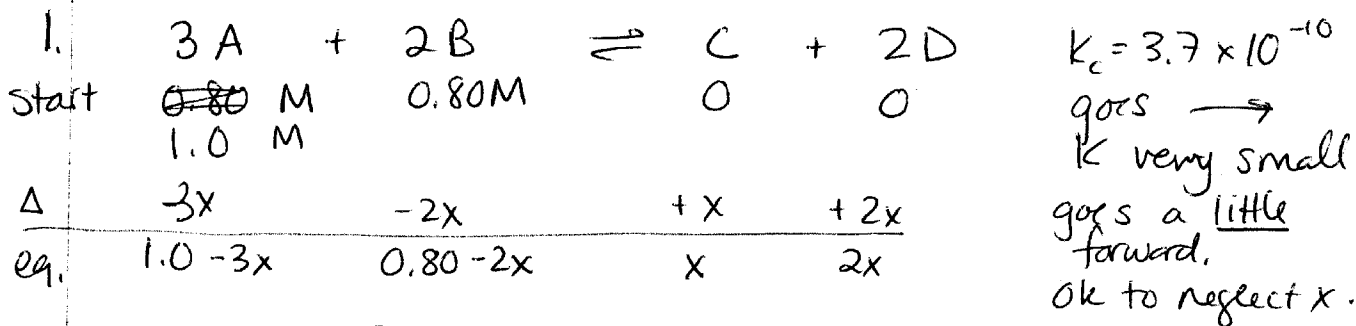


## Answers - Practice Equilibrium Problems



$$K_c = \frac{[C][D]^2}{[A]^3[B]^2} = \frac{(x)(2x)^2}{(1.0-3x)^3(0.80-2x)^2}$$

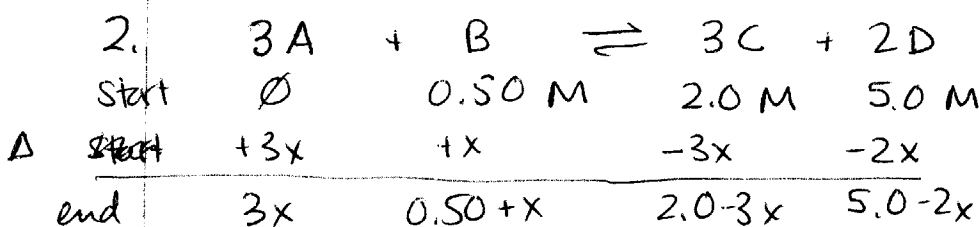
neglect x's

$$K_c = \frac{(x)(4x^2)}{(1.0)^3(0.80)^2} = 3.7 \times 10^{-10}$$

$$4x^3 = 3.7 \times 10^{-10} (1.0)^3 (0.80)^2$$

$$x = \sqrt[3]{\frac{(3.7 \times 10^{-10})(1.0)^3(0.80)^2}{4}} = 3.897 \times 10^{-4} \text{ M}$$

[A] = 1.0 M      [C] =  $3.9 \times 10^{-4}$  M  
[B] = 0.80 M      [D] =  $2x = 7.8 \times 10^{-4}$  M



must go  $\leftarrow$  to make some A.  
K reverse is huge.  
Goes  $\leftarrow$  to completion then forward a little to equilibrium.  
2 charts.

which is LR?

Need  $\frac{3C}{2D} = \frac{1.5C}{1D}$

Have  $\frac{\cancel{5.0D}}{2.0} = \frac{2.0C}{5.0D}$

Have  $\frac{0.4C}{1D}$  not enough C so C is LR.

