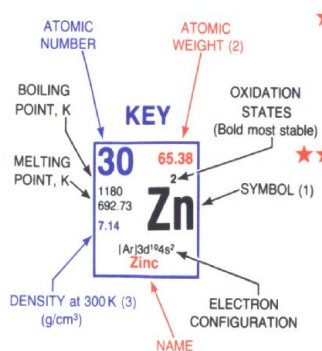


Understanding the Periodic Table



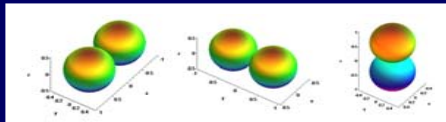
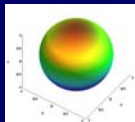
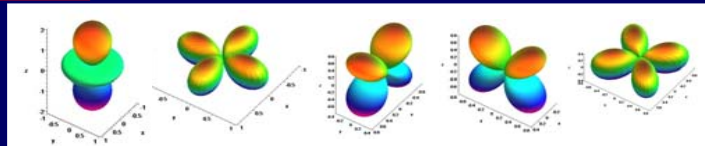
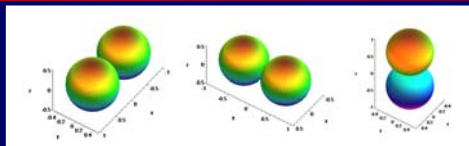
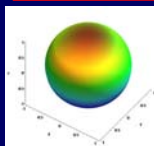
PERIODIC TABLE OF THE ELEMENTS

58140.12 3699 1071 6.78 Ce [Xe]4f¹5d¹6s² Cerium	59140.9077 3785 1204 6.77 Pr [Xe]4f³6s² Praseodymium	60144.24 3341 1289 7.00 Nd [Xe]4f⁴6s² Neodymium	61(145) 3785 1204 6.475 Pm [Xe]4f⁵6s² Promethium	62150.4 2064 1345 7.54 Sm [Xe]4f⁶6s² Samarium	63151.96 1870 1090 5.26 Eu [Xe]4f⁷6s² Europium	64157.25 3539 1585 7.89 Gd [Xe]4f⁷5d¹6s² Gadolinium	65158.9254 3496 1630 8.27 Tb [Xe]4f⁹6s² Terbium	66162.50 2835 1682 8.54 Dy [Xe]4f¹⁰6s² Dysprosium	67164.9304 2968 1743 8.80 Ho [Xe]4f¹¹6s² Holmium	68167.26 3136 1795 9.05 Er [Xe]4f¹²6s² Erbium	69168.9342 2220 1818 9.33 Tm [Xe]4f¹³6s² Thulium	70173.04 1467 1097 6.98 Yb [Xe]4f¹⁴6s² Ytterbium	71174.967 3668 1936 9.84 Lu [Xe]4f¹⁴5d¹6s² Lutetium
90232.0381 5061 2028 11.7 Th [Rn]5d³7s² Thorium	91231.0359 4407 1405 15.4 Pa [Rn]5f²6d¹7s² Protactinium	92238.029 4407 1405 18.90 U [Rn]5f³6d¹7s² Uranium	93237.0482 910 1405 20.4 Np [Rn]5f⁴6d¹7s² Neptunium	94(244) 3503 913 19.8 Pu [Rn]5f⁶7s² Plutonium	95(243) 2880 1266 13.6 Am [Rn]5f⁷7s² Americium	96(247) 1340 13.51 Cm [Rn]5f⁸6d¹7s² Curium	97(247) 1340 13.51 Bk [Rn]5f⁹7s² Berkelium	98(251) 900 Cf [Rn]5f¹⁰7s² Californium	99(252) 900 Es [Rn]5f¹¹7s² Einsteinium	100(257) 900 Fm [Rn]5f¹²7s² Fermium	101(258) 900 Md [Rn]5f¹³7s² Mendelevium	102(259) 900 No [Rn]5f¹⁴7s² Nobelium	103(260) 900 Lr [Rn]5f¹⁴6d¹7s² Lawrencium



$n=4$
 $n=3$
 $n=2$

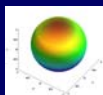
$n=5$



$$n = 1, 2, 3, \dots$$

$$l \leq n - 1$$

$$m = l, l - 1, l - 2, \dots, -l$$



$n=1$

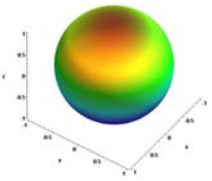
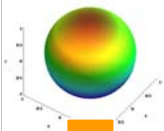
Energy levels (n, l, m) in the hydrogen atom

