

## Homework #10

### Problem #1

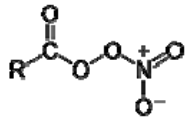
A circular cylinder of radius  $R$  rotates about the long axis with angular velocity  $\omega$ . The cylinder contains an ideal gas of atoms of mass  $m$  at temperature  $T$ . (The centrifugal force can be treated similar to the gravitational force in the atmosphere problem solved in class)

- Find an expression for the dependence of the concentration  $n(r)$  on the radial distance  $r$  from the axis, in terms of  $n(0)$  on the axis.
- What portion of the atoms in the cylinder is located in its central part between  $r=0$  and  $r=R/2$

### Problem #2

Inversion in SLC.

During the inversion in SLC, the pollution is caused in part by car exhaust which contains NO, CO and heavier molecules such as peroxyacetyl nitrate  $C_2H_3NO_5$



For each of those molecules compute the ratio of the concentrations in Alta and in down town SLC. Argue whether the inversion is equilibrium or non-equilibrium phenomenon.

### Problem #3

Monoatomic molecules (total number is  $N$ ) adsorbed on a surface are free to move on this surface and can be treated as a classical two-dimensional gas. Temperature is  $T$ .

- Write an expression for a probability to find a molecule with the velocity in the range between  $\vec{v}$  and  $\vec{v} + d\vec{v}$  ( $v_x$  and  $v_x + dv_x$ ;  $v_y$  and  $v_y + dv_y$ ) Evaluate normalization constant.
- Write an expression for a probability to find a molecule with the speed in the range between  $v$  and  $v + dv$ .
- What is the average number of molecules that have the speed in the range between  $v$  and  $v + dv$ ?
- 3 point of extra-credit. What is the heat capacity of this “surface” gas of  $N$  molecules?