

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 5.88×10^2 nm.

$$5.10 \times 10^{14} \text{ s}^{-1}$$

2. An AM radio station broadcasts at a frequency of 650. kHz. What is the wavelength of electromagnetic radiation emitted by the station?

$$461 \text{ m}$$

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?

$$1.3483 \times 10^7 \text{ nm}; \text{ microwaves}$$

4. The first step in the formation of ozone in the upper atmosphere occurs when O_2 molecules absorb UV radiation with a wavelength of about 242 nm. Calculate the energy of a photon of 242 nm radiation.

$$8.21 \times 10^{-19} \text{ J}$$

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?

$$7.95 \times 10^{-18} \text{ J}$$

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; $1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$). Calculate the frequency and the wavelength, in nm, of this γ -ray.

$$3.22 \times 10^{20} \text{ s}^{-1}; 9.32 \times 10^{-4} \text{ nm}$$

$$c = 2.9979 \times 10^8 \text{ m/s}$$

$$h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$$