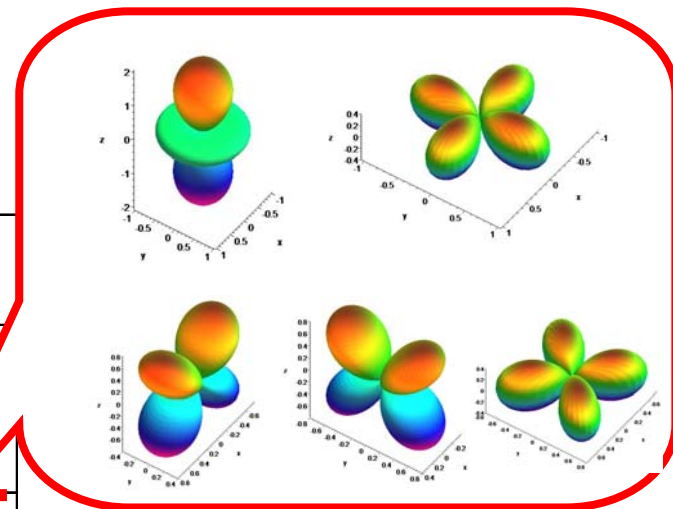
n	ϵ_n (eV)	$l=0$	$l=1$	$l=2$	$l=3$	$l=....$	degeneracy
n							n^2
..							
4	$\epsilon_4 = -0.85$	4s	4p	4d	4f		$1+3+5+7 = 16$
3	$\epsilon_3 = -1.51$	3s	3p	3d			$1+3+5 = 9$
2	$\epsilon_2 = -3.40$	2s	2p				$1+3 = 4$
1	$\epsilon_1 = -13.6$	1s					1

$$n = 1, 2, 3, \dots$$

$$l \leq n - 1$$

$$m = l, l - 1, l - 2, \dots, -l$$

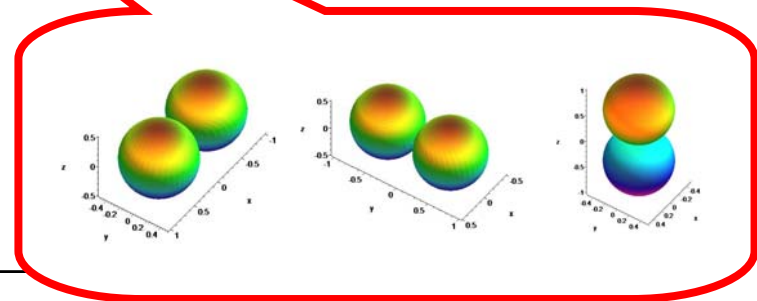
n	ϵ_n (eV)	$l=0$	$l=1$	$l=2$
n				
..				
4	$\epsilon_4 = -0.85$	4s 	4p 	4d 
3	$\epsilon_3 = -1.51$	3s 	3p 	3d
2	$\epsilon_2 = -3.40$	2s   	2p 	
1	$\epsilon_1 = -13.6$	1s 		



$$n = 1, 2, 3, \dots$$

$$l \leq n - 1$$

$$m = l, l - 1, l - 2, \dots, -l$$



Why $1s^2 2s^2 p^4$?

						VIII
IIIB		IVB	VB	VIB	VIIB	
5 4275 2300 2.34 B $1s^2 2s^2 p^1$ Boron	6 4470* 4100* 2.62 C $1s^2 2s^2 p^2$ Carbon	7 77.35 63.14 1.251* N $1s^2 2s^2 p^3$ Nitrogen	8 90.1 50.35 1.429* O $1s^2 2s^2 p^4$ Oxygen	9 84.95 53.48 1.696* F $1s^2 2s^2 p^5$ Fluorine	10 27.096 24.553 0.901* Ne $1s^2 2s^2 p^6$ Neon	2 4.00260 4.215 0.95 (at 26 atm) 0.1787* He $1s^2$ Helium
13 2793 933.25 2.70 Al [Ne]3s ² p ¹ Aluminum	14 3540 1685 2.33 Si [Ne]3s ² p ² Silicon	15 550 317.30 1.82 P [Ne]3s ² p ³ Phosphorus	16 717.75 388.36 2.07 S [Ne]3s ² p ⁴ Sulfur	17 239.1 172.16 3.17* Cl [Ne]3s ² p ⁵ Chlorine	18 87.30 83.81 1.784* Ar [Ne]3s ² p ⁶ Argon	

No more than
2 electrons per
state

Pauli
exclusion
principle



Energy levels in an H-like atom

$$m \frac{v^2}{r} = \frac{e (Ze)}{4\pi\epsilon_0 r^2}$$

$$E = \frac{1}{2}mv^2 - \frac{Ze^2}{4\pi\epsilon_0 r} = -\frac{Ze^2}{8\pi\epsilon_0 r}$$

