Problems of Spectrum of hydrogen atom

1) According to Bohr's theory, the energies allowed to an electron in the hydrogen atom are given by the so−called Bohr's Equation $E = -A/n^2$, where $A = 2.1799\times10^{-18}$ J and n is the quantum number of the energy level. Find out:

a) First ionization energy of hydrogen atom in eV.
b) Energy of an electron (in J and eV) of a hydrogen atom when its energy level is 2.
c) The wavelength (in nm) of a photon given off when the electron falls from level 5 to level 2.

Data: $h = 6.6261\times10^{-34}$ J·s, $c = 3\times10^{8}$ m/s, 1 eV = 1.6022×10^{-19} J.

Answer: **a)** 13.61 eV, **b)** -5.450×10^{-19} J = −3.401 eV, **c)** 434.2 nm.

2) In the emission spectrum of hydrogen atom, the Paschen series is obtained when an electron falls from higher energy levels to level 3. According to Bohr's theory, the energies allowed to an electron in the hydrogen atom are given by the so−called Bohr's Equation $E = -A/n^2$, where $A = 2.1799\times10^{-18}$ J and n is the quantum number of the energy level. Determine the energy of the photons (in eV) given off for the line number 5 of the Paschen series, its frequency and wavelength.

Data: $h = 6.6261\times10^{-34}$ J·s, $c = 3\times10^{8}$ m/s, 1 eV = 1.6022×10^{-19} J.

Answer: 1.299 eV, 3.141×10^{14} Hz, 955 nm.

3) According to Bohr's theory, the energies allowed to an electron in the hydrogen atom are given by the so−called Bohr's Equation $E = -A/n^2$, where $A = 2.1799\times10^{-18}$ J and n is the quantum number of the energy level. Determine:

a) First ionization energy of hydrogen atom in eV.
b) Energy of an electron (in J and eV) of a hydrogen atom when its energy level is 3.
c) The wavelength (in nm) of a photon given off when the electron falls from level 7 to level 3.

Data: $h = 6.6261\times10^{-34}$ J·s, $c = 3\times10^{8}$ m/s, 1 eV = 1.6022×10^{-19} J.

Answer: **a)** 13.61 eV, **b)** -2.422×10^{-19} J = −1.512 eV, **c)** 1005 nm.

4) In the emission spectrum of hydrogen atom, the Balmer series is obtained when an electron falls from higher energy levels to level 2. According to Bohr's theory, the energies allowed to an electron in the hydrogen atom are given by the so−called Bohr's Equation $E = -A/n^2$, where $A = 2.1799\times10^{-18}$ J and n is the quantum number of the energy level. Determine the energy of the photons (in eV) given off for the line number 3 of the Balmer series, its frequency and wavelength.

Data: $h = 6.6261\times10^{-34}$ J·s, $c = 3\times10^{8}$ m/s, 1 eV = 1.6022×10^{-19} J.

Answer: 2.857 eV, 6.909×10^{14} Hz, 434.2 nm.