Eq'm Practice Questions

(1)

$$4NH_{3(g)} + 5O_{2(g)} \rightleftharpoons 4NO_{(g)} + 6H_2O_{(g)}$$

Σ_1	2.50	1.25	2.0	3.625
Stress	$+\frac{y}{6}$	—	—	—
I	$2.50+\frac{y}{6}$	1.25	2	3.625
C	$-4x$	$-5x$	$+4x$	$+6x$
E	$2.5+\frac{y}{6}-4x$	$1.25-5x$	$2+4x$	$3.625+6x$
	$=5.00$			

cannot solve for x bcz calculation is to complicated

(2)

$$NOCl_{(g)} \rightleftharpoons NO_{(g)} + \tfrac{1}{2}Cl_{2(g)}$$

I	0.0229	0	0
C	$-x$	$+x$	$+\frac{1}{2}x$
E	$0.0229-x$	x	$\frac{1}{2}x$

$$[NOCl]_{initial} = \frac{m}{MV} = 1.50\,g\,NOCl \times \frac{1\,mol\,NOCl}{65.46\,g\,NOCl} \times \frac{1}{1.06} = 0.0229\,\frac{mol\,NOCl}{L}$$

% dissociation = 57.2%

means 57.2% broke down and at eq'm 42.8% of initial remains

$$[NOCl]_{eq'm} = 42.8\%\,[NOCl]_{initial}$$
$$= 42.8\%\,(0.0229\,\tfrac{mol}{L})$$

$$[NOCl]_{eq'm} = 0.00980\,\tfrac{mol}{L} = 0.0229 - x$$

$$x = 0.0131$$

$$[NO]_{eq'm} = 0.0131\,\tfrac{mol}{L}$$

$$[Cl_2]_{eq'm} = \tfrac{1}{2}(0.0131) = 0.00655\,\tfrac{mol}{L}$$

$$K_c = \frac{[NO][Cl_2]^{\frac{1}{2}}}{[NOCl]}$$

$$= \frac{(0.0131)(0.00655)^{\frac{1}{2}}}{(0.00980)}$$

$$= 0.1082$$

2B)

	$NOCl_{(g)}$	$\rightleftharpoons$	$NO_{(g)}$	+	$\frac{1}{2}Cl_{2(g)}$
E_1	0.00980		0.0131		0.00655
Stress					$-y$
I	.0098		.0131		$.00655-y$
C	$-x$		$+x$		$+\frac{1}{2}x$
Σ	$.0098-x$		$0.0131+x$ $= 0.0262$		$.00655-y+\frac{1}{2}x$

$$[NO]_{E_2} = 0.0131 + x = 0.0262$$
$$x = 0.0131$$

$$[NOCl]_{E_2} = 0.0098 - 0.0131$$
$$= -0.0033$$

∴ since $[NOCl]_{E_2}$ would be -ve cannot double NO C]

3.

	$H_{2(g)}$	+	$I_{2(g)}$	$\rightleftharpoons$	$2HI_{(g)}$
E	0.015		0.015		0.087
Stress					0.040
I	0.015		0.015		0.127
C	$+x$		$+x$		$-2x$
E	$0.015+x$		$0.015+x$		$0.127-2x$

$$K_c = \frac{[HI]^2}{[H_2][I_2]}$$
$$= \frac{(0.087)^2}{(0.015)(0.015)}$$
$$= 33.64$$

$$K_c = \frac{[HI]^2}{[H_2][I_2]}$$

$$33.64 = \frac{(0.127-2x)^2}{(0.015+x)(0.015+x)}$$

$$5.8 = \frac{0.127-2x}{0.015+x}$$

$$5.8(0.015+x) = 0.127-2x$$
$$0.087+5.8x = 0.127-2x$$
$$7.8x = 0.04$$
$$x = 0.00513$$

$[H_2] = [I_2]_{eq'm} = 0.015 + 0.005$
$= 0.020 mol/L$

$[HI] = 0.127 - 2(0.005)$
$= 0.117 mol/L$

④ a)

	N_2O_2 (g)	+ H_2 (g)	⇌ N_2O (g)	+ H_2O (g)
I	1.5	2.5	0	0
C	−x	−x	+x	+x
E	1.5 − x	2.5 − x	x	x

$$K_c = \frac{[N_2O][H_2O]}{[N_2O_2][H_2]}$$

$$1 = \frac{(x)(x)}{(1.5-x)(2.5-x)}$$

$$1 = \frac{x^2}{3.75 - 4x + x^2}$$

$$3.75 - 4x + x^2 = x^2$$

$$3.75 - 4x = 0$$

$$3.75 = 4x$$

$$x = 0.938$$

$[N_2O_2]_{eq'm} = 1.50 - x = 0.56$ mol/L

$[H_2]_{eq'm} = 2.5 - x = 1.56$ mol/L

$[N_2O]_{eq'm} = [H_2O]_{eq'm} = 0.94$ mol/L

b)

