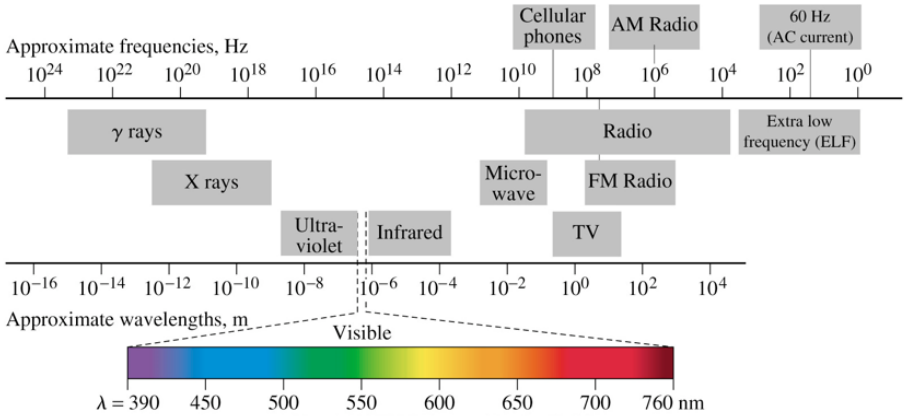
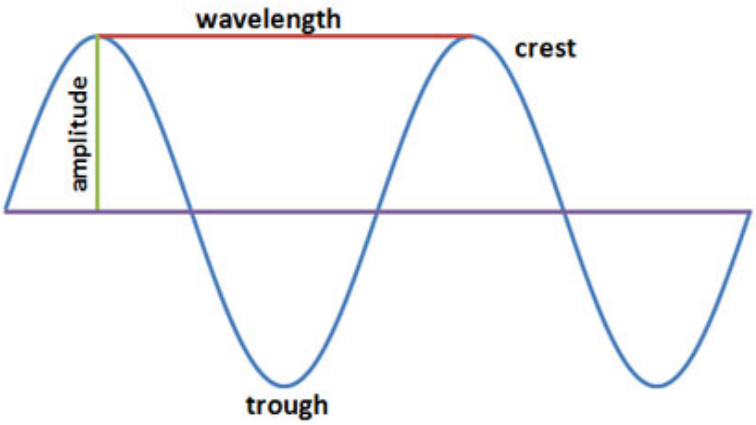
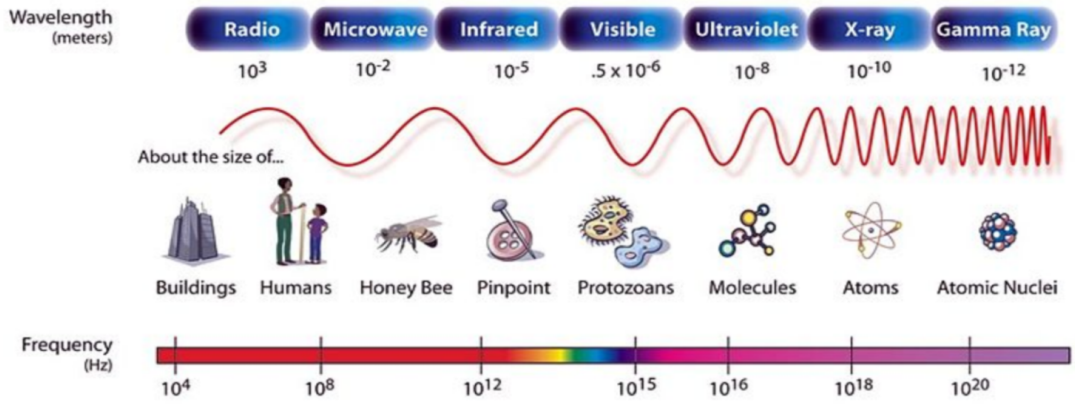
The Electromagnetic Spectrum: **Light**



How do we describe the waves that are light?

