QUESTION SET | 15 QUESTIONS

Emission Spectra & Threshold Energy Calculations

Calculate spectral limits, photon energies, threshold wavelengths, and related molar quantities.

Constants: $c = 3.00 \times 10^{8}$ m s^{-1}; $h = 6.63 \times 10^{-34}$ J s; $N_A = 6.02 \times 10^{23}$ mol^{-1}
Relationships: c = lambda f; E = hf = hc/lambda

Practice Questions

1. The convergence-limit wavelength in an emission spectrum is 121.6 nm. Calculate the corresponding frequency in s^{-1}.

2. A convergence-limit photon has a wavelength of 102.6 nm. Calculate the energy of one photon in joules.

3. Hydrogen has a convergence-limit wavelength of 91.2 nm. Calculate its first ionization energy in kJ mol^{-1}.

4. Species A has a convergence-limit wavelength of 80.0 nm, while species B has one at 120.0 nm. Which species has the larger ionization energy? Calculate the ionization energy of each in kJ mol^{-1}.

5. The longest wavelength capable of ionizing an atom is 250.0 nm. Calculate the atom's ionization energy in kJ mol^{-1}.

6. The minimum energy required to remove one electron from an atom is 3.40×10^{-18} J. Calculate the convergence-limit wavelength in nm.

7. An element has a first ionization energy of 738 kJ mol^{-1}. Calculate the convergence-limit wavelength in nm.

8. The convergence-limit frequency of a spectrum is 3.29×10^{15} s^{-1}. Calculate the ionization energy in kJ mol^{-1}.

9. A one-electron ion has a convergence-limit wavelength of 50.0 nm. Calculate (a) the energy needed to remove one electron and (b) the energy needed to remove one mole of electrons.

10. An atom requires 2.50×10^{-18} J for ionization. It absorbs a photon with energy 4.00×10^{-18} J. Is ionization possible? If so, calculate the excess energy carried away by the electron.

11. Calculate the minimum frequency of radiation needed to ionize an atom with a first ionization energy of 900 kJ mol^{-1}.

12. Calculate the longest wavelength that can ionize an atom whose first ionization energy is 1200 kJ mol^{-1}.

13. The experimental ionization energy of hydrogen is 1312 kJ mol^{-1}. A student obtains 1305 kJ mol^{-1}. Calculate the percentage error.

14. How much energy, in kJ, is required to ionize 0.250 mol of ground-state hydrogen atoms? Use 1312 kJ mol^{-1}.

15. Two unknown atoms have convergence limits at 95.0 nm and 145.0 nm. Calculate both ionization energies in kJ mol^{-1}, then determine the difference between them.