

## Announcements – Lecture X – Wednesday, June 4<sup>th</sup>

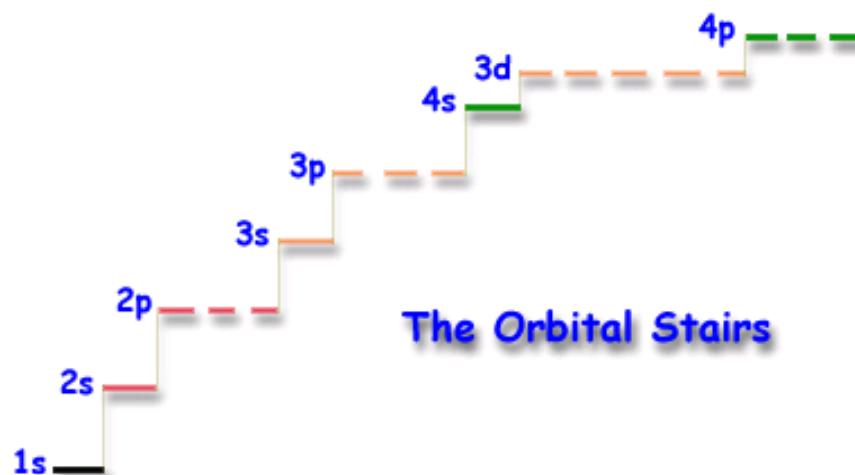
1. **Fourth Lab:** **Tuesday, June 10<sup>th</sup>, ISB 155 (A-C)**



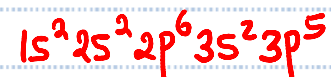
## Quiz 7

Class #: \_\_\_\_\_

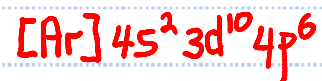
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1. Give the electronic configuration for **chlorine**.



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



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

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

**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.

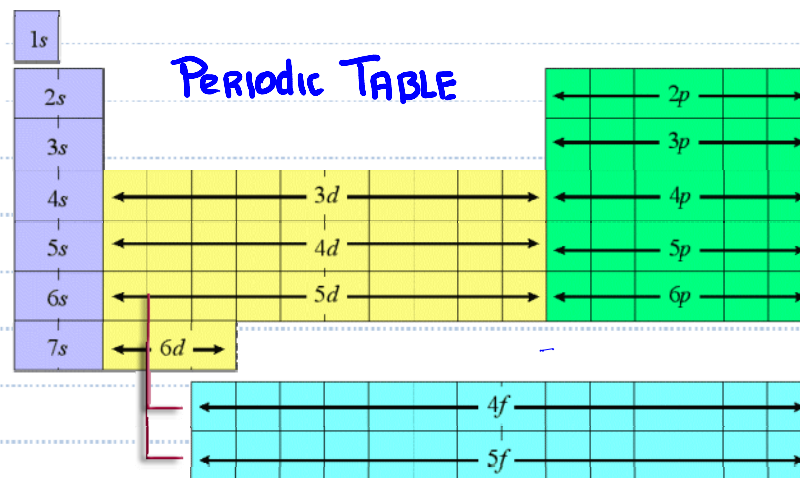
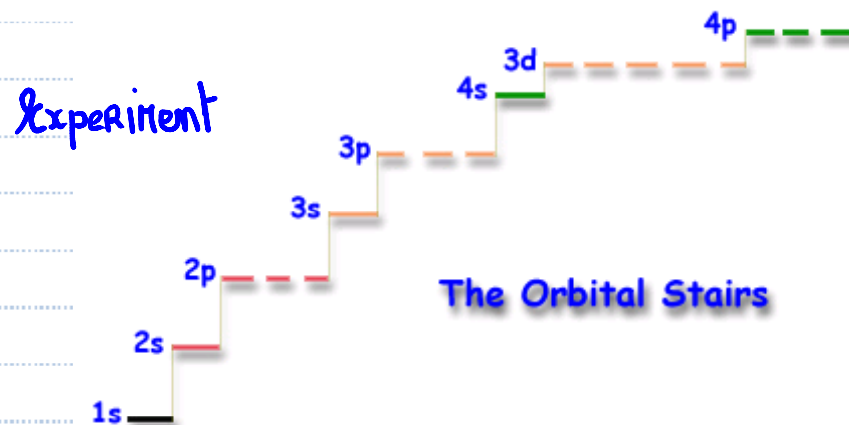
Element	#e-	Valence Configuration	Orbital Box	Magnetism
Li	3	[He]2s <sup>1</sup>	[He] ↑	<u>P</u>
Be	4	[He]2s <sup>2</sup>	[He] ↑↓	<u>D</u>
B	5	[He]2s <sup>2</sup> 2p <sup>1</sup>	[He] ↑↓    ↑    —    —	<u>P</u>
C	6	[He]2s <sup>2</sup> 2p <sup>2</sup>	[He] ↑↓    ↑    ↑    —	<u>P</u>
N	7	[He]2s <sup>2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

