

Announcements – Lecture IX – Tuesday, June 2nd

1. Third Lab: Today, ISB 155B

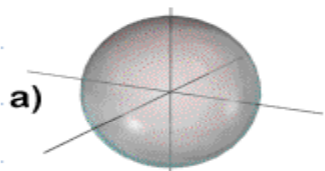


Quiz 6

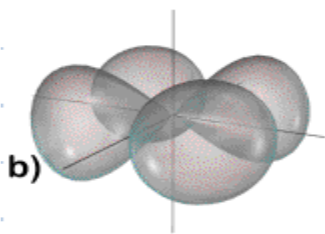
Class #: _____

Last Name: _____

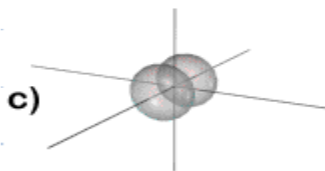
1. Label the orbitals depicted on the left as either s, p, d, f, or g.



s

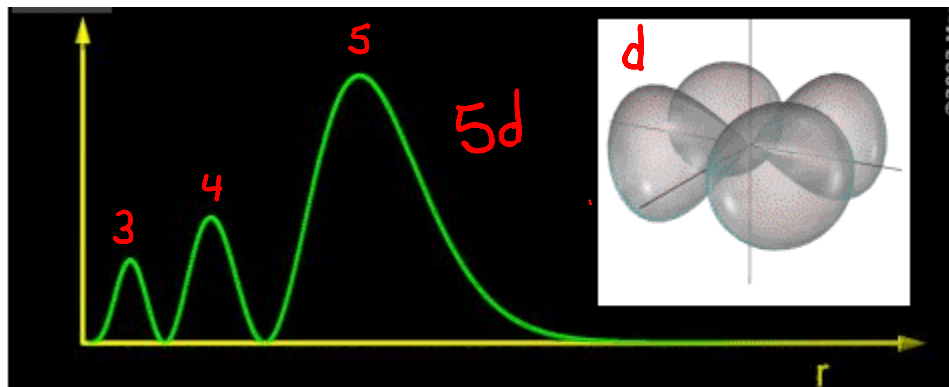


d



p

2. Label the orbital depicted below as either s, p, d, f, g – and give its correct n designation (ie 1, 2, 3, 4, 5, 6, 7, or 8)



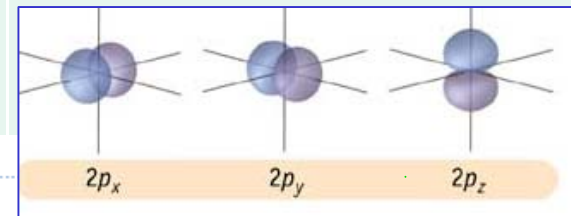
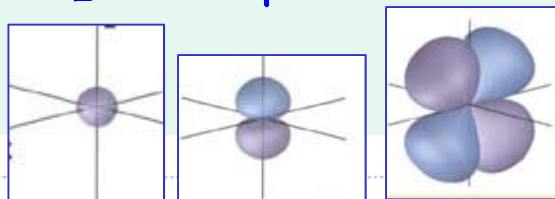
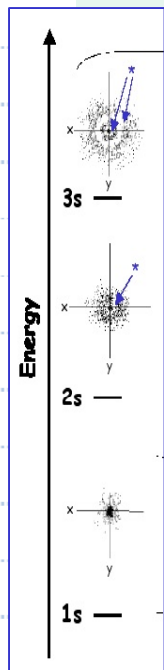
Schematic plot of the radial distribution function

