1. Exercise General Chemistry 28.10.2024

WS 2024/25

Due Oct 31st, 2024, 2pm c.t., AR-H100

1.1

How many electrons can be in the shell n = 7? What atomic number would an element have, in which all shells up to and including n = 7 are fully occupied and there are no electrons in higher shells? Give reasons why such an element does not exist.

1.2

Discuss the bonds and geometry of the cyanic acid molecule (HCN): involved atomic orbitals, molecular orbitals, single and multiple bonds, lone pairs of electrons, formal charges, and bond angles.

1.3

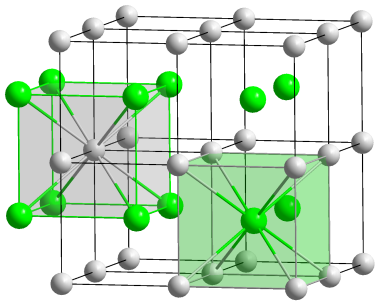
Discuss the bonds and geometry of the acetic acid molecule (CH_3COOH): involved atomic orbitals, molecular orbitals, single and multiple bonds, lone pairs of electrons, formal charges, and bond angles.

1.4

Give the Lewis formulas including lone pairs of electrons for the following molecules or ions: CCl_4, CH_2O, NO_3^-, N_2O_5 und NH_4Cl. Include mesomeric structures, if any exist.

1.5

Crystalline CsCl consists of two primitive cubic Cs^+ and Cl^- lattices. The lattice constant is 4.11 Å. Calculate the ionic radius of Cs^+ assuming that the anion and the cation are in mutual contact and the radius of the Cl^- is 1.81 Å. Compare the calculated value with the value listed in tables.



1.6

What are the dipole moments of CH_4, CH_3Cl, CH_2Cl_2, $CHCl_3$, $CHCl{=}CCl_2$, $ClC{\equiv}C\text{-}CClH_2$, $\begin{matrix} Cl \\ H \end{matrix}C{=}C\begin{matrix} Cl \\ H \end{matrix}$, $\begin{matrix} Cl \\ H \end{matrix}C{=}C\begin{matrix} H \\ Cl \end{matrix}$ expressed in multiples of the dipole moment of a C-Cl group? Suppose that the C-H group has no dipole moment and that the C-Cl dipole moment is not altered by the other bonds in the molecule.

1.7

How many molecules does 1 µg of pentane contain?

1.8

One half of compound A with a molar mass of 100 g/mol is dimerized to A_2. How many particles are there in 50 g of the compound?

1.9

Calculate the mass fraction of water in oxalic acid dihydrate.

1.10

Complete the following table:

Element	Z	MZ	Np	Nn	Ne
	18	40			18
	35	80			36
Ca^{2+}		40			
			15	16	18
I				74	