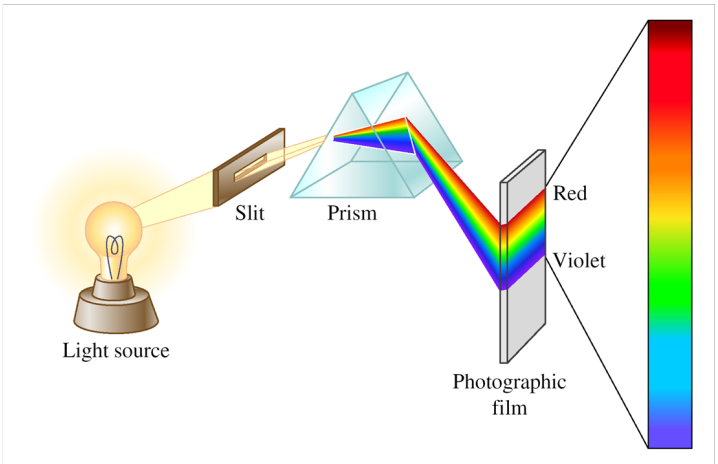


THE ELECTROMAGNETIC SPECTRUM



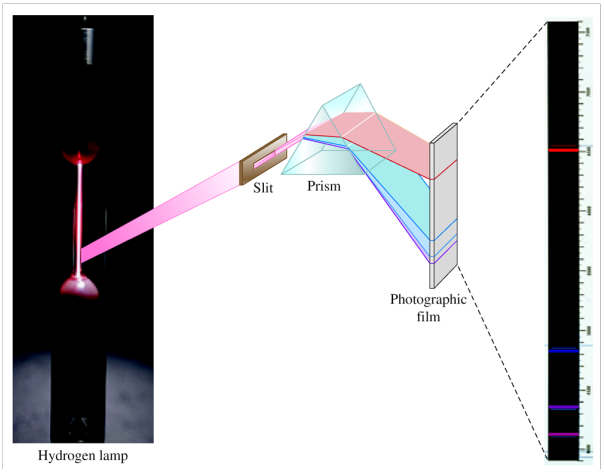
A *Continuous* Spectrum

When we diffract "white light", we see that every single wavelength of light from the visible portion of the EMS is present.



When we diffract light produced by an atomic source, such as a bulb filled with Neon gas, we see that many wavelengths of light from the visible portion of the spectrum are missing. The reason these wavelengths are missing has lead us to our understanding of where electrons are in the atom.

A *Line* Spectrum



The speed of light is a constant, you always know the speed of light!

3.00×10^8 m/s

$\lambda = c/\nu$ or $c = \lambda\nu$

What is the mathematical relationship between wavelength and frequency?

$E = h\nu$

Planck's Constant = 6.626×10^{-34} J•s

What is the mathematical relationship between energy and frequency?

To store a constant in your calculator:

1. Type in the constant 2. **3.** **4. Choose C for Speed of light 5.**
Choose H for Planck's Constant

What is the energy of light whose wavelength is 4.06×10^{-11} m? In what part of the EMS does this light exist?

What is the energy of light whose wavelength is 4.06 x 10^{-11} m?
In what part of the EMS does this light exist? X-Rays

$$c = \lambda \nu \qquad \frac{c}{\lambda} = \nu$$

$$\frac{3.00 \times 10^{8}\ \cancel{m}/s}{4.06 \times 10^{-11}\ \cancel{m}} = 7.389 \times 10^{18}/s \text{ or } s^{-1}$$

$$E = h\nu \quad E = 6.626 \times 10^{-34}\ J \cdot \cancel{s} \times 7.389 \times 10^{18}/\cancel{s}$$

