Announcements

Wednesday, March 25, 2009

MasteringChemistry assignments:

- Ch 7 due today
- Ch 8 due next Mon, Mar 30
- Ch 9 due next Wed, Apr 1

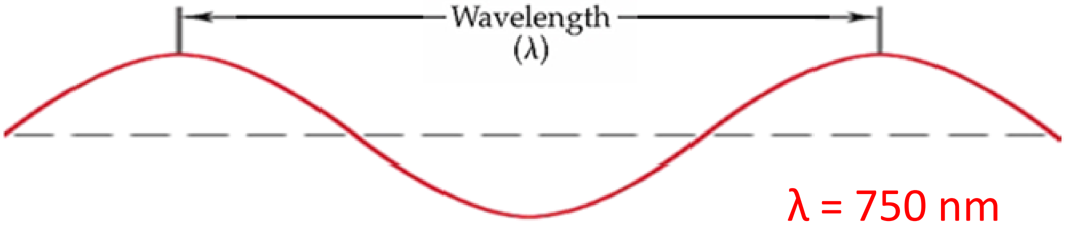
Exam 2 covering the end of Ch 5 through Ch 9 will be next Wed, April 1. The study guide is now available

QA sessions in lab next week - Tues 1pm, Wed 8am

Wavelength and color

greek lambda: λ

Red light:

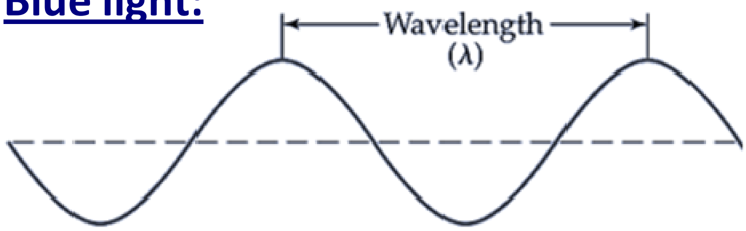


$\lambda = 750$ nm

n = 10^{-9} 750×10^{-9} m

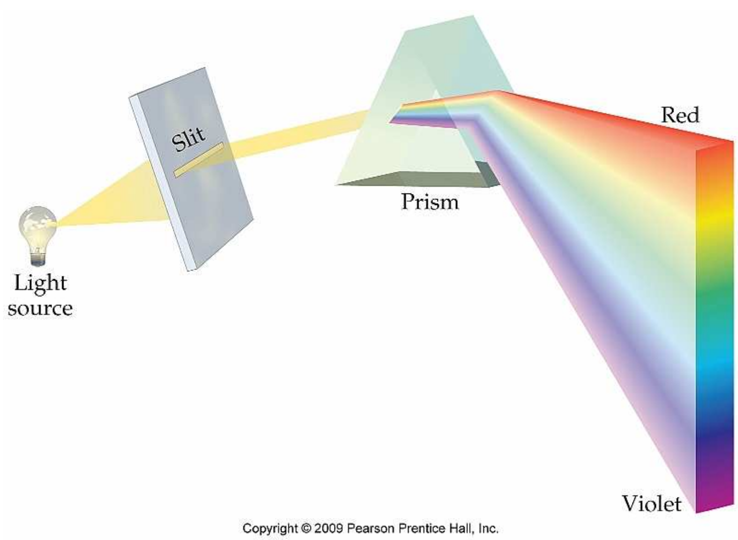
= 7.50×10^{-7} m

Blue light:



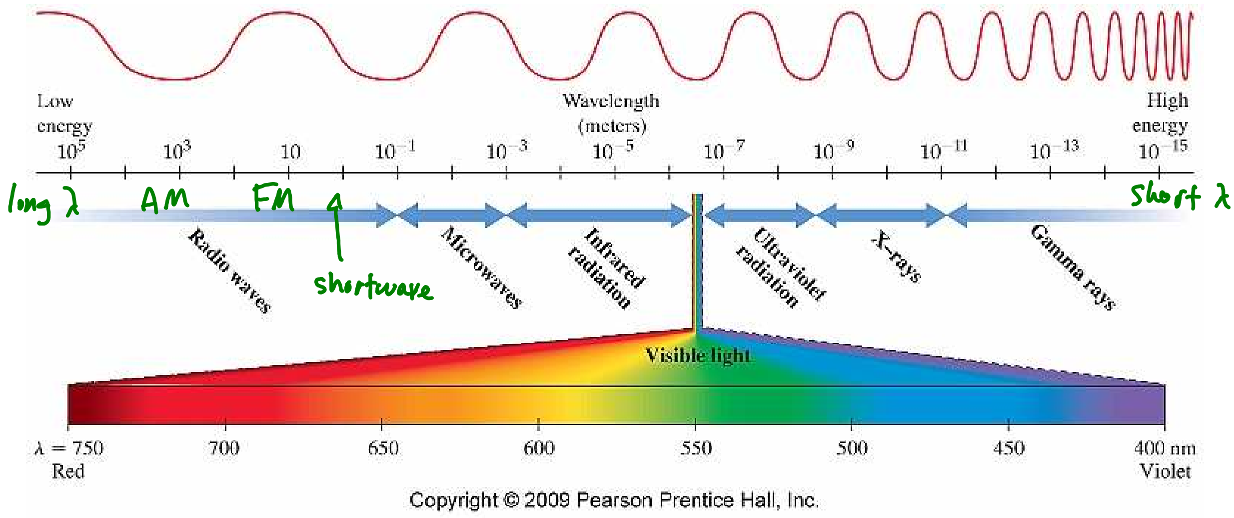
$\lambda = 450$ nm

The visible spectrum



R ≅ 750 nm
O
Y
G
B
I
V ≅ 380 nm

The electromagnetic spectrum



Energy and wavelength (λ) have what relationship?

inversely proportional : ↑energy = ↓λ

Radio: longest λ

Microwaves: cause H_2O molecules to move

Infrared: TV remote

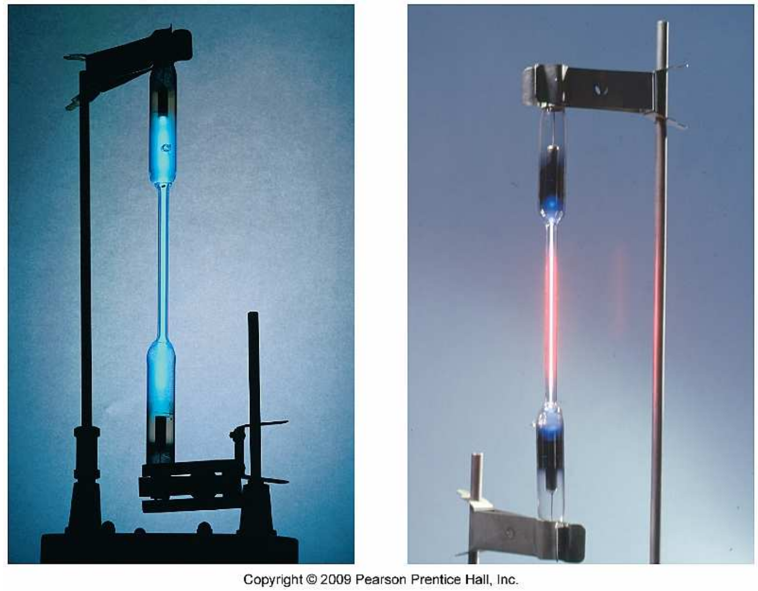
Visible:

UV:

X-ray:

Gamma: "radioactivity" most harmful EM radiation

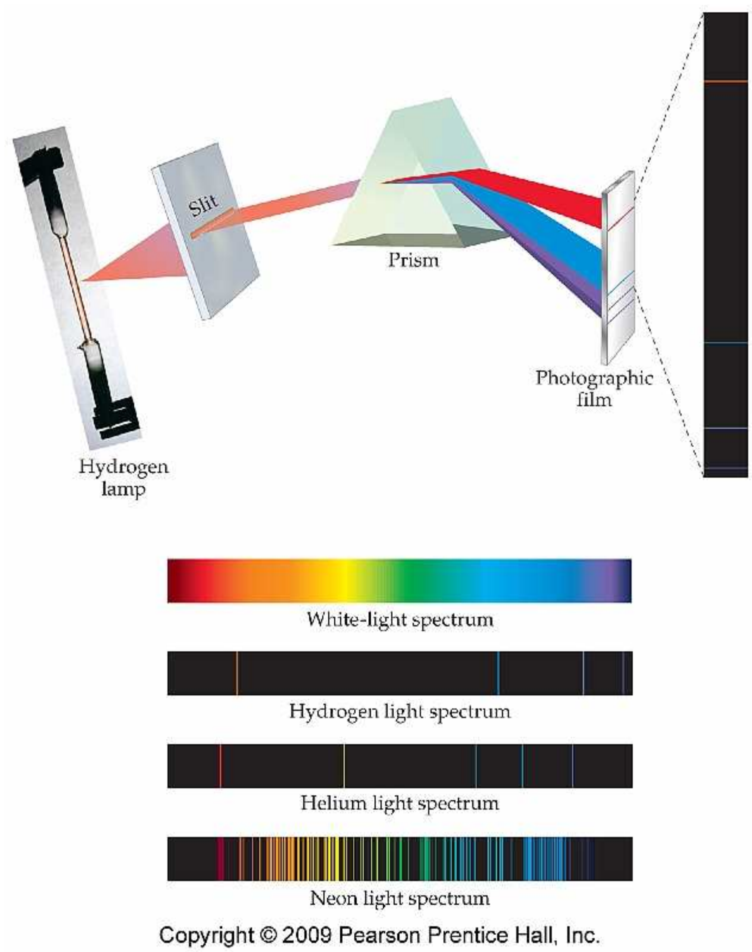
A **gas lamp** is a sealed glass tube that contains a gas sample, and **glows** when a high voltage is applied to it.



Hg(g) $H_2(g)$

But **only certain wavelengths** of light are given off by a gas lamp.

Compare with the continuous spectrum given off by a white light source like a light bulb.

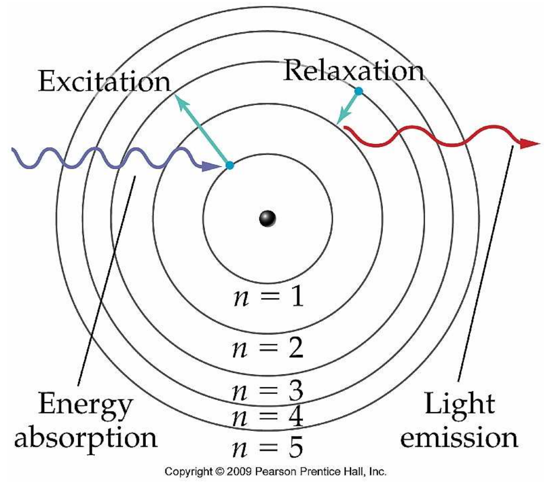


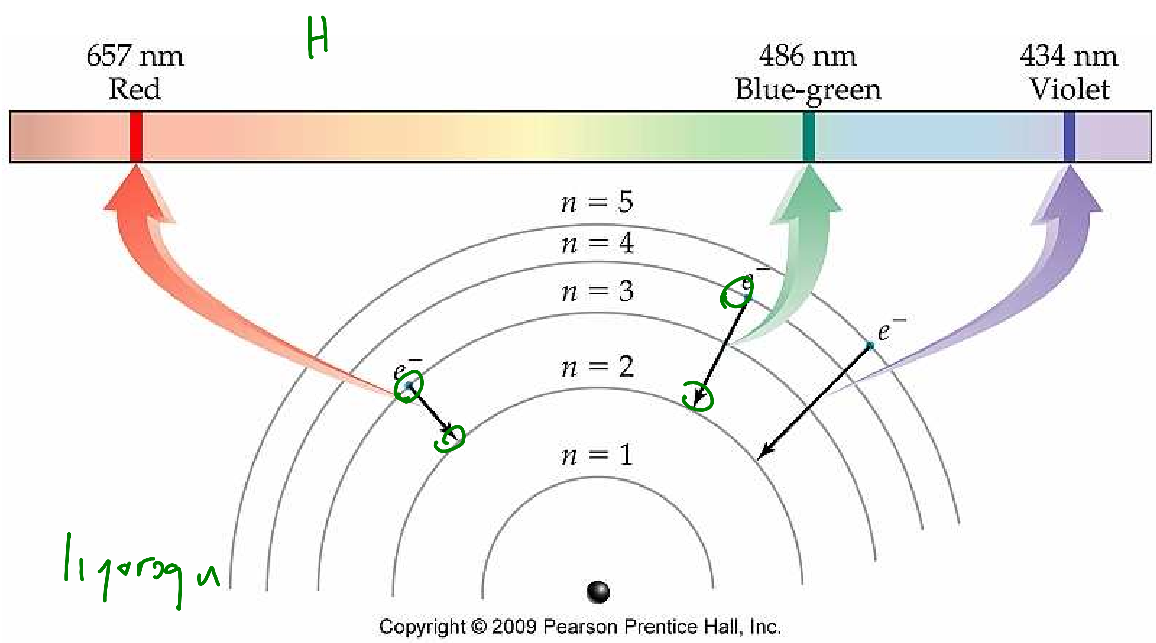
Bohr model

<u>Why</u> are only **<u>certain</u>** colors of light given off by a pure gas sample?