6.5 Quantum Numbers, Orbitals, and Nodes

C: Quantum Numbers

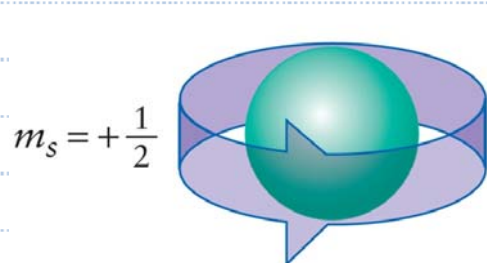
Each orbital (shape) described by 3 Quantum Numbers

n	l	m_l
Principal	Angular Momentum	Magnetic
Size	Shape	Orientation
<p>$n = 1, 2, 3 \dots$</p> <p>as $n \uparrow$, further away from the nucleus.</p> <p>Bigger!</p>	<p>limited by n</p> <p>$0, 1, \dots (n-1)$</p> <p>$l=0$ s</p> <p>$l=1$ p</p> <p>$l=2$ d</p>	<p>limited by l</p> <p>$-l, \dots 0 \dots, +l$</p> <p>x y z</p> <p>$2p_x$ $2p_y$ $2p_z$</p>

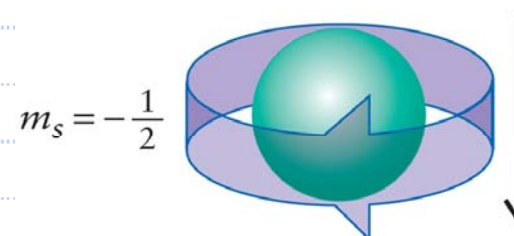


6.5 Quantum Numbers, Orbitals, and Nodes

Electron Spin



2 orientations
2 values for m_s



Align with field

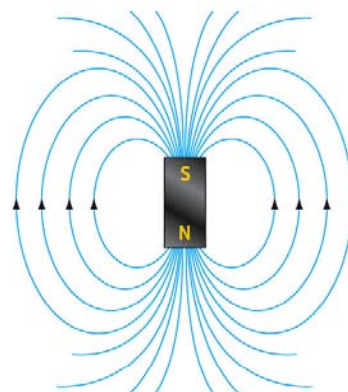
Align against field

Spin "up"

Spin "down"

