WORKSHEET -SOLIDS

SetA:

1. Indicate the type of crystalline solid each of the following would form upon crystallization. Tell what type of particles (atoms, ions, polar molecules, nonpolar molecules) are located at the lattice points and the types of attractive forces between the particles.

	Type of crystalline solid	Type of particles At lattice points	Attractive forces between particles
SiC			
HBr			
Cu			
Br2			
NH_4ClO_3			

2a. Draw and label the Börn-Haber cycle for the formation of strontium chloride from strontium and chlorine.

2b. Write the equation for each step of the cycle and use the following constants to calculate the enthalpy for formation of strontium chloride.

Enthalpy of sublimation of strontium: +164 kJ/mole
First ionization energy for strontium: +549 kJ/mole
Second ionization energy for strontium: +1064 kJ/mole
Enthalpy of dissociation (bond energy) of chlorine, Cl_2: +243 kJ/mole
The electron affinity of chlorine, Cl: −349 kJ/mole
Lattice energy of strontium chloride: −2150 kJ/mole

Answer= −828 kJ

3. Crystalline aluminum has cubic structure. The unit edge length is 4.05×10^{-8} cm. The density of solid aluminum is 2.6989 g/cm^3 Calculate the number of aluminum atoms in one unit cell.

(Answer = 4 atoms/unit cell)

4. Give the name of the constant used to calculate the energy, ΔH, of each of the following processes:

$2\ Cs^+(g) + O^{2-}(g) \longrightarrow Cs_2O(s)$ _____

$O(g) + 1\ e^- \longrightarrow O^-(g)$ _____

$2\ Cs(s) + \frac{1}{2}\ O_2(g) \longrightarrow Cs_2O(s)$ _____

5. The volume of a manganese atom is 9.21×10^{-24} cm^3. Manganese crystallizes in a face-centered cubic system. What is the density of manganese?

Answer: 7.33 g/cm^3

Set B:

1a. Draw and label the Börn-Haber cycle for the formation of calcium oxide from calcium and oxygen.

1b. Write the equation for each step of the cycle, and use the following constants to calculate the lattice energy of calcium oxide.

Heat of formation of calcium oxide: −636 kJ/mole
Enthalpy of sublimation of calcium: +192 kJ/mole
First ionization energy for calcium: +590 kJ/mole
Second ionization energy for calcium: +1145 kJ/mole
Enthalpy of dissociation (bond energy) of oxygen, O_2: +494 kJ/mole
First electron affinity of oxygen, O: −141 kJ/mole
Second electron affinity of O: +845 kJ/mole

Answer: -3514 kJ

2. $CaCl_2$ crystallizes in a cubic lattice. The unit cell has an edge of 4.77×10^{-8} cm. The density of $CaCl_2$ is 6.80 g/cm^3. How many formula units of $CaCl_2$ are there per unit cell?

Answer: 4 formula units

3. A metal crystallizes in a face centered cubic packing structure and its density is 9.25 g/cm^3. What is the molar mass of the metal, if the volume of one atom of the metal is 8.23×10^{-24} cm^3?

Answer: 61.8 g/mole

4a. Name the five types of crystalline solids.

4b. Indicate the type of crystalline solid each of the following would form upon crystallization. Tell what type of particles (atoms, ions, polar molecules, nonpolar molecules) are located at the lattice points and the types of attractive forces between the particles.

	Type of crystalline solid	Type of particles At lattice points	Attractive forces between particles
S_8			
HF			
$KMnO_4$			
Ni			
Si			

Set C:

1a. Draw and label the Börn-Haber cycle for the formation of cesium oxide from cesium and oxygen.

1b. Write the equation for each step of the cycle, and use the following constants to calculate the lattice energy of cesium oxide.

Heat of formation of cesium oxide: −233 kJ/mole
Enthalpy of sublimation of cesium: +78 kJ/mole
First ionization energy for cesium: +375 kJ/mole
Enthalpy of dissociation (bond energy) of oxygen, O_2: +494 kJ/mole
First electron affinity of oxygen, O: −141 kJ/mole
Second electron affinity of O: +845 kJ/mole

Answer: −2090 kJ

2. Nickel has a cubic unit cell. The edge of the unit cell is 3.524×10^{-8} cm. The density of nickel is 8.91 g/cm^3
   a. How many nickel atoms are in the unit cell?
   b. What is the radius of a nickel atom?

Answers: 2a. 4 atoms 2b. 1.25×10^{-8} cm

3. The volume of a metal atom is 7.24×10^{-24} cm^3. The metal crystallizes in a face-centered cubic structure. The density of the metal is 8.77 g/cm^3. What is the molar mass of the metal?

Answer: 51.5 g/mole

4. Indicate the type of crystalline solid each of the following would form upon crystallization. Tell what type of particles (atoms, ions, polar molecules, nonpolar molecules) are located at the lattice points and the types of attractive forces between the particles.

	Type of crystalline solid	Type of particles At lattice points	Attractive forces between particles
NH_4HS0_4			
SiO_2			
Si			
HCl			
Al			
I_2			

5. Manganese crystallizes in a face-centered cubic system. The radius of one manganese atom is 1.30×10^{-8} cm. What is the density of manganese?

Answer: 7.33 g/cm^3

6. Associate each of the solids: CsI, SiO_2, Ni, and $SiCl_3H$ with one of the following sets of properties:

a. A very hard solid subliming at 2900°C. a. _____

b. A yellowish solid having a melting point of 40°C and is a nonconductor of electricity when molten (in the liquid state). b. _____

c. A lustrous solid melting at about 1600°C. This substance conducts electricity in both the solid and liquid states. c. _____

d. A white solid melting at about 700°C. This substance conducts electricity in the liquid state, but not in the solid state d. _____