Lesson 08: Ceramics and polymers

Exercise 08.1 Polychlorotrifluoroethylene

a) Sketch the repeat unit (C_2ClF_3)
b) Calculate the molar mass of a monomer
c) Calculate the degree of polymerization in case of the molar mass being 10^6 g/mol?
d) What is the straightened chain length for a chain with molar mass 10^6 g/mol?
e) What is the start to end distance of a chain with a molar mass 10^6 g/mol?

Exercise 08.2: Ceramics

Magnesia is an ionic ceramic with the chemical formula MgO.
(a) Calculate the fraction of ionic bonding.
(b) Predict the crystal structure of MgO based on the ionic radii of Mg^{2+} (72 pm) and O^{2-} (140 pm).
(c) Predict the density of MgO.
(d) Compare with the density of pure Magnesium which is hexagonal and (almost) close packed. Why is MgO denser than the dense packed Mg, despite having lighter O atoms in the lattice?

Exercise 08.3 PE-C

Polyethylene can be modified by chlorination. This process leads to a substitution of hydrogen atoms by chlorine atoms.
a) Calculate the mass fraction (weight percentage) of chlorine in PE-C, if one fourth of the hydrogen atoms will be substituted by chlorine.
b) What changes in properties can be expected when PE is chlorinated to PE-C (e.g. mass density, melting temperature)
c) Is there a difference between PE-C and PVC? Explain your answer.

Exercise 08.4 Thermoplastic versus thermoset

Is it possible to cut polypropylene up for reusing the material?
Why are there efforts to replace thermosets by thermoplastics?

Exercise 08.5 Biopolymers

Where can we find polymers in nature?

Exercise 08.6 Polymer Crystallinity

Two PET batches differ in mass density and crystallinity as follows

	Mass density	Crystallinity
Batch A	1.408 g/cm^3	74.3 %
Batch B	1.343 g/cm^3	31.2 %

What is the mass densities in completely crystalline and completely amorphous regions?