Carbon dioxide in the air is in equilibrium with carbon dioxide in water.

$$f_{CO_2}^{v} = f_{CO_2}^{l}$$ *(1 point)*

For Henry's Law as the reference state,

$$y_{CO_2}\phi_{CO_2}P = x_{CO_2}\gamma_{CO_2}^{Henry's}\mathrm{H}_{CO_2}(Poynting)$$

(2 points)

Rearranging to get K_{CO2}

$$K_{CO_2} = \frac{y_{CO_2}}{x_{CO_2}} = \frac{\gamma_{CO_2}^{Henry's}\mathrm{H}_{CO_2}(Poynting)}{\phi_{CO_2}P}$$

(2 points)

Assumption 1: As P < 100 bar, Poynting correction can be assumed to be 1.

Assumption 2: As the amount of dissolved CO_2 is assumed to be small, CO_2 molecules can be assumed to be surrounded by water molecules only. Thus the interactions with respect to CO_2 molecules are all CO_2-water interactions. The liquid phase can then be assumed to be ideal solution, *(2 points)*

$$\gamma_{CO_2}^{Henry's} \approx 1.$$ *(1 point)*

Assumption 3: As the pressure is at 2 atm, the vapor phase can be assumed to be ideal,

(2 points)

$$\phi_{CO_2} \approx 1.$$ *(1 point)*

$$K_{CO_2} = \frac{y_{CO_2}}{x_{CO_2}} = \frac{\mathrm{H}_{CO_2}}{P}$$ *(2 points)*

$$K_{CO_2} = \frac{1700atm}{2atm}$$

$$\boxed{K_{CO_2} = 850}$$ *(2 points)*