Chapter 7: Quantum Theory & Electronic Structure of Atoms Worksheet #1

1. Yellow colors seen in fireworks are due to the emission of light with wavelength around 588 nm when sodium salts are burned. Calculate the frequency of yellow light of wavelength 5.88 x 10² nm. \( \text{c} = 2.997 \times 10^8 \text{ m/s} \)

2. An AM radio station broadcasts at a frequency of 650 kHz. What is the wavelength of electromagnetic radiation emitted by the station? \( 1 \text{ Hz} = 1 \text{ s}^{-1} \)

3. Police often monitor traffic with “K-band” radar guns that operate at 22.235 GHz. Find the wavelength of this radiation in nm. In what part of the electromagnetic spectrum is this radiation found?

4. The first step in the formation of ozone in the upper atmosphere occurs when O₂ molecules absorb UV radiation with a wavelength of about 242 nm. Calculate the energy of a photon of 242 nm radiation. \( h = 6.626 \times 10^{-34} \text{ J} \cdot \text{s} \)

5. Light from distant stars is very weak, and astronomers often need to detect just a few photons. What is the total energy of 23 photons having a wavelength of 575 nm?

6. Cobalt-60 is a radioactive isotope used to treat cancers of the brain and other tissues. A γ-ray emitted by an atom of this isotope has an energy of 1.33 MeV (million electron volts; 1 eV = 1.602 x 10⁻¹⁹ J). Calculate the frequency and the wavelength, in nm, of this γ-ray.

7. Calculate the energy required to excited the electron in Be³⁺ from principal energy level \( n = 3 \) to level \( n = 7 \). Calculate the wavelength of light that must be absorbed to do this.