

HOMEWORK ASSIGNMENT # 4

Due: Tuesday, 12 February

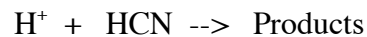
1. Complete the derivation sketched out in class for the Langevin rate coefficient. This is the rate coefficient that pertains to collisions between ions and non-polar neutrals:

$$k_L = 2\pi \sqrt{\frac{e^2 \alpha}{\mu}}$$

2. Consider an H_3^+ ion in a typical dense interstellar cloud, with total gas density 10^4 cm^{-3} and temperature 10 K. Determine the time interval between collisions with (a) H_2 molecules and (b) CO molecules, using the Langevin rate coefficient for the collisional rate. Then, determine the mean free path of the H_3^+ ion between successive H_2 collisions.

3. For the dissociative recombination of HN_2^+ with electrons, look up relevant heats of formation to find how many exothermic product channels exist and what their exothermicities are. Which product channel would you guess to be dominant? Why?

4. Using formulae given in class, estimate the rate coefficient at 10 K for the following reaction:



How much larger is your rate coefficient than the Langevin value?