## 7.3 Electron Configuration of the Elements

### Cheats to Remember the Order of Filling

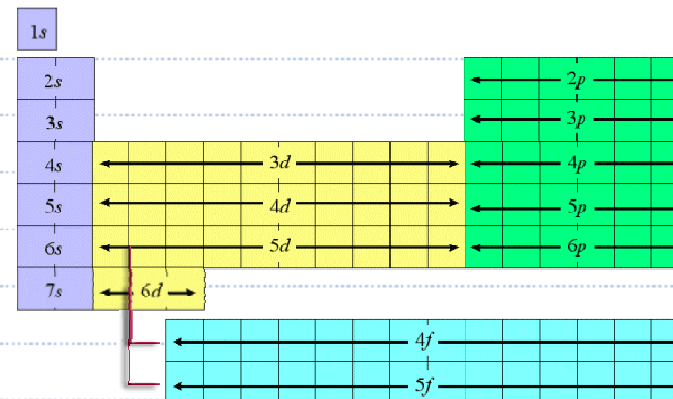
Diagonal method

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

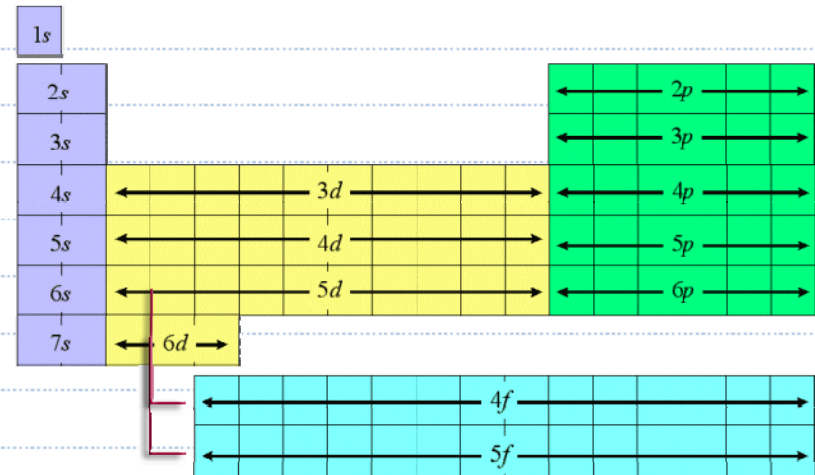
### Transition Metals



### Valence Configuration

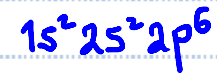
Element	#e-	Predicted Configuration	Actual Configuration
Sc	21	$[\text{Ar}] 4s^2 3d^1$	✓
Ti	22	$[\text{Ar}] 4s^2 3d^2$	✓
V	23	$[\text{Ar}] 4s^2 3d^3$	✓
Cr	24	$[\text{Ar}] 4s^2 3d^4$ X	$[\text{Ar}] 4s^1 3d^5$
Mn	25	$[\text{Ar}] 4s^2 3d^5$	✓
Fe	26	$[\text{Ar}] 4s^2 3d^6$	✓
Co	27	$[\text{Ar}] 4s^2 3d^7$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