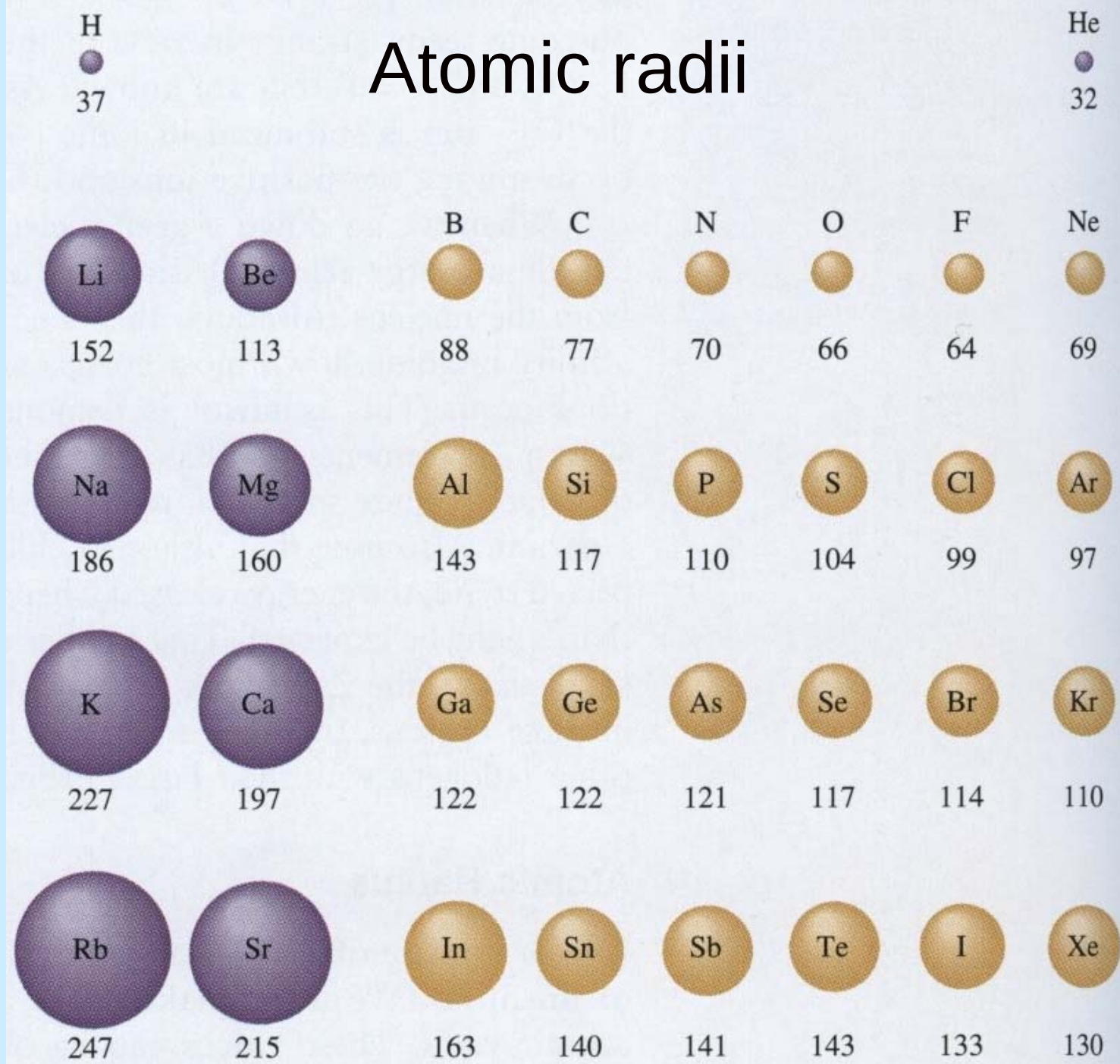
$$E_n = -\frac{mZ^2e^4}{2(4\pi\epsilon_0)^2\hbar^2} \frac{1}{n^2}$$

$$2\pi r = n\lambda$$

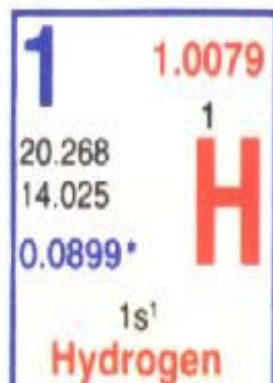
$$r_n = \frac{4\pi\epsilon_0\hbar^2}{mZe^2} n^2$$

