Advanced Higher: Electromagnetic Radiation

The electromagnetic spectrum is a spectrum of different types of radiation arranged in order of wavelength.

G________________

X________________

U________________

V________________

I_________________

M________________

R_________________

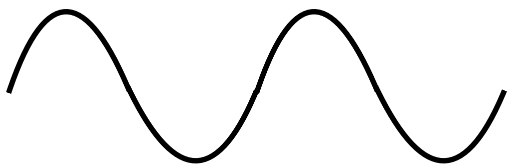
Increasing ______________

Increasing ______________

The different parts of the electromagnetic spectrum can be described in terms of waves with wavelength and frequency.

The value of the speed of light (c) is ___________________

Wavelength is given the symbol ________ and is measured in _____
However, wavelengths of visible light are often given in nanometers (nm).



Frequency is given the symbol _______ and is measured in _______.

Example: Calculate the frequency of a wave with wavelength 560nm.

?

1) Calculate the frequency of a wave with wavelength 470nm.

2) Calculate the wavelength of a wave with frequency $3.15 \times 10^{14} s^{-1}$

Electromagnetic radiation is said to display wave-particle duality. It can be described as a wave with wavelength and frequency but also as a particle called a _____________.

When matter absorbs or emits electromagnetic radiation it does so through photons. The energy of photons can be calculated using the following relationships:

Planck's constant is given the symbol ____ and takes the value _______________. These relationships give energy in ______

Example: Calculate the energy of a photon of light with wavelength 656 nm.

? 1)Calculate the energy of a photon of light with wavelength 550 nm

2) Calculate the energy of a photon of light with frequency of $5.2 \times 10^{14} s^{-1}$

These relationships give the energy of single photons, in chemistry it is often more useful to work in terms of moles of substances. For a mole of photons these relationships are used:

Avagadro’s constant is given the symbol _____ and takes the value _____________. These relationships give energy in ____. Energy is more commonly used in units of ________, to convert, your answer needs to be divided by 1000.

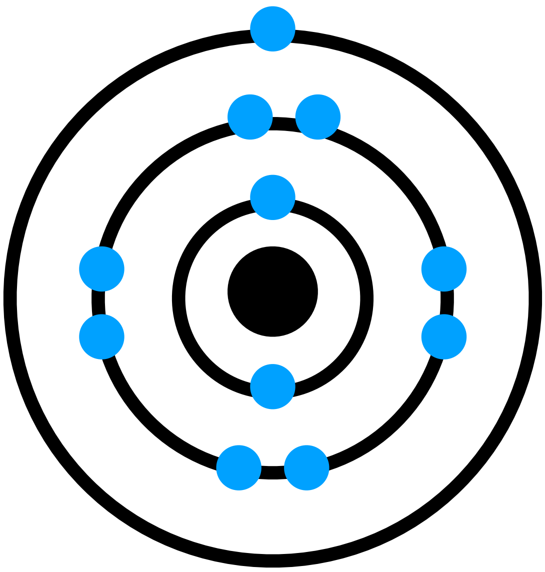
Example: Calculate the energy, in kJ/mol, of a mole of photons of wavelength 435 nm

?

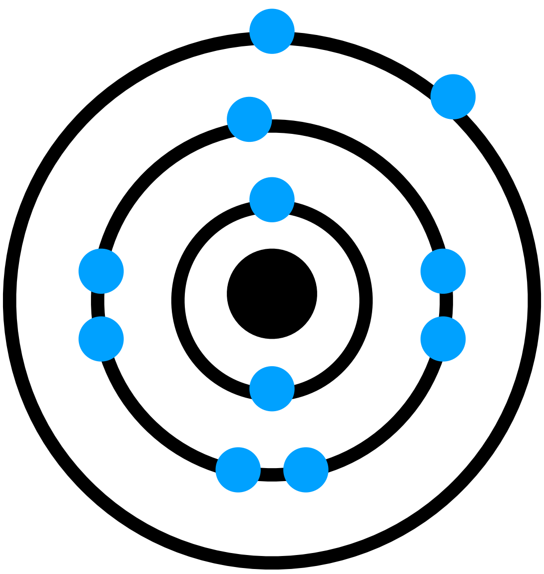
1) Calculate the energy, in kJ/mol, of a mole of photons of frequency $4.8 \times 10^{14} s^{-1}$

2) Calculate the energy, in kJ/mol, of a mole of photons of wavelength 620 nm.

When atoms absorb energy the electrons within those atoms can be promoted to higher energy levels. To do this the energy absorbed must be equivalent to the difference in energy between the levels. Only specific photons of light can do this.



When the electrons relax back to ground level they emit light. This light is of specific energy relating to the difference in energy between the levels. This gives rise to a spectrum of lines that show the different possible transitions between levels. These spectrums are used as evidence of the ______________________________ energy levels.



For each electron that relaxes back to ground state light is released and gives a line on the spectrum.

An absorption spectrum is produced when ________________ ___________ is directed at an __________ sample. The radiation is absorbed and _______________ are _____________ to ____________ levels. The spectrum is produced by measuring how the intensity of the light varies. Absorption spectra appear as ___________ lines missing from a _________ spectrum.

An emission spectrum is produced when _______ __________________ are used to _______ electrons in atoms. The electrons ___________ to _________ energy levels and _____________ are released. The spectrum is produced by measuring the intensity of each wavelength produced. Emission spectra appear as individual ____________ lines.

For both spectra the concentration of an element is related to a the intensity of light emitted or absorbed. Each element produces a characteristic spectrum which can be used to identify the element.