## 7.5 Electron Configuration of Ions B: Anions

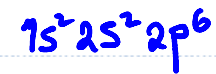


Add up the electrons and fill the orbitals based on the filling order given above.

$$\text{O}^{2-} : 8 + 2 = 10$$



$$\text{N}^{3-} : 7 + 3 = 10$$

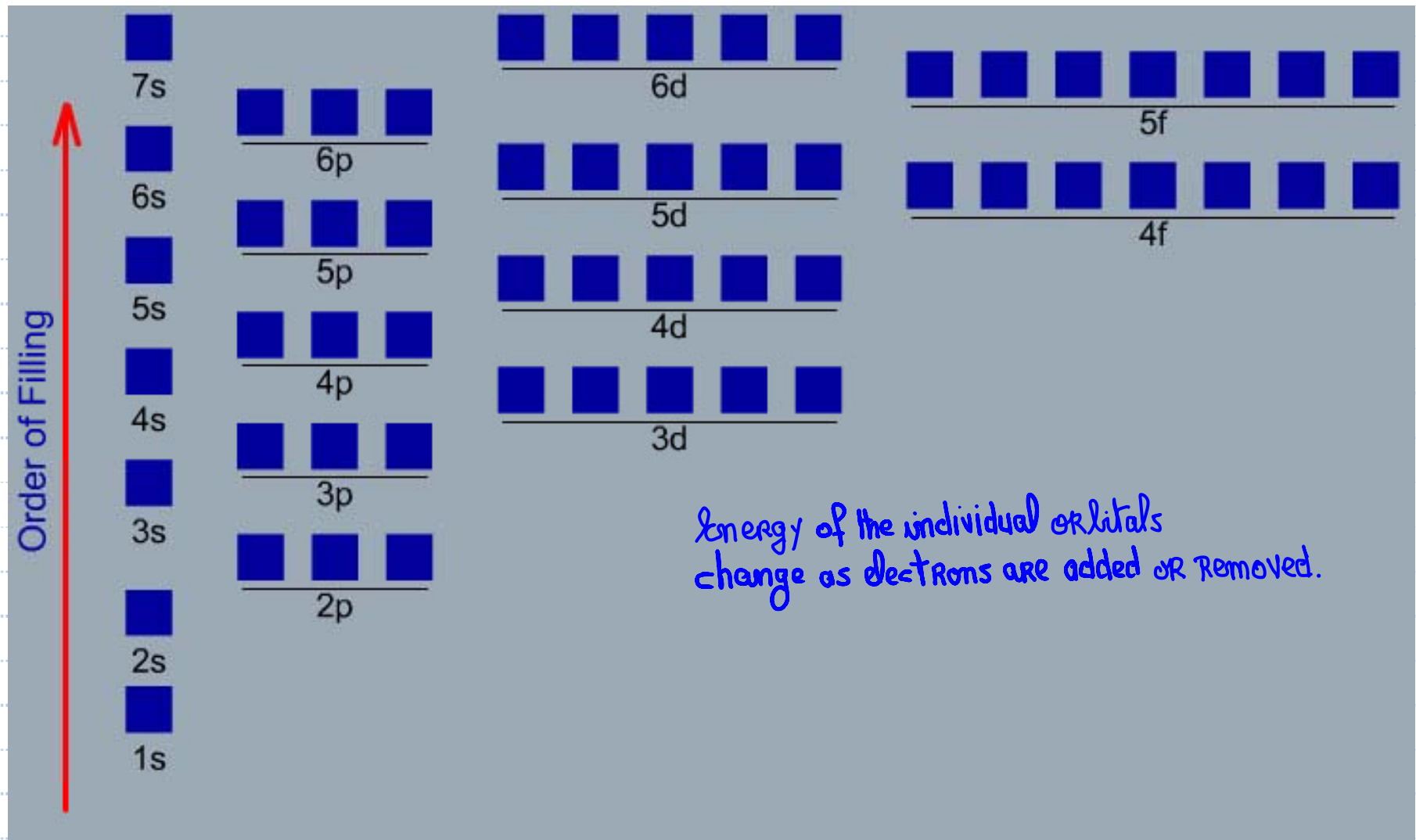


$$\text{Cl}^- : 17 + 1 = 18$$