Quantum
physics

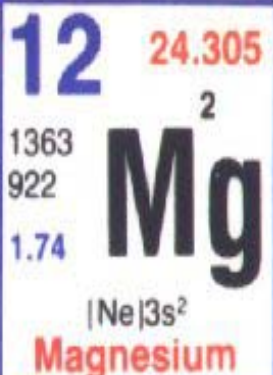
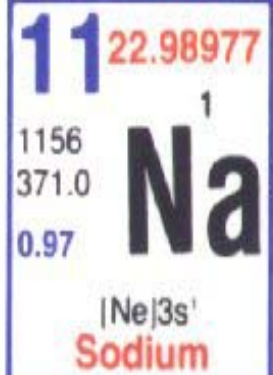
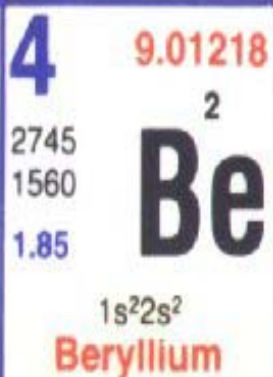
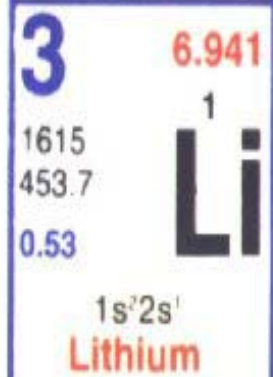
Atomic radii



