

Revised December 2008

AP WORKED ANSWERS

2008, 1

Points 1, 2, 3, 1, 2

$$(a) K_p = \frac{(ppCO)^2}{ppCO_2}$$

(b) At Time = 0, of the two gases only $CO_{2(g)}$ is present, so;

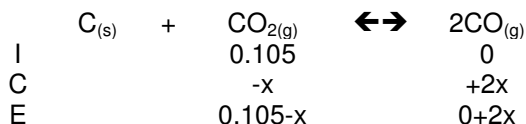
$$P V = n R T$$

$$n = \frac{(5.00 \text{ atm})(2.00 \text{ L})}{(0.0821 \text{ atm L mol}^{-1} \text{ K}^{-1})(1160 \text{ K})}$$

$$= \underline{\mathbf{0.105 \text{ mols}}}$$

(c)(i)

Two methods, FIRST in terms of MOLES;



Total moles of gas at equilibrium = $0.105 + x$

$ppCO_{2(g)}$ at equilibrium = 1.63 atm

= (mole fraction CO_2)(Total Pressure)

$$= \frac{0.105 - x}{(0.105 + x)} (8.37 \text{ atm})$$

$$x = 0.07077$$

So mole fraction of $CO_{2(g)}$ = 0.1947

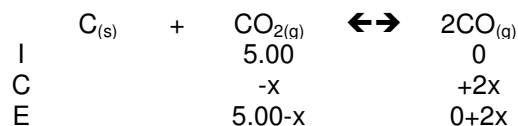
So mole fraction of $CO_{(g)}$ = $1 - 0.1947$

$$= 0.8053$$

So $ppCO_{(g)}$ = $(0.8053)(8.37) = \underline{\mathbf{6.74 \text{ atm}}}$

(c)(i) continued: OR

SECOND in terms of PARTIAL PRESSURES
(I prefer since it is easier);



Total pressure at equilibrium = $5.00 + x$

= 8.37 atm, so, $x = 3.37$ atm,

so $ppCO_{(g)}$ = $(2)(3.37) = \underline{\mathbf{6.74 \text{ atm}}}$

$$(ii) K_p = \frac{(ppCO)^2}{ppCO_2} = \frac{(6.74)^2}{1.63} = \underline{\mathbf{27.9}}$$

(units ignored)

(d) Total pressure would be equal with the catalyst. A catalyst only increases the speed at which the equilibrium is established, NOT the position of the equilibrium.

$$(e) Q = \frac{(2.00)^2}{2.00} = 2.00$$

The reaction must proceed to the product side in order to reach equilibrium (Q must increase in order to reach K_p at the same temperature)
so the partial pressure of $CO_{2(g)}$ will decrease.