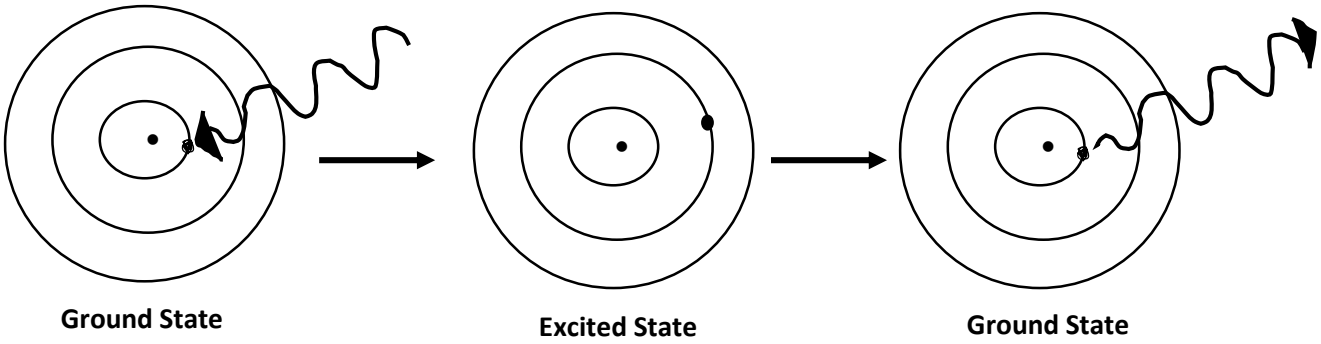
Name:_____Date:_____Block:_____

Fireworks…How Do They Work?

Fireworks are known for their spectacular display of colored lights, but how are these different colors produced? The wide variety of colors is due to the different metal salts that make up the fireworks. A "salt" is an ionic compound, thus a metal salt is an ionic compound made of a metal ion and a nonmetal ion bonded together. When the metal salt is ignited with a fuel source, energy is released in the form of light. The type of metal in the salt determines the color of the light. Therefore, every metal produces a specific color.

Why is light produced?

When the fuel source in the fireworks burns a lot of heat is produced. This heat causes the electrons in the metal atoms to gain energy and be excited to higher energy levels. These excited states are unstable, so the electron quickly returns to its original energy level (ground state). Since the electron loses energy as it moves to a lower energy level, energy is released from the atom as light.



What determines the color of light produced?

A photon is a packet of light with a specific amount of energy. Every photon from the electromagnetic spectrum travels at the speed of light, but not every photon contains the same amount of energy. Each color of the rainbow contains photons of a specific amount of energy. For example, red light contains a different amount of energy than blue light. Therefore, in fireworks, the amount of energy released from the atom as the electron moves to a lower energy level determines the color of light. Different metals will have different energy gaps between their ground and excited states, leading to the emission of different colors.

Energy Formulas

Formulas	Variables / Constants
$c = \lambda\nu$	**c** = speed of light = $\frac{3.00 \text{ x } 10^8 \text{ m}}{s}$ **λ =** wavelength, measured in nanometers 1 nm = 10^{-9} m **ν =** frequency, measured in $\frac{1}{s}$ = s^{-1} = Hz 1 THz = 10^{12} Hz
$E = h\nu$	**E** = energy, measured in Joules (J) **h** = Planck's constant = 6.626 x 10^{-34} J•s **ν =** frequency, measured in $\frac{1}{s}$ = s^{-1} = Hz 1 THz = 10^{12} Hz

Energy Practice Problems

1. Calculate the wavelength in meters of yellow light emitted from a sodium lamp if the frequency is 5.10 x 10^{14} Hz. Calculate the wavelength of the light in nanometers.

2. Ultraviolet radiation has a frequency of 6.8 × 10^{15} Hz. Calculate the energy, in joules, of the photon.

3. A certain photon of radiation has a frequency of 73 THz. Calculate the wavelength, in meters, of this photon. From which type of radiation of the electromagnetic spectrum does this photon belong?