

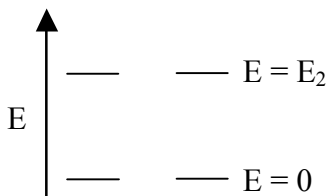
CH353 – Physical Chemistry I  
Spring 2013, Unique 52575

Homework, Week 11

1. Define the following terms in clear, comprehensible English:

- a) microscopic property
- b) macroscopic property
- c) partition function
- d) energy of a monatomic species
- e) energy of a polyatomic species
- f) degeneracy

2. The following diagram displays the lowest electronic energy states of the NO molecule:



- a) Determine the partition function  $q$  for this system.
- b) Plot  $q$  vs.  $T$ . Be sure to indicate the low- and high- $T$  limits.
- c) Plot the probability of each level vs.  $T$ . Be sure to indicate the low- and high- $T$  limits.

3. The lowest three electronic energy levels for the tellurium atom have the following energies and degeneracies:

Level	Energy	Degeneracy
3	$2\Delta$	3
2	$\Delta$	1
1 (ground)	0	5

- a) Determine the partition function  $q$  for this system.
- b) Plot  $q$  vs.  $T$ . Be sure to indicate the low- and high- $T$  limits.
- c) Plot the probability of each level vs.  $T$ . Be sure to indicate the low- and high- $T$  limits.

5. For the rigid rotator, the energy levels are described by

$$\epsilon_{rot} = \frac{\hbar J(J+1)}{2I}, J = 0, 1, 2, \dots$$

and each level has a degeneracy of

$$g_i = 2J + 1$$

Draw a labeled energy level diagram of all states in  $J = 0, 1,$  and  $2$  (i.e. in the three lowest energy levels).