3. Nitrogen monoxide, $NO(g)$, and carbon monoxide, $CO(g)$, are air pollutants generated by automobiles. It has been proposed that under suitable conditions these two gases could react to form $N_2(g)$ and $CO_2(g)$, which are components of unpolluted air.

(a) Write a balanced equation for the reaction described above. Indicate whether the carbon in CO is oxidized or whether it is reduced in the reaction. Justify your answer.

(b) Write the expression for the equilibrium constant, K_p, for the reaction.

(c) Consider the following thermodynamic data.

	NO	CO	CO$_2$
ΔG_f° (kJ mol^{-1})	+86.55	−137.15	−394.36

   (i) Calculate the value of $\Delta G°$ for the reaction at 298 K.

   (ii) Given that $\Delta H°$ for the reaction at 298 K is -746 kJ per mole of $N_2(g)$ formed, calculate the value of $\Delta S°$ for the reaction at 298 K. Include units with your answer.

(d) For the reaction at 298 K, the value of K_p is 3.3×10^{120}. In an urban area, typical pressures of the gases in the reaction are $P_{NO} = 5.0 \times 10^{-7}$ atm, $P_{CO} = 5.0 \times 10^{-5}$ atm, $P_{N_2} = 0.781$ atm, and $P_{CO_2} = 3.1 \times 10^{-4}$ atm.

   (i) Calculate the value of ΔG for the reaction at 298 K when the gases are at the partial pressures given above.

   (ii) In which direction (to the right or to the left) will the reaction be spontaneous at 298 K with these partial pressures? Explain.

GO ON TO THE NEXT PAGE.