GROUP IA



IIA



IIIA

IVA

VA

VIA

V

$l=0$	$l=1$	$l=2$
4s 	4p 	4d 
3s 	3p 	3d
2s	2p	
1s 		



1s

$l=0$	$l=1$	$l=2$
4s 	4p 	4d 
3s 	3p 	3d
2s	2p	
1s 		

He

$1s^2$

VIII

2 4.00260
 4.215
 0.95
 (at 26 atm)
 0.1787* **He**

 $1s^2$

Helium

IIIB

IVB

VB

VIB

VIIB

5 10.81
 4275
 2300
 2.34
B

 $1s^2 2s^2 p^1$

Boron

6 12.011
 4470*
 4100*
 2.62
C

 $1s^2 2s^2 p^2$

Carbon

7 14.0067
 77.35
 63.14
 1.251*
N

 $1s^2 2s^2 p^3$

Nitrogen

8 15.9994
 90.18
 50.35
 1.429*
O

 $1s^2 2s^2 p^4$

Oxygen

9 18.998403
 84.95
 53.48
 1.696*
F

 $1s^2 2s^2 p^5$

Fluorine

10 20.179
 27.096
 24.553
 0.901*
Ne

 $1s^2 2s^2 p^6$

Neon

13 26.98154
 2793
 933.25
 2.70
Al

 $[\text{Ne}] 3s^2 p^1$

Aluminum

14 28.0855
 3540
 1685
 2.33
Si

 $[\text{Ne}] 3s^2 p^2$

Silicon

15 30.97376
 550
 317.30
 1.82
P

 $[\text{Ne}] 3s^2 p^3$

Phosphorus

16 32.06
 717.75
 388.36
 2.07
S

 $[\text{Ne}] 3s^2 p^4$

Sulfur

17 35.453
 239.1
 172.16
 3.17*
Cl

 $[\text{Ne}] 3s^2 p^5$

Chlorine

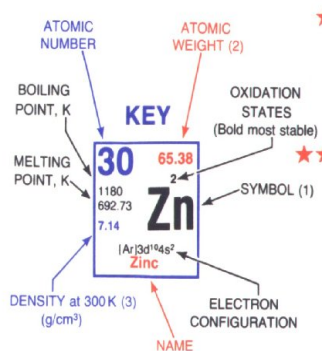
18 39.948
 87.30
 83.81
 1.784*
Ar

 $[\text{Ne}] 3s^2 p^6$

Argon

PERIODIC TABLE OF THE ELEMENTS

58140.12Ce3,4369910716.78[Xe]4f ¹ 5d ¹ 6s ² Cerium	59140.9077Pr3,4378512046.77[Xe]4f ³ 6s ² Praseodymium	60144.24Nd3334112897.00[Xe]4f ⁴ 6s ² Neodymium	61(145)Pm3378512046.475[Xe]4f ⁵ 6s ² Promethium	62150.4Sm3,2206413457.54[Xe]4f ⁶ 6s ² Samarium	63151.96Eu3,2187010905.26[Xe]4f ⁷ 6s ² Europium	64157.25Gd3353915857.89[Xe]4f ⁷ 5d ¹ 6s ² Gadolinium	65158.9254Tb3,4349616308.27[Xe]4f ⁸ 6s ² Terbium	66162.50Dy3283516828.54[Xe]4f ⁹ 6s ² Dysprosium	67164.9304Ho3296817438.80[Xe]4f ¹⁰ 6s ² Holmium	68167.26Er3313617959.05[Xe]4f ¹¹ 6s ² Erbium	69168.9342Tm3,2222018189.33[Xe]4f ¹² 6s ² Thulium	70173.04Yb3,2146710976.98[Xe]4f ¹⁴ 6s ² Ytterbium	71174.967Lu3366819369.84[Xe]4f ¹⁴ 5d ¹ 6s ² Lutetium
90232.0381Th45061202811.7[Rn]5f ⁷ 7s ² Thorium	91231.0359Pa5,44407140515.4[Rn]5f ⁶ 7s ² Protactinium	92238.029U6,5,4,34407140518.90[Rn]5f ⁶ 7s ² Uranium	93237.0482Np6,5,4,391020.4[Rn]5f ⁶ 7s ² Neptunium	94(244)Pu6,5,4,3350391319.8[Rn]5f ⁷ 7s ² Plutonium	95(243)Am6,5,4,32880126613.6[Rn]5f ⁷ 7s ² Americium	96(247)Cm3134013.51[Rn]5f ⁶ 7s ² Curium	97(247)Bk4,3900[Rn]5f ⁷ 7s ² Berkelium	98(251)Cf(251)900[Rn]5f ¹⁰ 7s ² Californium	99(252)Es(252)900[Rn]5f ¹¹ 7s ² Einsteinium	100(257)Fm(257)900[Rn]5f ¹² 7s ² Fermium	101(258)Md(258)900[Rn]5f ¹³ 7s ² Mendelevium	102(259)No(259)900[Rn]5f ¹⁴ 7s ² Nobelium	103(260)Lr(260)900[Rn]5f ¹⁴ 6d ¹ 7s ² Lawrencium



$l=0$	$l=1$	$l=2$
4s 	4p 	4d 
3s 	3p 	3d
2s	2p	
1s 		

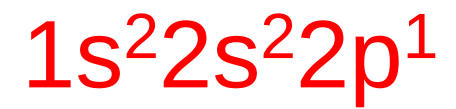
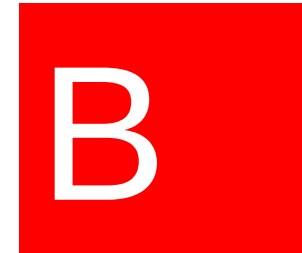


$l=0$	$l=1$	$l=2$
4s 	4p 	4d 
3s 	3p 	3d 
2s 	2p 	
1s 		

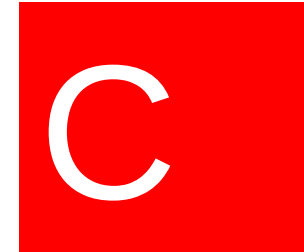
Be

$1s^2 2s^2$

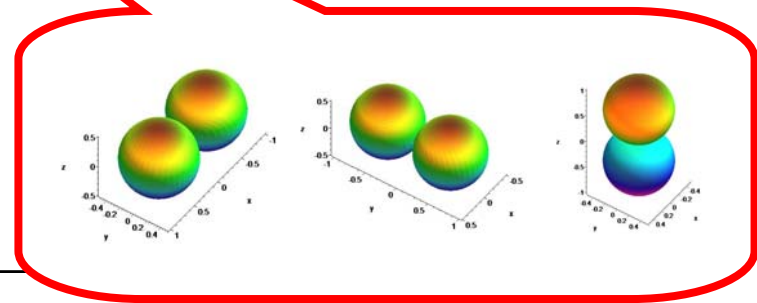
$l=0$	$l=1$	$l=2$
4s 	4p 	4d 
3s 	3p 	3d
2s 	2p	
1s 		



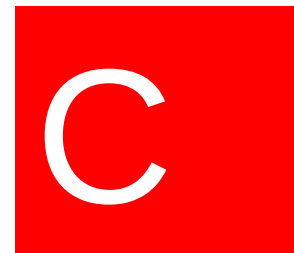
Is this the
best
possibility ?