LR  $\rightarrow \emptyset$

$$C: 2.0 - 3x = 0$$

$$\frac{2.0}{3} = \frac{3x}{3} \quad x = \frac{2}{3} = 0.6\bar{6}67$$

$$[A] = 3x = 3(0.6\bar{6}67) = 2.0 \text{ M}$$

$$[B] = 0.50 + 0.6\bar{6}67 = 1.1\bar{6}67 \text{ M}$$

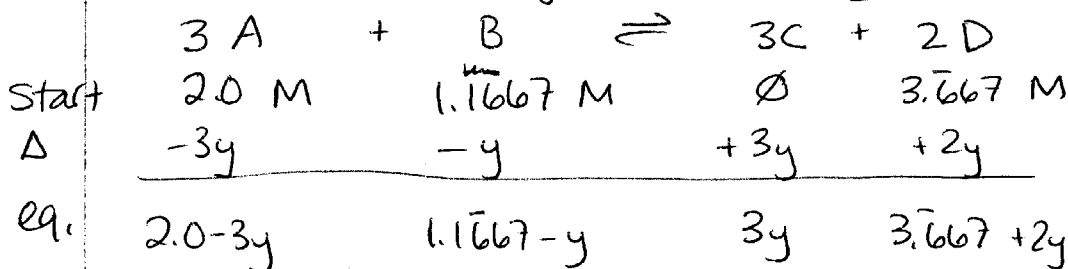
$$[C] = 0$$

$$[D] = 5.0 - 2(x) = 3.6\bar{6}67 \text{ M}$$

2nd Chart

goes forward a little

y is very small.



$$K_c = 3.2 \times 10^{-13} = \frac{[C]^3 [D]^2}{[A]^3 [B]} = \frac{(3y)^3 (3.6\bar{6}67 + 2y)^2}{(2.0 - 3y)^3 (1.1\bar{6}67 - y)} = 3.2 \times 10^{-13}$$

neglect y's

$$\frac{27 y^3 (3.6\bar{6}67)^2}{(2.0)^3 (1.1\bar{6}67)} = 3.2 \times 10^{-13}$$

solve for y

$$y = \sqrt[3]{\frac{(3.2 \times 10^{-13})(2.0)^3 (1.1\bar{6}67)}{(27)(3.6\bar{6}67)^2}} = \frac{2.0 \times 10^{-5} \text{ M}}{2.0187 \times 10^5}$$

equilibrium concentrations

$$[A] = 2.0 \text{ M}$$

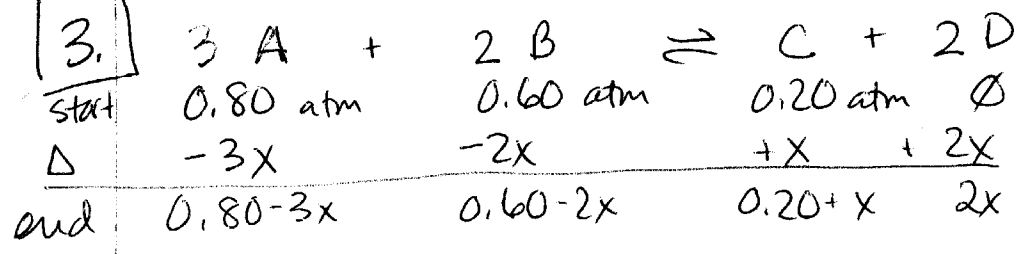
$$[B] = 1.17 \text{ M}$$

$$[C] = 3y = 6.1 \times 10^{-5} \text{ M}$$

$$[D] = 3.7 \text{ M}$$

(using unrounded value for y)

3.



P. 3  
 $K_p = 5.8 \times 10^{10}$   
 K is huge.  
 Rxn goes forward to make some D.  
 will go to completion  $\rightarrow$   
 then back a little to get to equilibrium,  $\leftarrow$

Need  $\frac{3A}{2B} = \frac{1.5A}{1B}$  Have  $\frac{0.8A}{0.6B} = \frac{1.3A}{1B}$

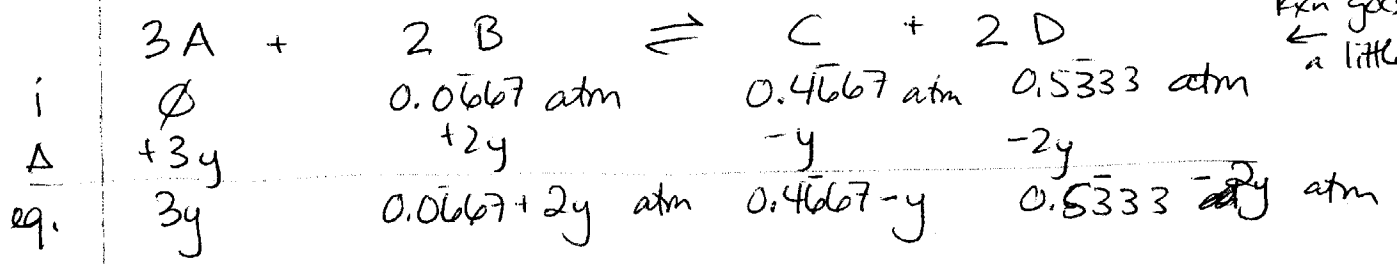
not enough A, so A is LR and it goes to zero.