$$m_s = +\frac{1}{2}$$

$$m_s = -\frac{1}{2}$$



(b) A bar magnet

6.5 Quantum Numbers, Orbitals, and Nodes

C: Quantum Numbers

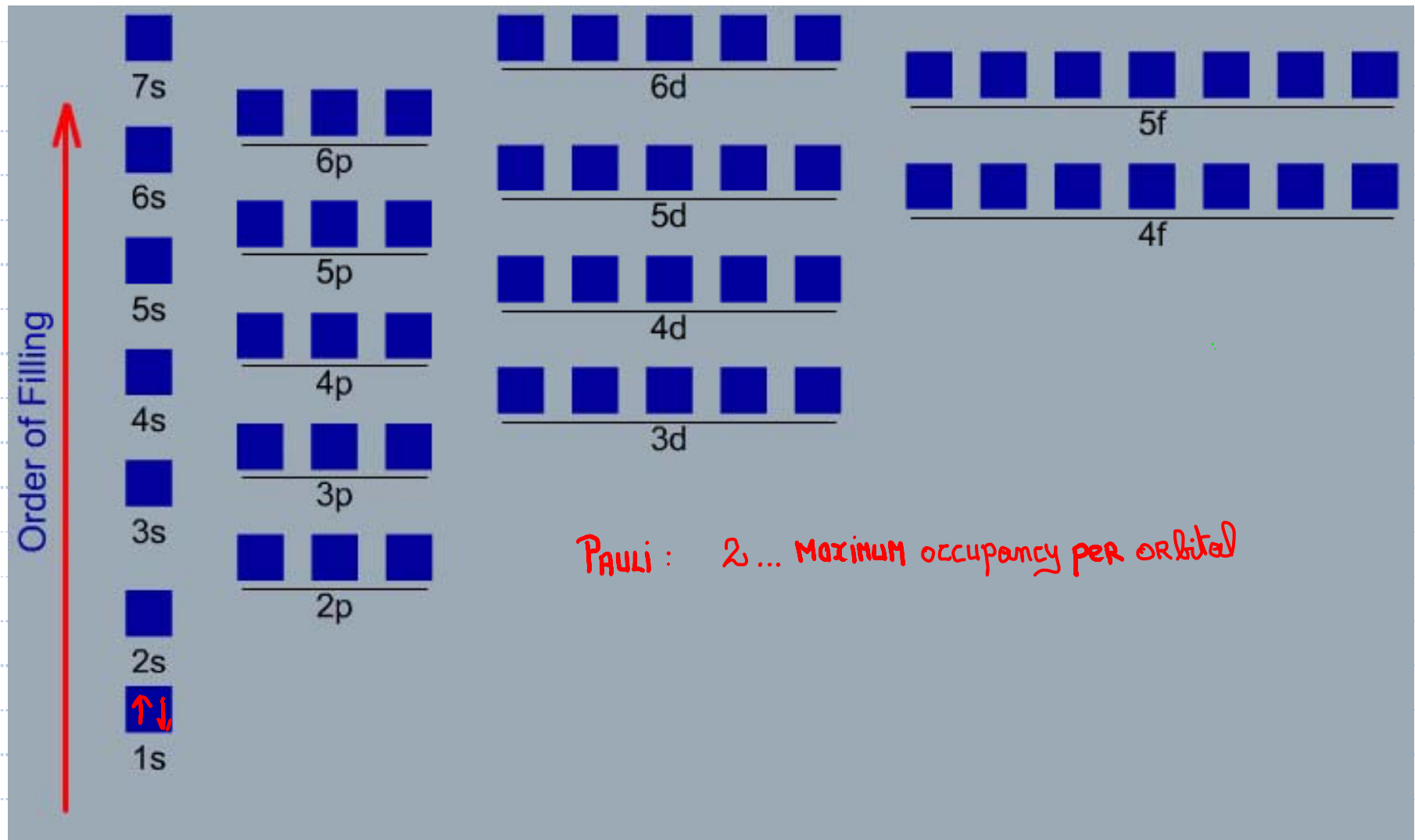
Each electron described by 4 Quantum Numbers.

n	l	m_l	m_s
Principal Q #	Angular Momentu Q #	Magnetic Q #	Spin Quantum Number
Size	Shape	Orientation	Electron orientation
$n = 1, 2, 3, \dots$	$l = 0, 1, \dots (n-1)$	$-l, \dots, 0, \dots, l$	$+\frac{1}{2}, -\frac{1}{2}$
			$\uparrow \quad \downarrow$

No two electrons can have the same 4 Quantum Numbers!

7.3 Electron Configuration of the Elements

A: The Pauli Exclusion Principle



7.3 Electron Configurations

B: spdf Notation

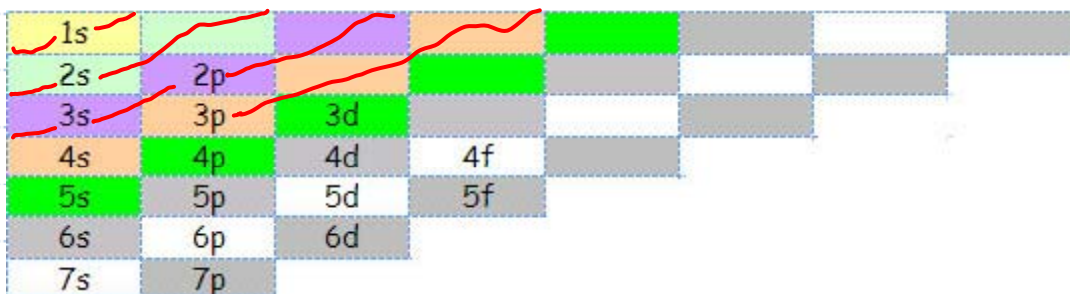
1s					
2s	2p				
3s	3p	3d			
4s	4p	4d	4f		
5s	5p	5d	5f		
6s	6p	6d			
7s	7p				