	N_2O_2 (g)	+ H_2 (g)	⇌ N_2O (g)	+ H_2O (g)
E_1	.56	1.56	.94	.94
stress	−y			
I	.56 − y	1.56	.94	.94
C	+x	+x	−x	−x
E_2	.56 − y + x = 0.75 − y	1.56 + x = 1.75	.94 − x = .75	.94 − x = .75

$[N_2O]_{eq'm} = 0.75 = 0.94 - x$

$x = 0.19$

$[N_2O_2]$ will change by 0.43 mol/L

$$K_c = \frac{[N_2][H_2]}{[N_2O_2][H_2]}$$

$$1 = \frac{(.75)(.75)}{(.75-y)(.75)}$$

$$.75 - y = 0.32$$

$$y = 0.43$$

5.

	$CO_{2(g)}$	+ $H_{2(g)}$	⇌ $CO_{(g)}$	+ $H_2O_{(g)}$
E_1	0.8	0.3	0.6	0.5
stress	$-y$			
I	$0.8-y$	0.3	0.6	0.5
change	$+x$	$+x$	$-x$	$-x$
E_2	$0.8-y+x$	$0.3+x$	$0.6-x$	$0.5-x$

$[CO]_{E_2} = 0.6 - x = 0.5$ mol/L

$x = 0.1$

$[H_2O]_{E_2} = 0.5 - x = 0.4 \frac{mol}{L}$

$[H_2]_{E_2} = 0.3 + x = 0.4 \frac{mol}{L}$

$[CO_2]_{E_2} = 0.8 - y + x = 0.9 - y \frac{mol}{L}$

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

$\frac{(0.6)(0.5)}{(0.8)(0.3)} = \frac{(0.5)(0.4)}{(0.9-y)(0.4)}$

$0.9 - y = \frac{(0.8)(0.8)(0.3)}{(0.8)(0.6)}$

$0.9 - y = 0.4$

$y = 0.5$

$n = [CO_2] \times V$

$= 0.5 \frac{mol\ CO_2}{L} \times 5.00 L$

$= 2.5$ mol CO_2

6. $SO_{2(g)} + NO_{2(g)} \rightleftharpoons SO_{3(g)} + NO_{(g)}$

	SO_2	NO_2	SO_3	NO
S_1	1.0	4.0	4.0	4.0
stress	↑ 3			
I	4.0	4.0	4.0	4.0
C	$-x$	$-x$	$+x$	$+x$
E_2	$4-x$	$4-x$	$4+x$	$4+x$

$$[NO]_{E_2} = [NO]_{E_2} = 4 + x$$
$$= 5.33 \text{ mol/L}$$

$$[SO_2]_{E_2} = [NO_2]_{E_2} = 4 - x$$
$$= 2.67 \frac{\text{mol}}{\text{L}}$$

$$K_c = \frac{[SO_3][NO]}{[SO_2][NO_2]}$$

$$\frac{(4.0)(4.0)}{(1.0)(4.0)} = \frac{(4+x)(4+x)}{(4-x)(4-x)}$$

$$4 = \frac{(4+x)^2}{(4-x)^2}$$

$$2 = \frac{4+x}{4-x}$$

$$8 - 2x = 4 + x$$
$$4 = 3x$$
$$x = 1.33$$

7. $H_{2(g)} + Cl_{2(g)} \rightleftharpoons 2HCl_{(g)}$

↑ P by ↓ V

→ no shift in eq'm position bcz same number of moles in both reactants & products

→ bcz Vol decreases [ ] of all gases ↑

8. $2Cl_{2(g)} + 2H_2O_{(g)} \rightleftharpoons 4HCl_{(g)} + O_{2(g)} \quad \Delta H > 0$

I. add Cl_2 — shift forward — increase [ ] HCl
bcz fwd rxn will consume the added Cl_2.

II ↑ T — shift forward — increase [ ] HCl
fwd rxn endothermic and will consume the added Energy

III ↓ V / ↑ P — shifts right — decrease [ ] HCl
fewer gas particles in reactants