## **Problem Solving Class: Van Quark tot Biomaterie**

Problem Set 7: Röntgen radiation and Resonance radiation Hand-in on paper Tuesday 14 October Hand-in digitally, email to: <u>m.t.talluri@vu.nl</u>; All documents in a single file [file: YourName-WC-Q7] All answers in English

## 1) Characteristic Röntgen radiation

- a) If for the element Aluminum (Z=13) the  $K\alpha$  wavelength is found at 0.8364 nm, then calculate the screening parameter  $z_{f}$ .
- b) Use this screening parameter. What is then the  $K\alpha$  wavelength for the element Manganese (Mn)?
- c) For what element the  $K\alpha$  wavelength is at 0.1798 nm.

## 2) Bremsstrahlung

Study the subject of Bremsstrahlung from the book.

If the Bremsstrahlung X-rays emitted from an X-ray tube have the shortest wavelength at  $\lambda$ =0.027 nm, what is then voltage across the tube.

Note that this is not element specific.

## 3) **Resonance radiation**

- a) Explain what the electron configuration of a sodium (natrium Na) is for its ground state.
- b) Explain what the simplest form of excitation of a Na atom is. Assume that the outer electron makes a quantum jump to this first excited level.
- c) Explain whether/why a transition between the ground state and this excited state is possible. (Selection rules)
- d) Na is known to absorb or emit light at 589 nm, the characteristic "yellow line". If that corresponds to the resonance line combining the ground state with the first excited state in the atom, what is then the excitation (in eV) of the Na atom.