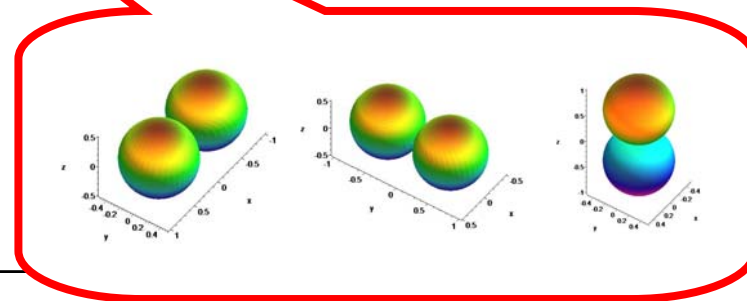
4s	4p	4d
3s	3p	3d
2s	2p	
1s		



$l=0$	$l=1$	$l=2$
4s 	4p 	4d 
3s	3p	3d
		
2s	2p	
1s 		



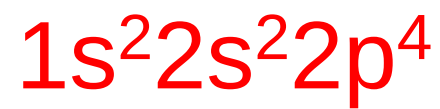
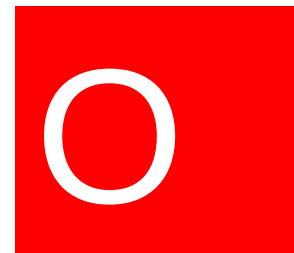
$1s^2 2s^2 2p^2$



$l=0$	$l=1$	$l=2$
4s 	4p 	4d 
3s 	3p 	3d 
2s 	2p 	
1s 		



$l=0$	$l=1$	$l=2$
4s 	4p 	4d 
3s 	3p 	3d 
2s 	2p 	
1s 		

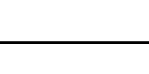


Now you know
why it is
 $1s^2 2s^2 p^4$

						VIII
						2 4.00260 4.215 0.95 (at 26 atm) 0.1787* He $1s^2$ Helium
IIIB	IVB	V	VIB	VIIB		
5 10.81 4275 2300 2.34 B $1s^2 2s^2 p^1$ Boron	6 12.011 4470* 4100* 2.62 C $1s^2 2s^2 p^2$ Carbon	7 14.006 77.35 63.14 1.251* N $1s^2 2s^2 p^3$ Nitrogen	8 15.9994 90.08 50.3 1.429* O $1s^2 2s^2 p^4$ Oxygen	9 18.998403 84.95 53.48 1.696* F $1s^2 2s^2 p^5$ Fluorine	10 20.179 27.096 24.553 0.901* Ne $1s^2 2s^2 p^6$ Neon	
13 26.98154 2793 933.25 2.70 Al [Ne]3s ² p ¹ Aluminum	14 28.0855 3540 1685 2.33 Si [Ne]3s ² p ² Silicon	15 30.97376 550 317.30 1.82 P [Ne]3s ² p ³ Phosphorus	16 32.06 717.75 388.36 2.07 S [Ne]3s ² p ⁴ Sulfur	17 35.453 239.1 172.16 3.17* Cl [Ne]3s ² p ⁵ Chlorine	18 39.948 87.30 83.81 1.784* Ar [Ne]3s ² p ⁶ Argon	

$l=0$	$l=1$	$l=2$
4s 	4p 	4d 
3s 	3p 	3d 
2s 	2p 	
1s 		



$l=0$	$l=1$	$l=2$
4s 	4p 	4d 
3s 	3p 	3d 
2s 	2p 	
1s 		

Ne



GROUP
IA

1 1.0079
20 268
14.025
0.0899*
1s¹
Hydrogen

IIA

3 6.941 4 9.01218
1615 1 2745 2
453.7 Li Be
0.53 1.85
1s²2s¹ 1s²2s²
Lithium Beryllium

11 22.98977 12 24.305
1156 1 1363 2
371.0 Na Mg
0.97 1.74
[Ne]3s¹ [Ne]3s²
Sodium Magnesium

19 39.0983 20 40.08
1032 1 1757 2
336.35 K Ca
0.86 1.55
[Ar] 4s¹ [Ar]4s²
Potassium Calcium

37 85.4678 38 87.62
961 1 1650 2
312.64 Rb Sr
1.53 2.6
[Kr]5s¹ [Kr]5s²
Rubidium Strontium

55 132.9054 56 137.33
944 1 2171 2
301.55 Cs Ba
1.87 3.5
[Xe]6s¹ [Xe]6s²
Cesium Barium

87 (223) 88 226.0254 89 227.0278
950 1 1809 2 3473 3
300 Fr Ra Ac
— 5 10.07
[Rn]7s¹ [Rn]7s² [Rn]6d⁷7s²
Francium Radium Actinium

104 (261) 105 (262) 106 (263)
Unq Unp Unh
[Rn]5f¹⁴6d⁷7s² [Rn]5f¹⁴6d⁷7s² [Rn]5f¹⁴6d⁷7s²
(Unnilquadium) (Unnilpentium) (Unnilhexium)

30 65.38
1180 2
692.73 Zn
7.14
[Ar]3d¹⁰4s²
Zinc

ATOMIC NUMBER
ATOMIC WEIGHT (2)
BOILING POINT, K
MELTING POINT, K
DENSITY at 300 K (3)
(g/cm³)
ELECTRON CONFIGURATION
NAME