2 charts

$0.80 - 3x = \emptyset$   
 $\frac{0.80}{3} = \frac{3x}{3}$

$x = 0.2667 \text{ atm}$   
 $P_B = 0.60 - 2x = 0.60 - 2(0.2667) = 0.0667 \text{ atm}$  (2 dec places)  
 $P_C = 0.20 + x = 0.20 + 0.2667 = 0.4667 \text{ atm}$   
 $P_D = 2x = 2(0.2667) = 0.5333$

K reverse is tiny.  
 Rxn goes  $\leftarrow$  a little



$$K_p = 5.8 \times 10^{10} = \frac{P_C P_D^2}{P_A^3 P_B^2} = \frac{(0.4667 - y)(0.5333 - 2y)^2}{(3y)^3 (0.0667 + 2y)^2} = 5.8 \times 10^{10}$$

neglect y's because they will be very tiny.

$$K_p = \frac{(0.4667)(0.5333)^2}{27y^3 (0.0667)^2} = 5.8 \times 10^{10}$$

$$y = \sqrt[3]{\frac{(0.4667)(0.5333)^2}{27(0.0667)^2(5.8 \times 10^{10})}} = \sqrt[3]{1.905 \times 10^{-11}} = 2.67 \times 10^{-4} \text{ M}$$

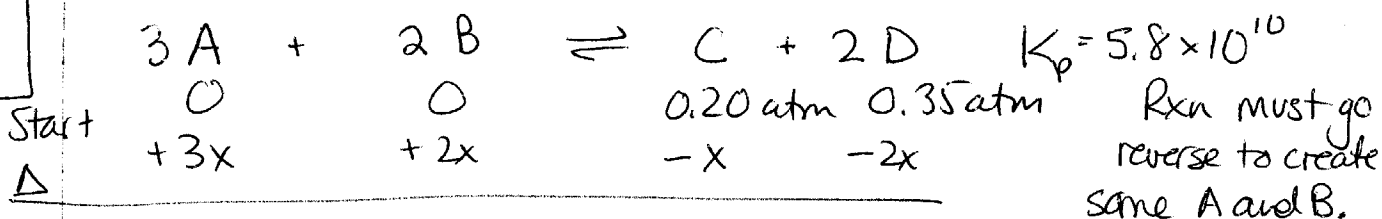
$$P_A = 3y = 8.0 \times 10^{-4} \text{ atm}$$

$$P_B = 0.0667 + 2y = 0.07 \text{ atm}$$

$$P_C = 0.4667 - y = 0.47 \text{ atm}$$

$$P_D = 0.5333 - 2y = 0.53 \text{ atm}$$

4.



$$K_p = 5.8 \times 10^{10} = \frac{P_C P_D^2}{P_A^3 P_B^2} = \frac{(0.20-x)(0.35-2x)^2}{(3x)^3 (2x)^2}$$

$K_{\text{reverse}}$  is very small,  
so it will go a little  
bit, in the reverse  
direction.

neglect x's - they  
will be very small.

$$K_p = \frac{(0.20)(0.35)^2}{27x^3 4x^2} = 5.8 \times 10^{10}$$

$$\frac{(0.20)(0.35)^2}{27 \cdot 4 (5.8 \times 10^{10})} = x^5$$

$$x = \sqrt[5]{\frac{0.20 (0.35)^2}{(27)(4)(5.8 \times 10^{10})}}$$

$$x = \sqrt[5]{3.911 \times 10^{-15}} = 0.001314$$

$$P_A = 3x = 0.0039 \text{ atm}$$

$$P_B = 2x = 0.0026 \text{ atm}$$

$$P_C = 0.20 - x = 0.20 \text{ atm}$$

$$P_D = 0.35 - 2x = 0.35 \text{ atm}$$