**Tasks for seminar classes**

Fall semester 2022-2023 academic year

on the educational program "Theory and Problems of Physical Chemistry"

Module 1-2 Modern problems of electrochemistry

Lesson 1 - Calculations of the energy of the crystal lattice

1.The radii, rNa+​=95 pm and rCl−​=181 pm in NaCl (rock salt) structure. What is the shortest distance (in pm) between Na+ions?

2.If the radius of Na+ is 97 pm and radius of Cl− is 181 pm, the edge length (in pm) of the NaCl unit cell will be:

3.The radii, rNa+​=95 pm and rCl−​=181 pm in NaCl (rock salt) structure. What is the shortest distance (in pm) between Na+ ions?

4.A closed packed structure of uniform spheres has the edge length of 534 pm. Calculate the radius of sphere in pm if it exists in simple cubic lattice.

# 5.A closed packed structure of uniform spheres has the unit cell edge length equal to 0.8 mm.The radius (in mm) of molecule if it has simple cubic lattice will be:

6.KBr crystallizes in NaCl type of unit cell. K+ radius =1.33Å,Br− radius =1.95Å

(a) How many K+ ions and how many Br− ions are in each unit cell ?

(b) Assuming the additivity of ionic radii, what is a ?

(c) Calculate the density of a perfect KBr crystal

(d) What minimum value of r+/r− is needed to prevent anion-anion contact in this structure

7.NaCl forms an ionic crystal in which Cl- ions forms CCP lattice. The number of Na+ ions present at a distance of √5 A/2 from Cl- ion at the corner is

Lesson 2 - Calculations of the thermal effect of the destruction of the crystal lattice

Lesson 3 - Calculations of energy and enthalpy of hydration (solvation)

1.The lattice energy of CsI(s) is −604 KJ/mol, and the enthalpy of solution is 33 KJ/mol. How would you calculate the enthalpy of hydration (KJ) of 0.65 moles of CsI? Enter a numeric answer only, do not include units in your answer?

2. Calculate heat of solution of NaCl from the following data :

Hydration energy of Na ⊕=−389kJmol −1

Hydration energy of Cl ⊕ =−382kJmol −1

Lattice energy of NaCl=−776kJmol −1

# 3. calculate the heat of hydration of Na2​SO4​(s) from integral heat of solution of Na2​SO4​(s) and Na2​SO4​.10H2​O(s) in infinite amount of water, which are -2.34 kJmol−1 and 78.87 kJmol−1

# 4. One mole of anhydrous MgCl2​ dissolves in water and liberates 25cal/mol of heat. ΔHhydration​ of MgCl2​=−30cal/mol. Heat of dissolution if MgCl2​.H2​O is:

5. The enthalpy change of a solution for NaOH with differing amounts of water is shown. NaOH(s) + 3H₂O(l) ⟶ NaOH(aq), Δ𝐻\_sol = −28.9 kJ/mol NaOH(s) + 300H₂O(l) ⟶ NaOH(aq), Δ𝐻\_sol = −42.3 kJ/mol What is the enthalpy change of dilution, Δ𝐻\_dil?

6. When 85.0 g lithium perchlorate is dissolved in 375.0 g water in a coffee-cup calorimeter, the temperature changes from 20.18 °C to 31.21 °C. Calculate ΔHsolution for lithium perchlorate in kJ/mol. Use c = 4.18 J/(g °C) for the specific heat capacity of the solution.

Lessons 4 - Calculations according to the formulas of the theory of strong electrolytes

1.Calculate ionic strength, mean ionic activity coefficient γ±γ±, and the mean ionic molality m±m± for a 0.02 molal aqueous solution of zinc chloride, ZnCl2ZnCl2.

2.Determine the mean ionic activity coefficient and mean activity of a 0.004 molal of Ba(HCO3)2Ba(HCO3)2?

Lessons 5 - Fundamentals of statistical thermodynamics