Element	#e-	Electronic Configuration	Valence Configuration	#Valence e-
H	1	$1s^1$		
He	2	$1s^2$		
Li	3	$1s^2 2s^1$		
Be	4	$1s^2 2s^2$		
B	5	$1s^2 2s^2 2p^1$		
C	6	$1s^2 2s^2 2p^2$		
N	7	$1s^2 2s^2 2p^3$		
O	8	$1s^2 2s^2 2p^4$		
F	9	$1s^2 2s^2 2p^5$		
Ne	10	$1s^2 2s^2 2p^6$		



7.3 Electron Configurations

B: spdf Notation



Element	#e-	Electronic Configuration	Valence Configuration	#Valence e-
Na	11	$1s^2 2s^2 2p^6 3s^1$		
Mg	12	$1s^2 2s^2 2p^6 3s^2$		
Al	13	$1s^2 2s^2 2p^6 3s^2 3p^1$		
Si	14	$1s^2 2s^2 2p^6 3s^2 3p^2$		
P	15	$1s^2 2s^2 2p^6 3s^2 3p^3$		
S	16	$1s^2 2s^2 2p^6 3s^2 3p^4$		
Cl	17	$1s^2 2s^2 2p^6 3s^2 3p^5$		
Ar	18	$1s^2 2s^2 2p^6 3s^2 3p^6$		

7.3 Electron Configurations

B: Valence Notation

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

Element	#e-	Electronic Configuration	Valence Configuration	#Valence e-
H	1	$1s^1$	$1s^1$	
He	2	$1s^2$	$1s^2$	
Li	3	$1s^2 2s^1$	$[He] 2s^1$	
Be	4	$1s^2 2s^2$	$[He] 2s^2$	
B	5	$1s^2 2s^2 2p^1$	$[He] 2s^2 2p^1$	
C	6	$1s^2 2s^2 2p^2$	$[He] 2s^2 2p^2$	
N	7	$1s^2 2s^2 2p^3$	$[He] 2s^2 2p^3$	
O	8	$1s^2 2s^2 2p^4$	$[He] 2s^2 2p^4$	
F	9	$1s^2 2s^2 2p^5$	$[He] 2s^2 2p^5$	
Ne	10	$1s^2 2s^2 2p^6$	$[He] 2s^2 2p^6$	



7.3 Electron Configurations B: Valence Notation

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

Element	#e-	Electronic Configuration	Valence Configuration	#Valence e-
Na	11	$1s^2 2s^2 2p^6 3s^1$	$[\text{Ne}] 3s^1$	1
Mg	12	$1s^2 2s^2 2p^6 3s^2$	$[\text{Ne}] 3s^2$	2
Al	13	$1s^2 2s^2 2p^6 3s^2 3p^1$	$[\text{Ne}] 3s^2 3p^1$	3
Si	14	$1s^2 2s^2 2p^6 3s^2 3p^2$	$[\text{Ne}] 3s^2 3p^2$	4
P	15	$1s^2 2s^2 2p^6 3s^2 3p^3$	$[\text{Ne}] 3s^2 3p^3$	5
S	16	$1s^2 2s^2 2p^6 3s^2 3p^4$	$[\text{Ne}] 3s^2 3p^4$	6
Cl	17	$1s^2 2s^2 2p^6 3s^2 3p^5$	$[\text{Ne}] 3s^2 3p^5$	7
Ar	18	$1s^2 2s^2 2p^6 3s^2 3p^6$	$[\text{Ne}] 3s^2 3p^6$	8