$$= 4.90 \times 10^{-15}\ J$$

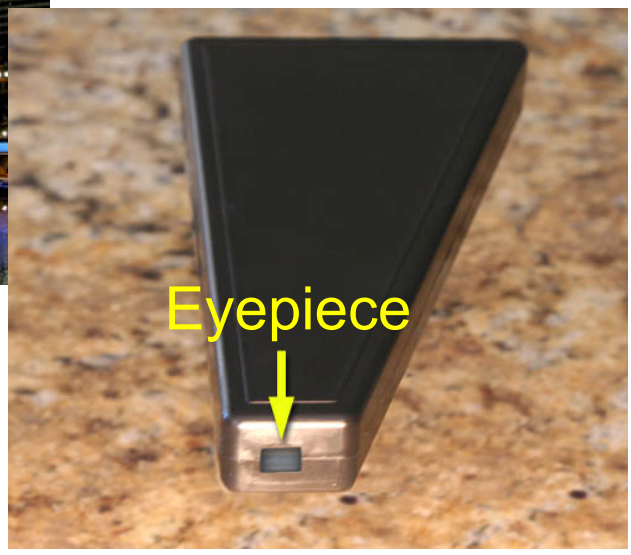
1. 7.98×10^{-7} m
2. 4.3×10^{20} s^{-1}
3. 1.00×10^{8} m
4. 4.04×10^{12} s^{-1}
5. 1.2×10^{7} s^{-1}
6. 6.91×10^{-8} m
7. 5.08×10^{-19} J
8. 1.26×10^{16} s^{-1}
9. 2.60×10^{-9} m

A negative exponent on a unit applies only to the unit, not the number. It means that unit belongs in the denominator. $s^{-1} = \frac{1}{s} = /s$

Light enters here to backlight the scale inside.

Line up light source with this slit.

Spectroscope

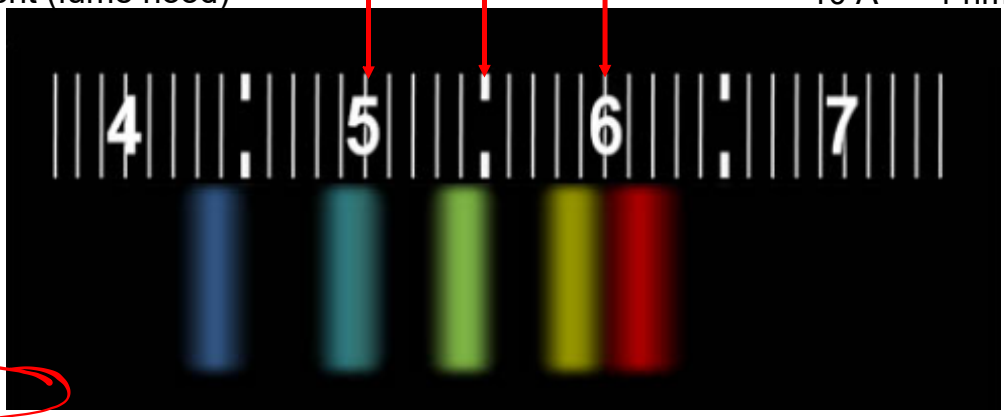


View:

- fluorescent (ceiling)
- incandescent (fume hood)
- sunlight
- H
- He
- Ne

Label each of your six spectra as continuous or line, staple to the salmon packet and hand in.