## 7.5 Electron Configuration of Ions

### A: Cations – Transition Metals

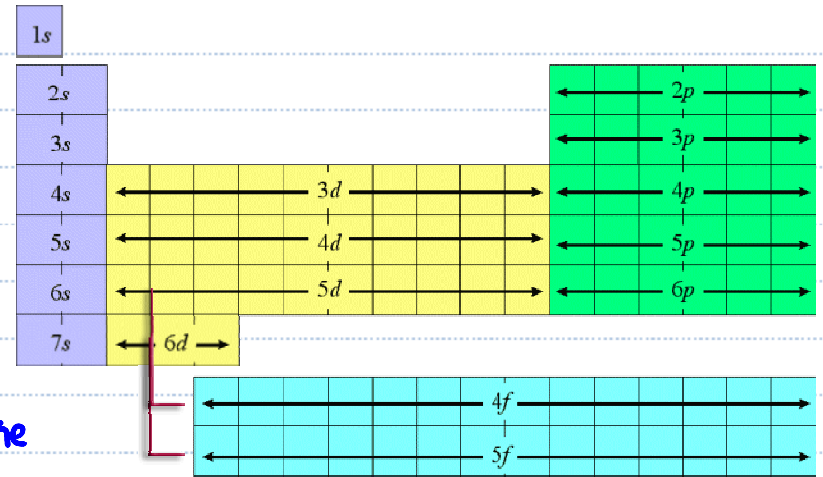




## 7.5 Electron Configuration of Ions A: Cations – Transition Metals

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  $f, d, p, s$ .



$\text{Na}^+$ :



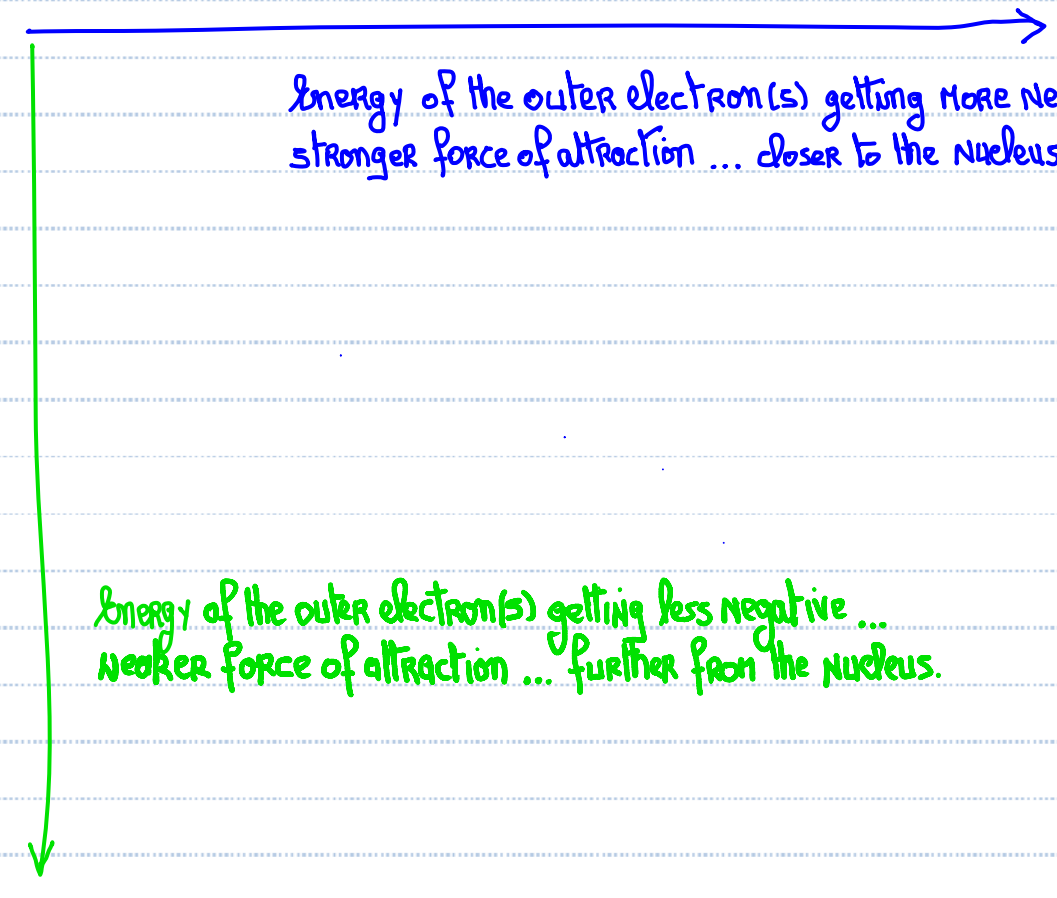
$\text{Fe}^{2+}$ :



