

Region	Wavelength	Frequency	Energy
Violet	440 nm – 400 nm	6.8×10^{14} – 7.5×10^{14} Hz	2.8 – 3.1 eV
Blue	480 nm – 440 nm	6.3×10^{14} – 6.8×10^{14} Hz	2.6 – 2.8 eV
Green	560 nm – 480 nm	5.4×10^{14} – 6.3×10^{14} Hz	2.2 – 2.6 eV
Yellow	590 nm – 560 nm	5.1×10^{14} – 5.4×10^{14} Hz	2.1 – 2.2 eV
Orange	630 nm – 590 nm	4.8×10^{14} – 5.1×10^{14} Hz	2.0 – 2.1 eV
Red	700 nm – 630 nm	4.3×10^{14} – 4.8×10^{14} Hz	1.8 – 2.0 eV

Table 1: Visible Region of the Electromagnetic Spectrum

Section 1. Multiple Choice

1. What is the energy of the first excited state of a hydrogen atom?
 - (a) -13.6 eV
 - (b) -3.4 eV
 - (c) -10.2 eV
 - (d) -1.51 eV
 - (e) -1.89 eV
2. Which scientist theorized that light is composed of photons of energy $E = hf$?
 - (a) Bowman
 - (b) Planck
 - (c) Bohr
 - (d) Newton
 - (e) Einstein
3. If a hydrogen atom absorbs a photon, then the radius of the electron's orbit will
 - (a) remains the same.
 - (b) decrease.
 - (c) increase.
4. What is the region of the electromagnetic spectrum that has a lower frequency than the visible region and is adjacent to the visible region?
 - (a) infrared
 - (b) ultraviolet
 - (c) radio
 - (d) x-ray
 - (e) gamma ray

Section 2. Problem Solving

5. (a) The energy levels of a particular quantum object are -12 eV , -5.5 eV , -3.2 eV , and -2.8 eV . If a collection of these objects is bombarded by an electron beam so that there are some objects in each excited state, what are the energies of the photons that will be emitted?

(b) In lab, you observed emission lines for various elements (and molecules). How many emission lines would appear in the visible spectrum for this collection of quantum objects? (In other words, which emission lines can you see?)

(c) What are the frequencies and wavelengths of the visible emission lines and what colors are they (see the given table)? Give the wavelengths in nm and frequencies in Hz.