7.3 Electron Configurations

B: # Valence e-

MAIN GROUP:

electrons in the highest n orbitals

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

Element	#e-	Electronic Configuration	Valence Configuration	#Valence e-
H	1	$1s^1$	$1s^1$	<u>1</u>
He	2	$1s^2$	$1s^2$	<u>2</u>
Li	3	$1s^2 2s^1$	$[He]2s^1$	<u>1</u>
Be	4	$1s^2 2s^2$	$[He]2s^2$	<u>2</u>
B	5	$1s^2 2s^2 2p^1$	$[He]2s^2 2p^1$	<u>3</u>
C	6	$1s^2 2s^2 2p^2$	$[He]2s^2 2p^2$	<u>4</u>
N	7	$1s^2 2s^2 2p^3$	$[He]2s^2 2p^3$	<u>5</u>
O	8	$1s^2 2s^2 2p^4$	$[He]2s^2 2p^4$	<u>6</u>
F	9	$1s^2 2s^2 2p^5$	$[He]2s^2 2p^5$	<u>7</u>
Ne	10	$1s^2 2s^2 2p^6$	$[He]2s^2 2p^6$	<u>8</u>



7.3 Electron Configurations

B: # Valence e-

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

Element	#e-	Electronic Configuration	Valence Configuration	#Valence e-
Na	11	$1s^2 2s^2 2p^6 3s^1$	$[\text{Ne}]3s^1$	<u>1</u>
Mg	12	$1s^2 2s^2 2p^6 3s^2$	$[\text{Ne}]3s^2$	<u>2</u>
Al	13	$1s^2 2s^2 2p^6 3s^2 3p^1$	$[\text{Ne}]3s^2 3p^1$	<u>3</u>
Si	14	$1s^2 2s^2 2p^6 3s^2 3p^2$	$[\text{Ne}]3s^2 3p^2$	<u>4</u>
P	15	$1s^2 2s^2 2p^6 3s^2 3p^3$	$[\text{Ne}]3s^2 3p^3$	<u>5</u>
S	16	$1s^2 2s^2 2p^6 3s^2 3p^4$	$[\text{Ne}]3s^2 3p^4$	<u>6</u>
Cl	17	$1s^2 2s^2 2p^6 3s^2 3p^5$	$[\text{Ne}]3s^2 3p^5$	<u>7</u>
Ar	18	$1s^2 2s^2 2p^6 3s^2 3p^6$	$[\text{Ne}]3s^2 3p^6$	<u>8</u>

7.3 Electron Configurations of the Elements

D: Electron Configurations and the Periodic Table

GROUP 2A ... preferred charge, +2

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

Element	#e-	Electronic Configuration	Valence Configuration	#Valence e-
Be	4		[He]2s ²	<u>2</u>
Mg	12		[Ne]3s ²	<u>2</u>
Ca	20		[Ar]4s ²	<u>2</u>
Sr	38		[Kr]5s ²	<u>2</u>

7.3 Electron Configurations of the Elements

D: Electron Configurations and the Periodic Table

Group 6A ... preferred charge, -2

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

Element	#e-	Electronic Configuration	Valence Configuration	#Valence e-
O	8		$[\text{He}]2s^2 2p^4$	<u>6</u>
S	16		$[\text{Ne}] 3s^2 3p^4$	<u>6</u>
Se	34		$[\text{Ar}]4s^2 3d^{10}4p^4$	<u>6</u>
Te	52		$[\text{Kr}]5s^2 4d^{10}5p^4$	<u>6</u>

7.3 Electron Configurations of the Elements

D: Electron Configurations and the Periodic Table – Group 8A

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

Element	#e-	Electronic Configuration	Valence Configuration	#Valence e-
He	2		$1s^2$	<u>2</u>
Ne	10		$[\text{He}]2s^2 2p^6$	<u>8</u>
Ar	18		$[\text{Ne}]3s^2 3p^6$	<u>8</u>
Kr	36		$[\text{Ar}]4s^2 3d^{10} 4p^6$	<u>8</u>
Xe	54		$[\text{Kr}]5s^2 4d^{10} 5p^6$	<u>8</u>
Rn	86		$[\text{Xe}]6s^2 5d^{10} 4f^{14} 6p^6$	<u>8</u>