PERIODIC TABLE OF THE ELEMENTS

VIII

2 4.00260
4 215
0.95
0.1787*
1s²
Helium

5 10.81 6 12.011 7 14.0067 8 15.9994 9 18.998403 10 20.179
4275 1 4470* 2 77.35 3 84.95 4 84.95 5 27.096
2300 B C N O F Ne
2.34 2.62 1.251* 1.429* 1.696* 0.901*
1s²2s²p¹ 1s²2s²p² 1s²2s²p³ 1s²2s²p⁴ 1s²2s²p⁵ 1s²2s²p⁶
Boron Carbon Nitrogen Oxygen Fluorine Neon

13 26.98154 14 28.0855 15 30.97376 16 32.06 17 35.453 18 39.948
2793 3 3540 4 550 5 717.75 6 239.1 7 87.30
933.25 Al Si P S Cl Ar
2.70 2.33 1.82 2.07 3.17* 1.784*
[Ne]3s²p¹ [Ne]3s²p² [Ne]3s²p³ [Ne]3s²p⁴ [Ne]3s²p⁵ [Ne]3s²p⁶
Aluminum Silicon Phosphorus Sulfur Chlorine Argon

19 39.0983 20 40.08 21 44.9559 22 47.90 23 50.9415 24 51.996 25 54.9380 26 55.847 27 58.9332 28 58.70 29 63.546 30 65.38 31 69.72 32 72.59 33 74.9216 34 78.96 35 79.904 36 83.80
1032 1 1757 2 3104 3 3562 4 3662 5 2945 6 2335 7 3201 8 3187 9 2836 10 1180 11 2478 12 3107 13 876 (ind.) 14 958 15 332.25 16 119.80
0.86 K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn Ga Ge As Se Br Kr
1.55 4.50 4.50 5.8 7.19 7.43 7.86 8.90 8.96 7.14 5.91 5.32 5.72 4.80 3.12 3.74*
[Ar] 4s¹ [Ar]4s² [Ar]3d¹4s² [Ar]3d²4s² [Ar]3d³4s² [Ar]3d⁴4s² [Ar]3d⁵4s² [Ar]3d⁶4s² [Ar]3d⁷4s² [Ar]3d⁸4s² [Ar]3d⁹4s² [Ar]3d¹⁰4s² [Ar]3d¹⁰4s²4p¹ [Ar]3d¹⁰4s²4p² [Ar]3d¹⁰4s²4p³ [Ar]3d¹⁰4s²4p⁴ [Ar]3d¹⁰4s²4p⁵ [Ar]3d¹⁰4s²4p⁶
Potassium Calcium Scandium Titanium Vanadium Chromium Manganese Iron Cobalt Nickel Copper Zinc Gallium Germanium Arsenic Selenium Bromine Krypton

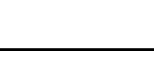
37 85.4678 38 87.62 39 88.9059 40 91.22 41 92.9064 42 95.94 43 (98) 44 101.07 45 102.9055 46 106.4 47 107.868 48 112.41 49 114.82 50 118.69 51 121.75 52 127.60 53 126.9045 54 131.30
961 1 1650 2 3611 3 4662 4 5017 5 4912 6 4423 7 3970 8 4237 9 2436 10 1040 11 2346 12 2876 13 561 14 521 15 1860 16 458.4 17 165.03
1.53 Rb Sr Y Zr Nb Mo Tc Ru Rh Pd Ag Cd In Sn Sb Te I Xe
2.6 4.5 4.5 8.55 10.2 11.5 12.2 12.4 10.5 8.65 7.31 7.30 6.88 6.24 4.92 5.89*
[Kr]5s¹ [Kr]5s² [Kr]4d¹5s² [Kr]4d²5s² [Kr]4d³5s² [Kr]4d⁴5s² [Kr]4d⁵5s² [Kr]4d⁶5s² [Kr]4d⁷5s² [Kr]4d⁸5s² [Kr]4d⁹5s² [Kr]4d¹⁰5s² [Kr]4d¹⁰5s²4p¹ [Kr]4d¹⁰5s²4p² [Kr]4d¹⁰5s²4p³ [Kr]4d¹⁰5s²4p⁴ [Kr]4d¹⁰5s²4p⁵ [Kr]4d¹⁰5s²4p⁶
Rubidium Strontium Yttrium Zirconium Niobium Molybdenum Technetium Ruthenium Rhodium Palladium Silver Cadmium Indium Tin Antimony Tellurium Iodine Xenon

