Modern physics Chapter 7-8

7.1.1 Calculate the wavelength for the Balmer series \( \lambda_{10} \) (i.e. for \( m = 10 \)).
Answer: 380 nm

7.3.1 What is the energy difference between level \( n = 2 \) and \( n = 1 \) for the hydrogen atom expressed in the unit eV.
Answer: 10.2 eV

7.3.2 Calculate the wavelength for the convergence limit of the Balmer series.
Answer: 365 nm

7.3.3 Calculate the wavelength for the convergence limit of the Lyman series.
Answer: 91.2 nm

7.4.1 One puts 40 kV over an X-ray tube. Calculate the shortest wavelength we can get from the tube.
Answer: 31 pm

7.4.2 Calculate the lowest energy \( E_1 \) for an element with \( Z = 10 \) in the unit eV.
Answer: 1.1 keV

7.4.3 What is the energy difference between \( E_2 \) and \( E_1 \) for the element with \( Z = 10 \)?
Answer: 826 eV

7.4.4 What will the frequency become in the corresponding transition?
Answer: 1,99 x 10\(^{17}\) Hz

8.4.1 For a diatomic molecule one measured the vibrational energy \( E_{0} \) till 212 cm\(^{-1}\) (common unit in chemical physics) for \( \nu = 0 \). Calculate the vibrational constant \( \omega_v \) for the molecule.
Answer: 414 cm\(^{-1}\).

8.4.2 The rotational energy \( F(J) \) can be determined if you know the \( B \)-value (rotational constant) of a molecule. Suppose that \( B = 4.4 \) cm\(^{-1}\). Calculate \( F(J=5) \).
Answer: \( F(J=5) = 132 \) cm\(^{-1}\).