The **<u>Bohr model</u>** can help explain why:

- Electrons orbit in specific fixed distances from nucleus, called **<u>shells</u>**
- Electrons **jump** to higher, more distant orbits when they **absorb** energy (excitation)
- They **drop** down to lower orbits when they **give off** energy, usually as <u>light</u> (relaxation)





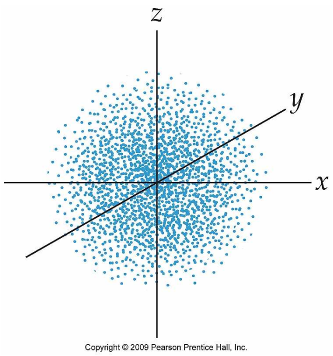
Shortcomings of the Bohr model:

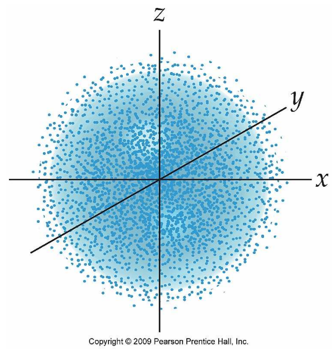
- Can predict the energies of electrons in a hydrogen atom, but not for any other element
- Assumes electrons travel in single circular paths, not likely
- Does not explain periodic table behavior

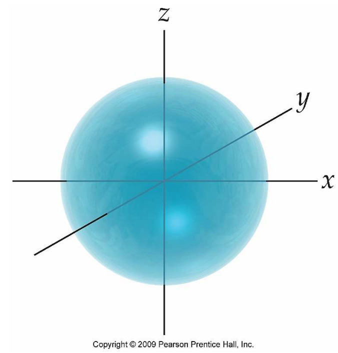
<u>Quantum mechanical model:</u>

- Assumes electrons can act like particles **<u>or</u>** waves (supported by experimental evidence)
- Exact position or path of a single electron are impossible to predict
- But, you can predict the probability of finding an electron within a certain space:

<u>Orbital</u>: 3-dimensional shape that defines the **probability** of finding an electron







The quantum mechanical model has **<u>shells</u>** like the Bohr model

lowest energy shell

- *n* = 1, 2, 3, 4, … (principal quantum number)
- As *n* increases, energy of the electron increases, and **average** distance from the nucleus increases.

But shells alone cannot explain electron behavior. Each new row on the periodic table is a new shell, and the major sections (main group, transition, etc) each have their own **subshell**.

Each shell has *n* subshells:

Shell	# subshells	Subshell letters
n = 1	1	1s
n = 2	2	2s, 2p
n = 3	3	3s, 3p, 3d
n = 4	4	4s, 4p, 4d, 4f

Electron configurations

Period 1	H (1e$^-$)							He (2e$^-$)
Period 2	Li (3e$^-$)	Be (4e$^-$)	B (5e$^-$)	C (6e$^-$)	N (7e$^-$)	O (8e$^-$)	F (9e$^-$)	Ne (10e$^-$)
	2s		2p					

If the elements in period 1 have their electrons in the 1s subshell,
the s subshell can hold a maximum of 2 electrons.

Electron configuration: subshell$^{\# e-}$

H: $1s^1$ **He**: $1s^2$ ← full

Actually, **every s subshell** can hold a max of 2 electrons (including 2s, 3s, 4s, 5s, etc)

In period 2, we fill the 2nd shell (2s and 2p subshells)

Li: $1s^2\ 2s^1$ (2e$^-$) (1e$^-$)

Be: $1s^2\ 2s^2$

When we cross to a new section on the periodic table, a new subshell is being filled. B-Ne fill into the 2p subshell

B: $1s^2 2s^2 2p^1$ **C**: $1s^2 2s^2 2p^2$ **N**: $1s^2 2s^2 2p^3$

O: ... $2p^4$ **F**: ... $2p^5$ **Ne**: $1s^2 2s^2 2p^6$

Electron configurations and the rest of the periodic table

Available subshells to fill:

