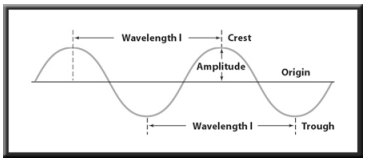
Electronic Structure

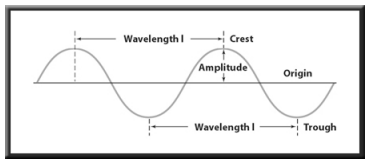
Wavelength

- _____ (λ) - the shortest distance between equal points wave.



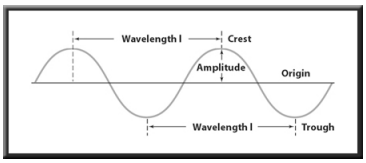
Wavelength

- The wavelength is measured from _____ or from _____ .
- Wavelength is usually expressed in nanometers ($1\ nm = 1 \times 10^{-9}\ m$).
- *I told you those pesky prefixes would come back to haunt you!!!*



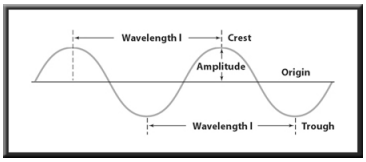
Frequency

- _____(*n*) is the number of waves that pass a given point per second.
- _____ (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 3.00 x 10^8 m/s in a vacuum.
- Speed of light = *c*.

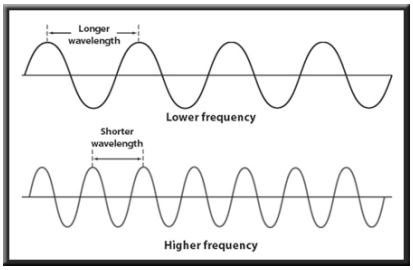
$$c = \lambda\nu$$

Wave Nature of Light

- Although the speed of all electromagnetic waves is the same, waves may have different wavelengths and frequencies.
- As you can see from the equation, wavelength and frequency are _____ related.

$$c = \lambda\nu$$

Wave Nature of Light



Electromagnetic Radiation

- When we say "light," we generally are referring to visible light—a type of electromagnetic radiation.
- Visible light constitutes a very small segment of the electromagnetic spectrum, which is composed of various types of electromagnetic radiation in order of increasing wavelength.
- Electromagnetic Spectrum

Calculating Wavelength

- Microwaves are used to transmit information. What is the wavelength of a microwave having a frequency of 3.44×10^9 Hz?
- NOTE: Wavelength (λ) MUST be in meters!!!
- NOTE: Frequency MUST be in Hertz!!!

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?

Try this one on your own…

A laser has a frequency of 4.69×10^{14} s^{-1}. What is the wavelength?

Energy

- Matter can gain or lose energy only in small, specific amounts called _____ .

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

Energy

- _____ (h) has a value of 6.63×10^{-34} J · s
- J is the symbol for the joule, the SI unit of energy.
- Don't forget…frequency must be in hertz

Example

A laser has a frequency of 4.69×10^{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.

De Broglie

- De Broglie had been thinking that electron orbits had characteristics similar to those of waves.
- Note: m is the mass and MUST be in Kg, v is the velocity of the particle and MUST be in m/s.

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

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?

More examples

- What velocity must a neutron move at for it to exhibit a wavelength of 501 pm if the mass of a neutron is 1.675×10^{-24} g?

More examples

- What is the frequency of a green light which has a wavelength of 490 nm?

More examples

- What is the energy given off from the violet portion of the rainbow if the wavelength is 415 nm?

More examples

- What is the mass of a particle traveling at 955 m/s with a wavelength of 650 pm?