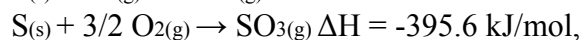
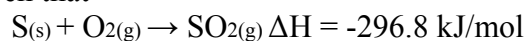


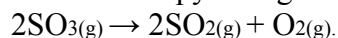
Spring 2006 CH302: Worksheet 1c
More Challenging Thermodynamics Multiple Choice problems

• **Hess's Law and combined reaction enthalpies**

1. Given that



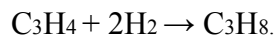
determine the enthalpy change for the decomposition reaction



2. Given that



determine the heat of the reaction for



• **Internal Energy calculations**

3. The standard molar heat of freezing for water is -6020 J/mol . Calculate q , w , and ΔE for freezing 1.0 mol of water at 0°C and 1 atm pressure. (Hint: there is no need to use a calculator.)

4. For a reaction in which more moles of gas are produced than are consumed (at constant pressure), ΔH is

- a) Equal to ΔE
- b) Less than ΔE
- c) Greater than ΔE

• **Statistical thermodynamics: internal energy theory**

5. What is the total motional contribution to the molar internal energy of CO_2 ? (Express your answer in amounts of RT .)

6. What is the total motional contribution to the molar internal energy of NH_3 ? (Express your answer in Amounts of RT .)

• **Statistical thermodynamics: heat capacity theory**

7. When 25g of a metal at 90°C is added to 50 g of water at 25°C , the temperature of the water rises to 29.8°C . What is the specific heat capacity of the metal?

• **Calculation of the entropy change at a phase transition**

8. What is the entropy change for the freezing of 3.33 grams of an alcohol, C_2H_3OH , at 373.2K given that $\Delta H = -40,700 \text{ J/mol}$?

• **Statistical thermodynamics: Boltzmann formula**

9. Use the Boltzmann formula to calculate the entropy at $T = 0$ for
- a mole of NCl_3 that can be oriented one way
 - a mole of NCl_2Br that can be oriented three ways

• **Statistical thermodynamics: Third Law**

10. Based on the structures of each of the following molecules, which are most likely to have a residual energy in their crystal forms at $T = 0$?

- a) CO_2 b) O_3 c) HCl d) Cl_2

• **Entropy Change and the surrounding**

11. When a sugar cube dissolves in a cup of coffee (an endothermic process), what the the signs of the entropy change for the system, surroundings and universe, respectively.

- , -, -
- , +, +
- +, -, +
- +, +, +
- none are correct

• **Calculating the change in free energy**

12. Calculate ΔG° for the reaction $2N_2(g) + 3O_3(g) \rightarrow 2 N_2O_3(g)$ at $25^\circ C$

	ΔH_f°	S°
N_2	0	191.5
O_3	0	205
N_2O_3	83.72	312.2

- 540 kJ/mol rxn
- 278.7 kJ/mol rxn
- 561 kJ/mol rxn
- 540 kJ/mol rxn
- +56 kJ/mol rxn