Problem set 0, due on September 15, **before** the beginning of the lecture

This homework will help to ensure that you have some of the necessary and basic chemistry background for the course.

Motivate your solution sufficiently and make a sketch where necessary. You will get a part of the points for a correct outline and derivation of the solution even if you make a mistake and cannot provide the final result. This is not a group exercise, please solve individually.

1 State of matter of the elements (3 points)

Name the two elements which are liquid at ambient conditions. Name at least one element that is so soft that it can be easily cut with a knife. Except for the noble gases, which elements are gaseous at ambient conditions?

2 Elements and compounds (3 points)

Categorize the following materials/substances as consisting of either a single element or of multiple elements: (i) Ozone, (ii) Steel, (iii) Iron, (iv) Soot, (v) Quartz, (vi) Diamond.

3 Isotopes (4 points)

Define the term isotope. How can an element be lighter than another one, while also having a greater atomic number? Explain why the chemical properties (bonding properties) of two isotopes of the same element are basically identical, while physical properties like the boiling point and the density can vary more strongly.

4 Atomic dimensions (3 points)

To within an order of magnitude, what are the atomic and nuclear diameters, respectively? Why can the atomic radius not be determined precisely?

5 Chemical formulas (6 points)

Write down the chemical equations for the following elemental reactions. Indicate whether you will obtain individual *molecules* corresponding to the nominal chemical formula, or whether you will obtain crystals, at ambient conditions. Provide common (colloquial) names for the products. Earn two extra points for commenting on their toxicity. (i) Hydrogen and fluorine. (ii) Hydrogen and oxygen. (iii) Hydrogen and nitrogen. (iv) Hydrogen and carbon. (v) Carbon and oxygen (two different products). (vi) Sodium and chlorine. (vii) Silicon and oxygen.