Chapter 3

**KE = ½ mu2 E = h C =  h = 6.626 x 10-34 J\*sec C = 3.00 x 108 m/sec**

Threshold frequency is the frequency required to get an electron ejected from a metal’s surface. The Energy associated with threshold frequency is called binding energy. Once an electron is ejected from the metal’s surface it has kinetic energy. Total Energy = Binding Energy + Kinetic Energy see power point notes for more detail

1. If the mass of an electron is 9.1 x 10-31 Kg. What must the wavelength of a photon be to eject an electron from a metal with a binding energy of 5.9 x 10-19J and have it travel at ½ the speed of light?

Total Energy = Binding Energy + Kinetic Energy

 = 5.9 x 10-19 J + ½ (9.1 x 10-31 Kg) [(0.5)(3.00x 108)]2 = 1.0 x 10-14 J

 1.0 x 10-14 = (6.626 x 10-34)(3.0 x 108)  = 2.0 x 10-11 m or 0.020 nm

 

1. What would the energy per mole be for photon with a frequency of 4.62 x 1014 Hz?

 E = h = (6.626 x 10-34 J\*sec)(4.62 x 1014 sec-1) = 3.06 x 10-19 J x 6.022 x 1023 photon = 1.84 x 105 J/ mol

Photon photon 1 mole

1. The binding energy of magnesium metal is 5.86 x 10-19J. Calculate the minimum frequency of light required to release an electron from the magnesium.

 E = h 5.86 x 10-19J = (6.626 x 10-34 J\*sec)   = 8.84 x 1014 hz

1. What is the kinetic energy of an ejected electron in problem 3 if a photon with a wavelength of 150 nM is used to irradiate the magnesium metal?

Total Energy = Binding Energy + Kinetic Energy

 E = hC = (6.626 x 10-34)(3.0 x 108) = 1.3 x 10-18 J = 5.86 x 10-19 J + Kinetic Energy

  1.5 x 10-7 m

 Kinetic Energy = 7.4 x 10-19 J

Bohr’s Theory: When the electrons in an atom are excited. They emit a certain wavelength of light when they return to ground state. Each element has their own unique emission spectrum. For example Sodium metal emits a single yellow wavelength which is known as sodium D light



Absorption Spectrum is:

What wavelengths of light are ***absorbed*** by an element

Emission Spectrum is:

What wavelengths are ***emitted*** by an element

**Bohr’s Theory:**

1. e\_ can only have specific (quantized) energy values
2. light is emitted as e\_ moves from one energy level to a lower energy level

E = -b

 n2

b = 2.18 x 10-18 J

E = Ef - Ei

1n

( )

1

n

i

f

-

2

2

E = - b

**de Broglie Hypothesis:**

 If substances that behave like waves have particle characteristics than particles could also have wave characteristics.

  = h

 mu

m = mass in Kg

u = velocity in m/sec

1. What is the de Broglie wavelength in nm of a 2.5 gram ping-pong ball traveling at 15.6 m/sec?

 = h 6.626 X 10-34 J\*sec = 1.7 x 10-32 m

 mu (2.5 x 10-3 Kg) (15.6 m/sec)

1. What is the de Broglie wavelength in nm of an electron traveling at 10% of the speed of light?

 = h 6.626 X 10-34 J\*sec = 2.4 x 10-11 m

 mu (9.1 x 10-31 Kg) (0.1 x 3.0 x 108 m/sec)

 What are the differences between 1 and 2?

 The ping pong ball has a wavelength outside of the electromagnetic spectrum because it is so large of an object while the electron has a wavelength within the electromagnetic spectrum because it is so small

**Heisenberg’s Uncertainty Principle:**

The position and Energy of an electron cannot be precisely defined.

The more accurately we know the position the more uncertain we are about energy