## 7.4 Properties of Atoms

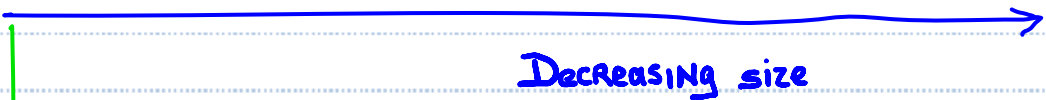

### A: Trends in Orbital Energies

Go to class web site to interact with simulation.

<b>Li</b> 3 6.94	<b>Be</b> 4 9.01	<b>B</b> 5 10.81	<b>C</b> 6 12.01	<b>N</b> 7 14.01	<b>O</b> 8 16.00	<b>F</b> 9 19.00	<b>Ne</b> 10 20.18
<b>Na</b> 11 22.99	 <p>Energy of the outer electron(s) getting more negative ... stronger force of attraction ... closer to the nucleus.</p> <p>Energy of the outer electron(s) getting less negative ... weaker force of attraction ... further from the nucleus.</p>						
<b>K</b> 19 39.10							
<b>Rb</b> 37 85.47							
<b>Cs</b> 55 132.91							
<b>Fr</b> 87 223.02							

## 7.4 Properties of Atoms

### B: Atomic Size

<b>Li</b> 3 6.94	<b>Be</b> 4 9.01	<b>B</b> 5 10.81	<b>C</b> 6 12.01	<b>N</b> 7 14.01	<b>O</b> 8 16.00	<b>F</b> 9 19.00	<b>Ne</b> 10 20.18
<b>Na</b> 11 22.99	 						
<b>K</b> 19 39.10							
<b>Rb</b> 37 85.47							
<b>Cs</b> 55 132.91							
<b>Fr</b> 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 – 1<sup>st</sup> Ionization Energy

<b>Li</b> 3 6.94	<b>Be</b> 4 9.01	<b>B</b> 5 10.81	<b>C</b> 6 12.01	<b>N</b> 7 14.01	<b>O</b> 8 16.00	<b>F</b> 9 19.00	<b>Ne</b> 10 20.18
<b>Na</b> 11 22.99	<p>Increasing ionization energy.</p> <p>The amount of energy required to remove the outermost electron (in the gas phase).</p> <p>a) The <b>closer</b> the outermost electron is to the nucleus the <b>more energy</b> it takes to remove it.</p> <p>b) The <b>further away</b> the outermost electron is from the nucleus the <b>less energy</b> it takes to remove it.</p>						
<b>K</b> 19 39.10							
<b>Rb</b> 37 85.47							
<b>Cs</b> 55 132.91							
<b>Fr</b> 87 223.02							

Decreasing ionization energy

## 7.4 Properties of Atoms

### D: Electron Affinity

Li 3 6.94	Be 4 9.01	B 5 10.81	C 6 12.01	N 7 14.01	O 8 16.00	F 9 19.00
Na 11 22.99	<p>← Increasing electron affinity</p> <p>the attractive power an element has for an electron!</p> <p>Where would a free electron like to reside?</p> <p>A) Close to the nucleus    :)</p> <p>B) Furthest away from the nucleus    :('</p> <p>Decreasing electron affinity</p>					
K 19 39.10						
Rb 37 85.47						
Cs 55 132.91						
Fr 87 223.02						

← Missing?