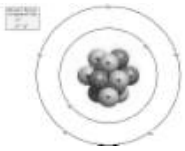
Electronic Structure

Bohr

- Bohr proposed that the _____ atom has only certain allowable energy states.



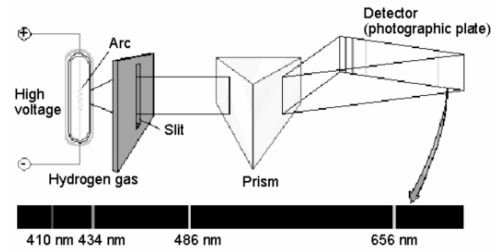
Spectroscope

- Using a device called a _____ it was found that gaseous elements emitted electromagnetic radiation when they were heated
- The light emitted discrete packets of energy (quanta) and each element emits its own unique pattern of radiation

Spectroscope

- The release of radiation was caused by the electrons absorbing energy & being promoted to a shell further away from the nucleus (_____ state)
- When the electron goes back to its original shell (_____ state) it releases the energy that it absorbed
- This created a line in the spectra

Spectroscope



Rydberg Equation

- The Rydberg equation is used to calculate the energy changes when electrons are promoted to higher energy levels and fall back to their lower energy levels
- $\Delta E = R_H\left(\frac{\blacksquare}{\blacksquare} - \frac{\blacksquare}{\blacksquare}\right)$
- R_H = the Rydberg constant (2.178×10^{-18} J)
- n_f = quantum number of the final state
- n_i = quantum number of the initial state

Example

- Calculate the energy required to excite the hydrogen atom from level n=1 to n=2.

De Broglie

- DeBroglie stated that electrons had wave like characteristics
- Came up with the equation:

The Heisenberg Uncertainty Principle

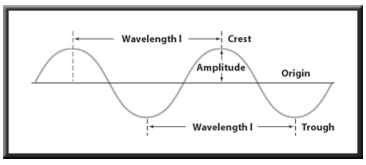
- Heisenberg concluded that it is impossible to make any measurement on an object without disturbing the object
- The **Heisenberg uncertainty principle** states that it is fundamentally impossible to know precisely both the _____ and _____ of a particle at the same time.

The Schrödinger wave equation

- Combined the ideas of Bohr & DeBroglie
- The atomic model in which electrons are treated as _____ and _____ is called the **quantum mechanical model**.

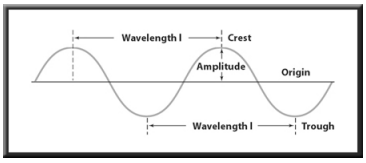
Wavelength

- _____(λ) - shortest distance between equivalent points on a continuous wave.



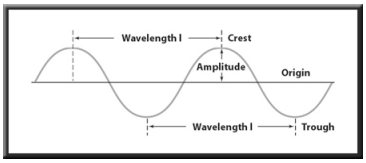
Wavelength

- The wavelength is measured from _____ to _____ or from _____ to _____ .
- Wavelength is usually expressed in meters./



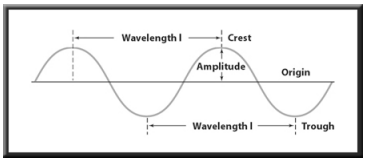
Frequency

- _____(*v*) - number of “waves” that pass a given point per second.
- One hertz (Hz), the SI unit of frequency, equals one wave per second (s^{-1}).



Amplitude

- _____ - wave’s height from the origin to a _____ , or from the origin to a _____ .



Wave Nature of Light

- All electromagnetic waves, including visible light, travel at a speed of _____ m/s in a vacuum.
- The speed of light is the product of its wavelength (λ) and its frequency (*n*).

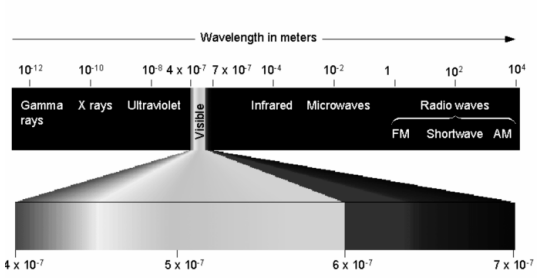
$$c = \lambda\nu$$

Wave Nature of Light

- Wavelength and frequency are _____ proportional
- As one quantity increases, the other decreases.

$$c = \lambda\nu$$

Electromagnetic Radiation



Calculating Wavelength of an EM Wave

- Microwaves are used to transmit information. What is the wavelength of a microwave having a frequency of 3.44×10^9 Hz?

Try this one…

A yellow light given off by a sodium vapor lamp has a wavelength of 589 nm. What is the frequency of the radiation?

$v = 5.09 \times 10^{14}\ s^{-1}$

Energy

- Matter can gain or lose energy only in small, specific amounts called quanta.
- _____ is the minimum amount of energy that can be gained or lost by an atom.

$$E_{quantum} = h\nu$$

Energy

- **Planck's constant** has a value of _____ J · s
- J is the symbol for the _____ , the SI unit of energy.

Example

A laser has a frequency of 4.69 x 10^{14} s^{-1}. How much energy is released?

Try this one…

- Calculate how much energy that an object can absorb from a light whose wavelength is 589 nm.

E = 3.37 x 10^{-19} J

De Broglie

- De Broglie had been thinking that electron orbits had characteristics similar to those of waves.

$$\lambda = \frac{h}{mv}$$

Example

- What is the wavelength of an electron with a velocity of 5.97×10^{6} m/s if the mass of an electron in 9.11×10^{-28} g?