Problem Session # 7

1) Calculate $\Delta S°_r$ for the reaction H_2 (g) + Cl_2 (g)→ 2HCl (g) at 725 K. Omit terms in the temperature-dependent heat capacities higher than T^2/K^2.

$$C^0_p(H_2,g) = 22.66 + 4.38x10^{-2}T/K - 1.0835x10^{-4}T^2/K^2 \ (JK^{-1}mol^{-1})$$

$$C^0_p(Cl_2,g) = 22.85 + 6.543x10^{-2}T/K - 1.2517x10^{-4}T^2/K^2 \ (JK^{-1}mol^{-1})$$

$$C^0_p(HCl,g) = 29.81 - 4.12x10^{-3}T/K + 6.2231x10^{-6}T^2/K^2 \ (JK^{-1}mol^{-1})$$

S^0_{298} (HCl,g)=186.9 $J.K^{-1}.mol^{-1}$ S^0_{298} (Cl_2,g)=223.1 $J.K^{-1}.mol^{-1}$ S^0_{298} (H_2,g)=223.1 $J.K^{-1}.mol^{-1}$

2) The amino acid glycerine dimerizes to form dipeptide glycylglycine according to the reaction

2 Glycine (s) → Glycylglycine (s) + H_2O (l)

Calculate ΔS at T 298 K. Useful thermodynamic data are:

	Glycine	Glycylglycine	Water
S° ($JK^{-1}mol^{-1}$)	103.5	190.0	70.0

3) Determine the change in the entropy the following chemical reaction occuring at standard pressure and the stated temperature.

$2H_2$ (g) + O_2 (g)→ $2H_2O$ (l)

S° [H_2 (g)]=130.7 (J/mol.K), S° [O_2 (g)]=205.1 (J/mol.K), S° [H_2O (l)]=69.91 (J/mol.K)

4) Calculate ΔS if the temperature of 1.75 mol of an ideal gas with $C_{v,m} = (3/2)R$ is increased from 195 to 425 K under conditions of a) constant pressure b) constant volume.

5) What is the entropy change of the reaction
$2H_2$ (g) + O_2 (g)→ $2H_2O$ (l) at 99°C and standard pressure? Treat the heat capacities of H_2, O_2, H_2O as constant at 28.8, 29,4 and 75.3 J/mol.K,

respectively. Assume molar quantities based on the balanced chemical reaction and ideal gas behavior.
ΔS^0_{298}=-326.7 $J.K^{-1}.mol^{-1}$

6) If an isolated flask 200 g of gold at 120°C are added to 25 g of water at 10°C. 5g of ice at -10°C is added in to this isolated flask.
If heat capacities are $C_p(H_2O, s)$ =0.5 cal.K/g , $C_p(H_2O, l)$ =1.0 cal.K/g
$C_p(Au)$= 0.0313cal.K/g $\Delta H_{m,water}$=80 cal/g

a) What is the final temperature of the system?

b) Calculate ΔS for the transformation.