

MATE 201

Fall 2019

Homework # 3

Due date: November 4th, 2019

(lecture time)

No late submissions!

Group submission (up to 4 students per group) is allowed.

Your homework submission should have a cover page which contains the following information;
your name, student number, course name, homework number and date of submission.

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Question 1:

What point defects are possible for MgO as an impurity in Al_2O_3 ? How many Mg^{2+} ions must be added to form each of these defects?

Question 2:

Based on the ionic charge and ionic radii, predict crystal structures for the following materials: (a) NiS, (b) KBr, and (c) CsBr.

Question 3:

Compute the atomic packing factor for the rock salt crystal structure in which $r_C/r_A = 0.414$

Question 4:

Calculate the theoretical density of FeO, given that it has the rock salt crystal structure.

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Question 5:

Calculate the number of Frenkel defects per cubic centimeter in silver chloride at 300°C . The energy for defect formation is 1.1 eV, while the density for AgCl is 5.50 g/cm^3 at 300°C .

$$N_{fr} = N \exp\left(-\frac{Q_{fr}}{2kT}\right)$$

Question 6:

Calculate the number of Frenkel defects per cubic centimeter in silver chloride at 300°C . The energy for defect formation is 1.1 eV, while the density for AgCl is 5.50 g/cm^3 at 300°C .

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Question 7:

The modulus of elasticity for spinel (MgAl_2O_4) having 4 vol% porosity is 245.3 GPa.

- Compute the modulus of elasticity for the nonporous material.
- Compute the modulus of elasticity for 9 vol% porosity.

Question 8:

- Compute the repeat unit molecular weight of polypropylene.
- Compute the number-average molecular weight for a polypropylene for which the degree of polymerization is 21000.

Question 9:

Molecular weight data for some polymer are tabulated here. Compute

- The number average molecular weight, and
- The weight-average molecular weight
- If it is known that this material's degree of polymerization is 760, which polymer is this?

Molecular Weight		
Range (g/mol)	x_i	w_i
8,000–20,000	0.05	0.02
20,000–32,000	0.15	0.08
32,000–44,000	0.21	0.17
44,000–56,000	0.28	0.29
56,000–68,000	0.18	0.23
68,000–80,000	0.10	0.16
80,000–92,000	0.03	0.05