55 132.9054 56 137.33 57 138.9055 72 178.49 73 180.9479 74 183.85 75 186.207 76 190.2 77 192.22 78 195.09 79 196.9665 80 200.59 81 204.37 82 207.2 83 208.9804 84 (209) 85 (210) 86 (222)
944 1 2171 2 3730 3 4876 4 5731 5 5828 6 5453 7 4701 8 4100 9 3130 10 630 11 1746 12 2023 13 1837 14 544.52 15 1235 16 610 17 575 18 211
1.87 Cs Ba La Hf Ta W Re Os Ir Pt Au Hg Tl Pb Bi Po At Rn
3.5 6.7 13.1 16.6 19.3 21.0 22.5 21.4 19.3 13.53 11.85 11.4 9.8 9.4 — 9.91*
[Xe]6s¹ [Xe]6s² [Xe]4f¹5d¹6s² [Xe]4f¹⁴5d²6s² [Xe]4f¹⁴5d³6s² [Xe]4f¹⁴5d⁴6s² [Xe]4f¹⁴5d⁵6s² [Xe]4f¹⁴5d⁶6s² [Xe]4f¹⁴5d⁷6s² [Xe]4f¹⁴5d⁸6s² [Xe]4f¹⁴5d⁹6s² [Xe]4f¹⁴5d¹⁰6s² [Xe]4f¹⁴5d¹⁰6s²4p¹ [Xe]4f¹⁴5d¹⁰6s²4p² [Xe]4f¹⁴5d¹⁰6s²4p³ [Xe]4f¹⁴5d¹⁰6s²4p⁴ [Xe]4f¹⁴5d¹⁰6s²4p⁵ [Xe]4f¹⁴5d¹⁰6s²4p⁶
Cesium Barium Lanthanum Hafnium Tantalum Tungsten Rhenium Osmium Iridium Platinum Gold Mercury Thallium Lead Bismuth Polonium Astatine Radon

58 140.12 59 140.9077 60 144.24 61 (145) 62 150.4 63 151.96 64 157.25 65 158.9254 66 162.50 67 164.9304 68 167.26 69 168.9342 70 173.04 71 174.967
3699 3 3785 3 3341 3 3785 3 2064 3 3539 3 3496 3 2835 3 3136 3 2220 3 1467 3 3668
1071 1204 1289 1204 1345 1090 1090 1682 1795 1936
6.78 Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu
[Xe]4f¹5d¹6s² [Xe]4f²6s² [Xe]4f³6s² [Xe]4f⁴6s² [Xe]4f⁵6s² [Xe]4f⁶6s² [Xe]4f⁷6s² [Xe]4f⁸6s² [Xe]4f⁹6s² [Xe]4f¹⁰6s² [Xe]4f¹¹6s² [Xe]4f¹²6s² [Xe]4f¹³6s²
Cerium Praseodymium Neodymium Promethium Samarium Europium Gadolinium Terbium Dysprosium Holmium Erbium Thulium Ytterbium Lutetium

90 232.0381 91 231.0359 92 238.029 93 237.0482 94 (244) 95 (243) 96 (247) 97 (247) 98 (251) 99 (252) 100 (257) 101 (258) 102 (259) 103 (260)
5061 2 4407 2 3503 2 2880 2 1340 2 900 2 1818 2 2220 2 1467 2 3668
1071 1204 1289 1204 1345 1090 1090 1682 1795 1936
6.78 Th Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr
[Rn]6d²7s² [Rn]5f²6d¹7s² [Rn]5f³6d¹7s² [Rn]5f⁴6d¹7s² [Rn]5f⁶7s² [Rn]5f⁷7s² [Rn]5f⁷7s² [Rn]5f⁷7s² [Rn]5f⁷7s² [Rn]5f⁷7s² [Rn]5f⁷7s² [Rn]5f⁷7s² [Rn]5f⁷7s² [Rn]5f⁷7s²
Thorium Protactinium Uranium Neptunium Plutonium Americium Curium Berkelium Californium Einsteinium Fermium Mendelevium Nobelium Lawrencium

Why $[Ar]4s^23d^1$?

$l=0$	$l=1$	$l=2$
4s 	4p 	4d 
3s 	3p 	3d 
2s 	2p 	
1s 		



$[\text{Ar}]3d^1$

This is not
what
happens

$l=0$	$l=1$	$l=2$
4s 	3p 	3d 
3s 	2p 	
2s 		
1s 		



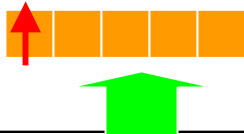
$[\text{Ar}]4s^1$

In reality the
3d-states
are higher
than the 4s

$l=0$	$l=1$	$l=2$
4s 	3p 	3d 
3s 	2p 	
2s 		
1s 		

Ca

$[\text{Ar}]4s^2$

$l=0$	$l=1$	$l=2$
4s 		
3s 	3p 	3d
2s	2p	
1s 		

Sc

$[\text{Ar}]4s^23d^1$

