CHEMISTRY 253
Spring, 2015 - Dixon
Group Assignment #2

Group Names _____

Stratospheric Chemistry Problem:

1. By carrying out a number of calculations or thought experiments, we can better understand the Chapman Mechanism chemistry involving ozone production and destruction.

The Chapman mechanism reactions are:
1) $O_2 + h\nu \rightarrow 2O$
2) $O + O_2 + M \rightarrow O_3 + M$
3) $O_3 + h\nu \rightarrow O_2 + O$
and 4) $O + O_3 \rightarrow 2O_2$

Answer the following specific questions:
1. What does M refer to in step 2)?

2. If the rate constant, k, for reaction 2 is 2 $x10^{-33}$ cm^6 $molec^{-2}$ s^{-1}, calculate the lifetime of O atoms with respect to loss by reaction 2 at 25 km if P_{air} = 0.04 atm and $\%O_2$ by volume = 20%. Assume T = -40°C. R = 0.0821 L atm/mol K and 0°C = 273 K.
Hint: you can use the ideal gas law to get n/V in mol/L and then convert to molec cm^{-3}. The lifetime (in s) can be calculated as the ratio of the concentration (molec cm^{-3}) to the sink (molec O cm^{-3} s^{-1}), cancelling out [O] (since it is not given).
$N_{Avagadro}$ = 6.02 x 10^{23} molecules/mol

3. Within the stratosphere, how will the lifetime of O with respect to reaction 2 depend on altitude?

4. At night in the stratosphere, reactions 1 and 3 are stopped. Would you expect the concentration of O_3 to decrease to zero? What about the concentration of O atoms? You can assume that the concentration of O_3 is much higher than O atoms.