

AST 300B – Spring 2018

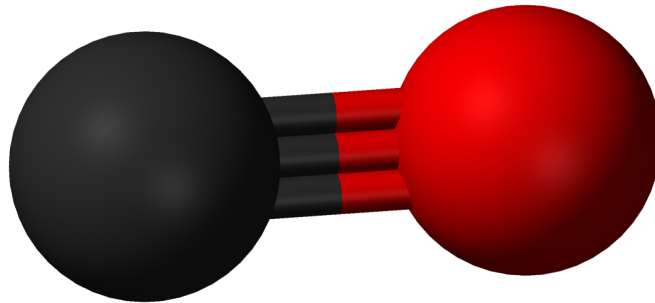
In-class/Take-home Problems Due: Monday March 26

30. The CO molecule has rotational energy levels quantized by the rotational angular momentum of the molecule denoted $J = 0, 1, 2$, etc. Observational of molecular clouds indicate that the typical CO excitation temperature is $\sim 10\text{K}$.

(a) Using the table below of the first few rotational energy levels of CO, calculate the “rotational partition function” at 10 K.

(b) Calculate the fraction of CO molecules that are in the $J=0$, $J=1$, and $J=2$ levels at 10K.

(c) What is the frequency (GHz) and wavelength (mm) of the ground state $J=1-0$ transition?



CO Rotational Energy Levels

J	E/k (K)	$g (=2J+1)$
0	0	1
1	5.532	3
2	16.596	5
3	33.192	7
4	55.318	9
5	82.974	11