INORGANIC MATERIALS

Final Test 100 points ..... name

1. a) (10 points) Consider coordination number of cations and anions in the following structure type compounds, fill the blank positions:

n:m = 1:1	CN (a:b)	n:m = 1:2	CN (a:b)	n:m = 1:3	CN (a:b)	n:m = 2:3	CN (a:b)
NaCl		CaF_2	8:4	ReO_3		Al_2O_3	6:4
CsCl		TiO_2 rutile	6:3	$AlCl_3$	6:2	♣♣♣♣♣	♣♣♣♣♣
ZnS		SiO_2 quartz		♣♣♣♣♣	♣♣♣♣♣	♣♣♣♣♣	♣♣♣♣♣
NiAs	6:6	♣♣♣♣♣	♣♣♣♣♣	♣♣♣♣♣	♣♣♣♣♣	♣♣♣♣♣	♣♣♣♣♣

b) (10 points) Devise a general rule which links stoichiometric coefficients n, m in M_nX_m with coordination numbers a and b for cations and anions, respectively.

2. (10 points) Zeolite-A (LTA) has a single peak in the ^{29}Si NMR spectrum (- 89 ppm) and has a Si/Al ratio of 1. Comment on these observations with respect to the Si and Al distribution and ordering.

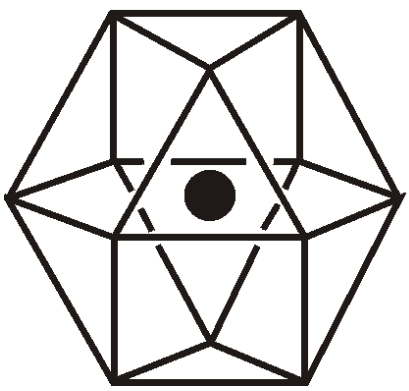
3. (20 points) Semiconductors of the 13/15 and 12/16 types frequently adopt the sphalerite (zinc blende) structure. Draw a unit cell of ZnS-blende and calculate the number of formula units in the unit cell.

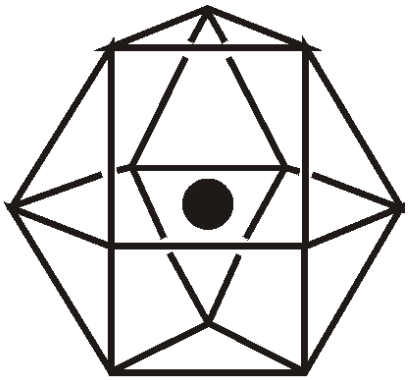
4. (10 points) Stishovite is a high-pressure modification of SiO_2 having the rutile structure. Should it have longer or shorter bond lengths then quartz?

5. (10 points) Which of these polyhedra represent the coordination environment of a metal atom in

a) copper

b) magnesium





6. The solid state reaction between CaO and SiO_2 is an important process in the cement and iron production (slag formation). Ca_2SiO_4 is formed in the first step. Write chemical reactions taking place at the interfaces and calculate the Kirkendall ratio for this process

a) (10 points) First, assume counter diffusion of Ca^{2+} and Si^{4+}

b) (20 points) The assumption a) is unrealistic, because the highly charged Si^{4+} is very strongly bound to the oxide network and its diffusion coefficient is negligible. Suggest alternative diffusion process and calculate the Kirkendall ratio.