

CHEM441-001/002  
College of Charleston  
Fall 1999  
Exam III

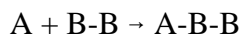
1(25). The molar mass of gaseous IO is  $142.9 \text{ g mol}^{-1}$ ; the vibrational frequency of the ground state is  $681.6004 \text{ cm}^{-1}$ ; and the moment of inertia is  $8.228 \times 10^{-46} \text{ kg m}^2$ . At  $25 \text{ }^\circ\text{C}$  and  $1.00 \text{ bar}$ , calculate the molar

- a) translational partition function
- b) rotational partition function
- c) vibrational partition function
- d) complete molecular partition function

2(15). The important energy levels of gaseous IO consist of a doubly degenerate ground level, a doubly degenerate first excited level at  $25\,014 \text{ J mol}^{-1}$ , and a doubly degenerate second excited level at  $257\,889 \text{ J mol}^{-1}$ . Calculate the partition function at

- a)  $25 \text{ }^\circ\text{C}$
- b)  $T \rightarrow 0$
- c)  $T \rightarrow \infty$

3(10). Consider the reaction



Excluding electronic and vibrational contributions, calculate  $\Delta U$  assuming

- a) A-B-B to be linear
- b) A-B-B to be nonlinear

4(25). Calculate  $\Delta H(\text{thermal})$  at  $1000 \text{ K}$  for  $\text{NH}_3(\text{g})$ . The vibrational information is  $\tilde{\nu}/(\text{cm}^{-1}) = 3506, 1022, 3577$  (doubly degenerate), and  $1691$  (doubly degenerate).

5(25). The heat capacity of  $\text{NH}_3(\text{g})$  at  $1000 \text{ K}$  is  $C_p = 56.491 \text{ J K}^{-1} \text{ mol}^{-1}$  and can be considered to be constant over small temperature changes. A molar sample of ammonia was subjected to a process in which the sample released  $265 \text{ J}$  of heat to the surroundings and delivered  $112 \text{ J}$  of work to the surroundings. What temperature change occurred in the system?