(A)

Eq'm Calc

0.321 mol $NH_4(N_2CO_2)$

$NH_4(NH_2CO_2)_{(s)} \rightleftharpoons 2\,NH_{3(g)} + CO_{2(g)}$

I		0	0
C		+2x	+x
E		2x	x

$K_c = 58.3$

$K_c = [NH_3]^2[CO_2]$

$58.3 = (2x)^2(x)$

$4x^3 = 58.3$

$x = 2.44$

$2\,Cl_{2(g)} + 2\,H_2O_{(g)} \rightleftharpoons 4\,HCl_{(g)} + O_{2(g)}$

I	0.20 mol	0.80 mol		
I	0.0667	0.267	0	0
C	-2x	-2x	+4x	+x
E	0.0667-2x	0.267-2x	4x	x

give mol ratio. Cl_2 is limiting bcz there is less

$\therefore$ mol HCl theor = $0.20\ mol\ Cl_2 \times \frac{4\ mol\ HCl}{2\ mol\ Cl_2} = 0.40\ mol\ HCl$

$\%\ rxn = \frac{n_{HCl\ eq'm}}{n_{HCl\ theo}} \times 100\%$

$n_{HCl\ eq'm} = \left(\frac{45\%}{100\%}\right) 0.40\ mol\ HCl$

$= 0.18\ mol\ HCl$

$[HCl]_{eq'm} = \frac{0.18\ mol}{3\ L} = 0.06\ \frac{mol}{L}$

$4x = 0.06\ \frac{mol}{L}$

$x = 0.015$

$[HCl]_{eq'm} = 0.06\ mol/L$

$[O_2]_{eq'm} = 0.015\ mol/L$

$[Cl_2]_{eq'm} = 0.0667 - 2x$

$= 0.0667 - 2(0.015)$

$[Cl_2]_{eq'm} = 0.0367\ \frac{mol}{L}$

$[H_2O]_{eq'm} = 0.267 - 2x$

$= 0.237\ \frac{mol}{L}$

$$K_c = \frac{[HCl]^4[O_2]}{[Cl_2]^2[H_2O]^2}$$

$$= \frac{(0.06)^4(0.015)}{(0.036)^2(0.237)^2}$$

$$= \frac{1.94 \times 10^{-7}}{7.28 \times 10^{-5}}$$

$$K_c = 2.66 \times 10^{-3}$$

$$CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$$

I	1.00	1.00	1.00	1.00
C	$-x$	$-x$	$+x$	$+x$
E	$1-x$	$1-x$	$1+x$	$1+x$

$$Q = \frac{[CO_2][H_2]}{[CO][H_2O]}$$

$$= \frac{(1)(1)}{(1)(1)}$$

$$= 1$$

$Q < K_c$

$\therefore$ shifts right

$$K_c = \frac{[CO_2][H_2]}{[CO][H_2O]}$$

$$2.38 = \frac{(1+x)(1+x)}{(1-x)(1-x)}$$

$$1.543 = \frac{1+x}{1-x}$$

$$1.543(1-x) = 1+x$$

$$1.543 - 1.543x = 1+x$$

$$0.543 = 2.543x$$

$$x = 0.214$$

$[H_2O]_{eq'm} = 1-x$

$= 1 - 0.214$

$= 0.786\ \frac{mol}{L}$

$PCl_5\ (g) \rightleftharpoons PCl_3\ (g) + Cl_2\ (g)$

	PCl_5	PCl_3	Cl_2
I	0	0.2	0.2
C	$+x$	$-x$	$-x$
E	x	$0.2-x$	$0.2-x$

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

$$0.040 = \frac{(0.2-x)(0.2-x)}{(x)}$$

$$0.040x = 0.04 - 0.4x + x^2$$

$$0 = x^2 - 0.44x + 0.04$$

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

$$= \frac{-(-0.44) \pm \sqrt{(0.44)^2 - 4(1)(+0.04)}}{2(1)}$$

$$= \frac{0.44 \pm \sqrt{0.03360}}{2}$$

$$x = \frac{0.441 \pm 0.183}{2}$$

$x = 0.129$ $\quad x = 0.208$

$[PCl_5]_{eq'm} = 0.129$ mol/L

$[PCl_3]_{eq'm} = [Cl_2]_{eq'm} = 0.2 - 0.129$

$= 0.071$ mol/L