1s
2s 2p
3s 3p 3d (1st available d subshell)
4s 4p 4d 4f
5s 5p 5d 5f
6s 6p 6d
7s 7p

Subshell	Max # e^-
s	2
p	6
d	10
f	

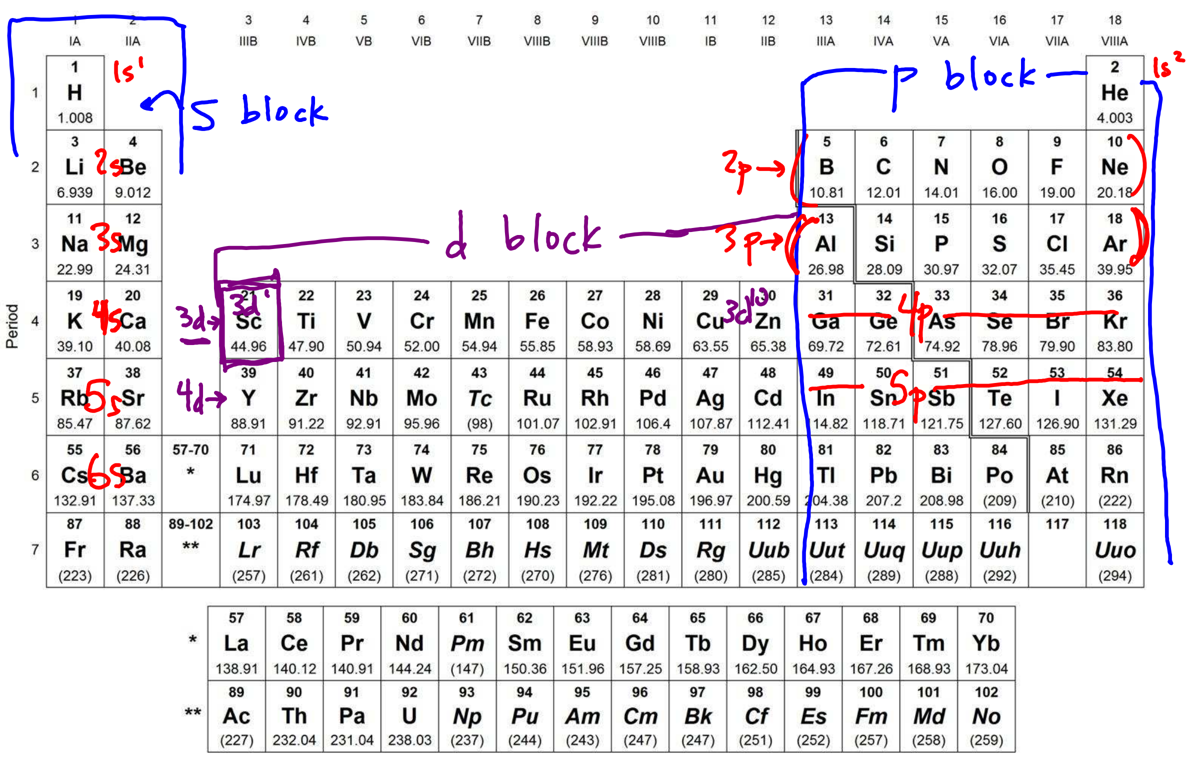
Na: $1s^2 2s^2 2p^6 3s^1$

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

Ca: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

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

Ba:



Periodic Table of the Elements

Period	1 IA	2 IIA		3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB	9 VIIIB	10 VIIIB	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1 H 1.008																		2 He 4.003
2	3 Li 6.939	4 Be 9.012												5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.31												13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
4	19 K 39.10	20 Ca 40.08		21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.47	38 Sr 87.62		39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.96	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.4	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.29
6	55 Cs 132.91	56 Ba 137.33	57-70 *	71 Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra (226)	89-102 **	103 Lr (257)	104 Rf (261)	105 Db (262)	106 Sg (271)	107 Bh (272)	108 Hs (270)	109 Mt (276)	110 Ds (281)	111 Rg (280)	112 Uub (285)	113 Uut (284)	114 Uuq (289)	115 Uup (288)	116 Uuh (292)	117	118 Uuo (294)

*	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (147)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04
**	89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)

Reference: http://www.webelements.com