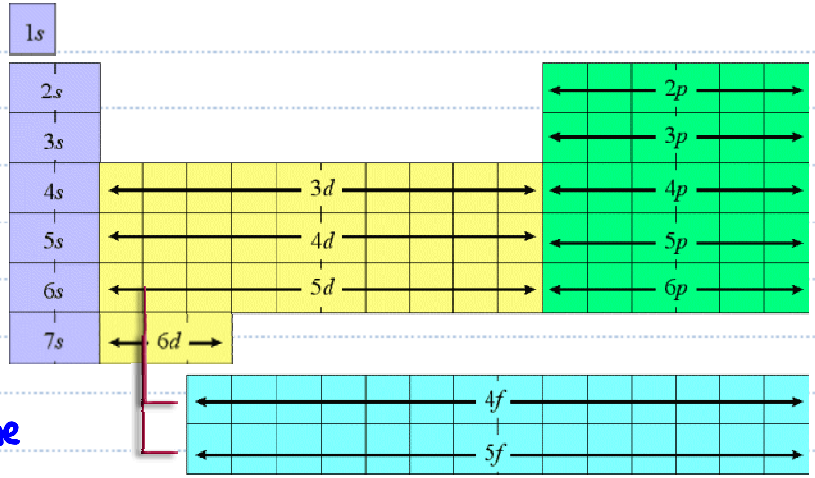
7.5 Electron Configuration of Ions

A: Cations – Transition Metals



7.5 Electron Configuration of Ions

A: Cations – Transition Metals



a) Write the configuration of the neutral metal.

b) Remove electrons from the largest n valued orbital ... in the case of choices (orbitals with the same n value) the order of removal is f, d, p, s.

Na^+:

Na : 11e⁻ ... $1s^2 2s^2 2p^6 3s^1$

Na^+ : 10e⁻ ... $1s^2 2s^2 2p^6$

Fe^{2+}:

Fe : 26e⁻ ... $[Ar] 4s^2 3d^6$

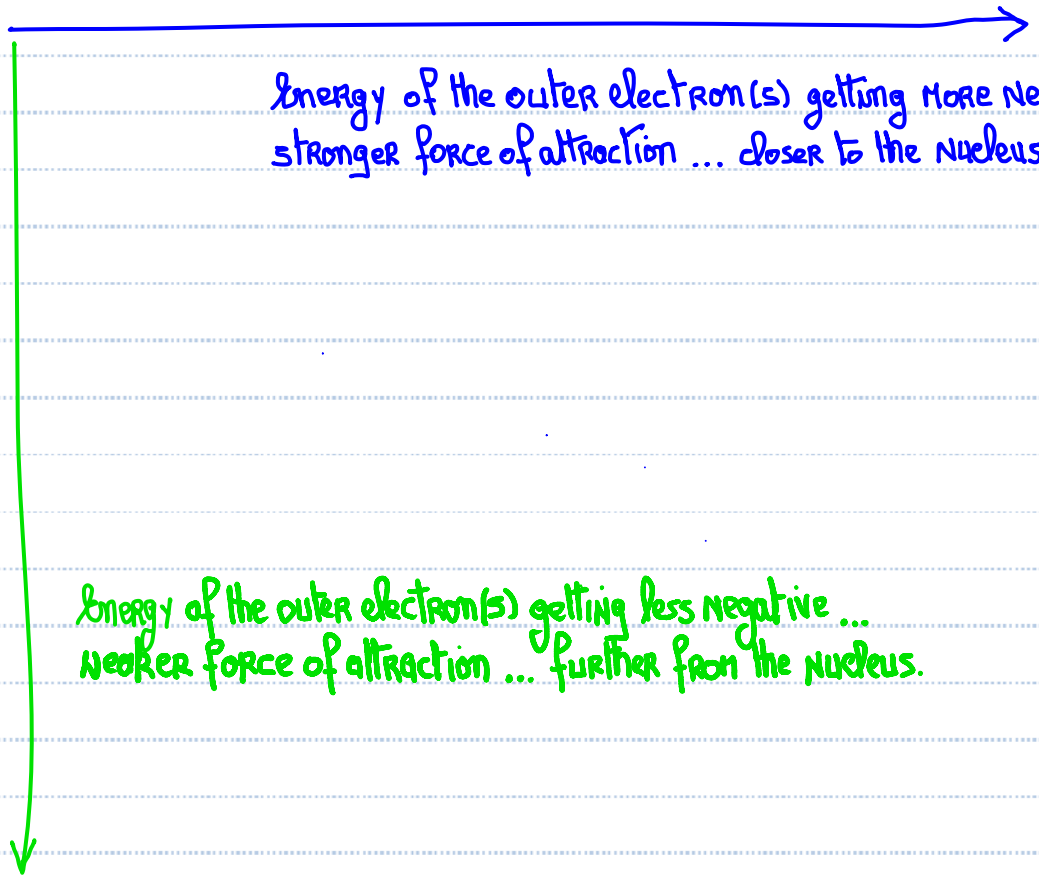
Fe^{2+} : 24e⁻ ... $[Ar] 3d^6$

7.4 Properties of Atoms

A: Trends in Orbital Energies

Go to class web site to interact with simulation.

Li	Be	B	C	N	O	F	Ne
3	4	5	6	7	8	9	10
6.94	9.01	10.81	12.01	14.01	16.00	19.00	20.18
Na							
11							
22.99							
K							
19							
39.10							
Rb							
37							
85.47							
Cs							
55							
132.91							
Fr							
87							
223.02							



Energy of the outer electron(s) getting more negative ...
stronger force of attraction ... closer to the nucleus.

Energy of the outer electron(s) getting less negative ...
weaker force of attraction ... further from the nucleus.

7.4 Properties of Atoms

B: Atomic Size

Li	Be	B	C	N	O	F	Ne
3	4	5	6	7	8	9	10
6.94	9.01	10.81	12.01	14.01	16.00	19.00	20.18
Na							
11							
22.99							
K							
19							
39.10							
Rb							
37							
85.47							
Cs							
55							
132.91							
Fr							
87							
223.02							

Size: Determined by the outermost electron(s). Distance from the outermost electron(s) to the nucleus.

7.4 Properties of Atoms

C: Ionization Energy – 1st Ionization Energy

Li	Be	B	C	N	O	F	Ne
3	4	5	6	7	8	9	10
6.94	9.01	10.81	12.01	14.01	16.00	19.00	20.18
Na							
11							
22.99							
K							
19							
39.10							
Rb							
37							
85.47							
Cs							
55							
132.91							
Fr							
87							
223.02							

Increasing ionization energy.

Decreasing ionization energy

The amount of energy required to remove the outermost electron (in the gas phase).

a) The closer the outermost electron is to the nucleus the more energy it takes to remove it.

b) The further away the outermost electron is from the nucleus the less energy it takes to remove it.

7.4 Properties of Atoms

D: Electron Affinity

Li	Be	B	C	N	O	F
3	4	5	6	7	8	9
6.94	9.01	10.81	12.01	14.01	16.00	19.00
Na						
11						
22.99						
K						
19						
39.10						
Rb						
37						
85.47						
Cs						
55						
132.91						
Fr						
87						
223.02						

← Missing?

Increasing electron affinity →

Decreasing electron affinity ↓

the attractive power an element has for an electron!

Where would a free electron like to reside?

A) Close to the nucleus

B) Furthest away from the nucleus