

PROBLEM SET #6

- 1.) At constant temperature of 273 K, if you compress 1.0 mole of gas from a pressure of 101.3 kPa to a pressure of 202.6 kPa, the work required is 1573 kJ. What is the internal energy change? (10 points)
- 2.) A balloon is heated very slowly, and absorbed 500 kJ of heat. It expanded against a constant pressure of the atmosphere (101.3 kPa) and did 350 kJ of work. Calculate the change in internal energy,  $dE$ . (10 points)
- 3.) You are doing an experiment to change aragonite to calcite at 25°C and 1 bar. The heat absorbed by the system is 59 calories/mole  $\text{CaCO}_3$ . The volume of calcite is 36.94  $\text{cm}^3$ /mole and that of aragonite is 34.16  $\text{cm}^3$ /mol. Calculate the change in internal energy for the reaction of aragonite to calcite. (One conversion that you will need to know: 1 cal/bar = 41.84  $\text{cm}^3$ ). (20 points)
- 4.) How many components, phases, and degrees of freedom in the system in the last question? (10 points)
- 5.) Which of the following are intensive properties of a system? Which are extensive? (20 points)
  - a). pressure; b). temperature; c). volume; d). molar volume
  - e). molar heat capacity; f). internal energy
  - g). chemical composition; h). density
- 6.) Think about the following five minerals:
  - Andalusite ( $\text{Al}_2\text{SiO}_5$ )
  - Sillimanite ( $\text{Al}_2\text{SiO}_5$ )
  - Kyanite ( $\text{Al}_2\text{SiO}_5$ )
  - Corundum ( $\text{Al}_2\text{O}_3$ )
  - Quartz ( $\text{SiO}_2$ )

If you find a rock sample that is composed of the following three minerals:  
andalusite, sillimanite, and kyanite

How many components, phases, and degrees of freedom does this system have? Is this system at equilibrium? (15 points)

- 7.) Would you expect to find a rock sample that contains: andalusite, sillimanite, kyanite, corundum, and quartz? Why or Why not? (15 points)