Cross out Violet #2

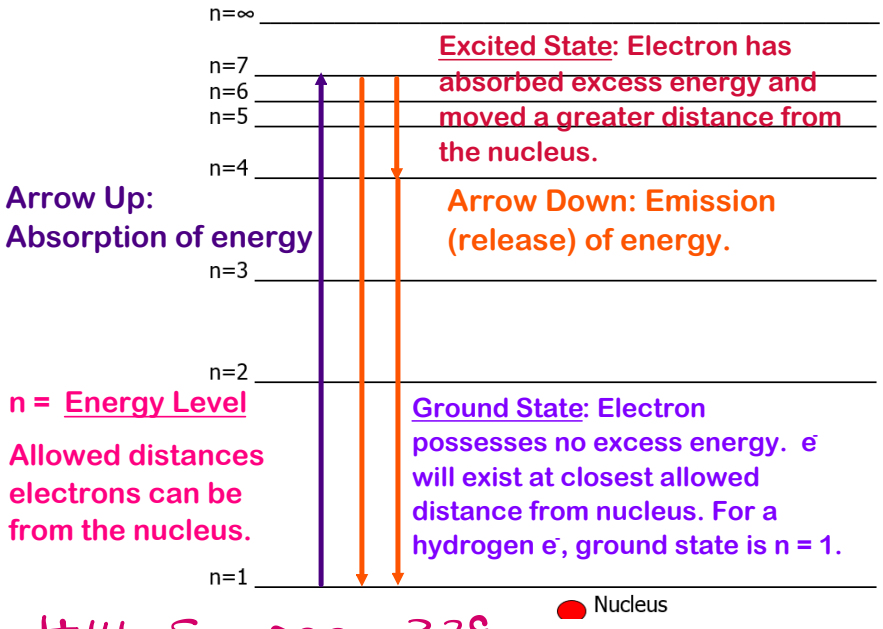


Å = Angstroms

10 Å = 1 nm

#14: See P. 279

Page 269 in your book has a color diagram of the electromagnetic spectrum.



Excited State: Electron has absorbed excess energy and moved a greater distance from the nucleus.

Arrow Down: Emission (release) of energy.

Arrow Up: Absorption of energy

n = Energy Level

Allowed distances electrons can be from the nucleus.

Ground State: Electron possesses no excess energy. e^- will exist at closest allowed distance from nucleus. For a hydrogen e^-, ground state is n = 1.

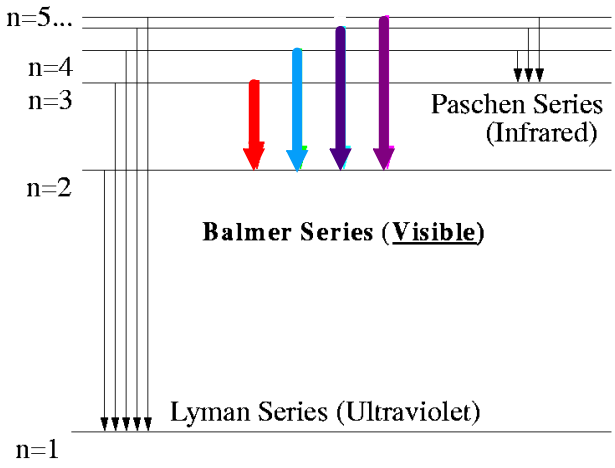
#14 - See page 279

Electron Transition: The movement of electrons from one energy level to another. Occurs when photons (energy) are absorbed or emitted.

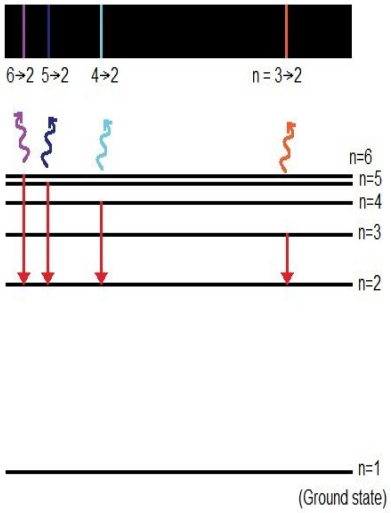
Arrows are used to represent electron transitions. The longer the arrow, the more energy absorbed or emitted by the electron.

P. 269
EMS

Hydrogen Transitions



The line spectrum (emission spectrum) below is the result of what series of electron transitions?



We can measure the quantity of energy released and use it to predict the allowed distances (energy levels) that electrons can be found in. Electrons will never exist between these levels. It's similar to climbing a ladder, you can only stand on a rung and you can never stand between the rungs

Why do the lines in the spectrum converge?

As we move away from the nucleus, the energy levels in the atom converge (move closer and closer together) so we see that the lines in the spectrum are also closer and closer together because the differences in energy between the levels is very small. When an electron moves from level 6 to level 5 a much smaller quantity of energy is released than when an electron moves from level 3 to level 1.