Equilibrium Worksheet

① (a) $k_{eq} = \dfrac{[NO_2]^4[O_2]}{[N_2O_5]^2}$ (b) $k_{eq} = \dfrac{[SO_3]^2}{[SO_2]^2[O_2]}$

(c) $k_{eq} = \dfrac{[SO_3]}{[SO_2][O_2]^{1/2}}$ (d) $k_{eq} = \dfrac{[P_4O_{10}]}{[P_4][O_2]^5}$

② (a) $k_{eq} = \dfrac{[NO]^2}{[N_2][O_2]}$ (b) mol/L

③ original $k_{eq} = \dfrac{[NO_2]^2}{[N_2O_4]} = 0.212$ (a) $k_{eq} = \dfrac{[N_2O_4]}{[NO_2]^2} = \dfrac{1}{0.212} = \underline{4.717}$

(b) $k_{eq} = \dfrac{[N_2O_4]^{1/2}}{[NO_2]} = \sqrt{\dfrac{[N_2O_4]}{[NO_2]^2}} = \sqrt{4.717} = \underline{2.172}$

④ $k_{eq} = \dfrac{[CH_3OH]}{[H_2]^2[CO]} = \dfrac{[.1]}{[.1]^2[.1]} = 100$

∴ the system is <u>not</u> at equilibrium

⑤ $k_{eq} = \dfrac{[SO_3]^2}{[SO_2]^2[O_2]} = \dfrac{(0.1)^2}{(0.01)^2(0.2)} = \underline{500}$

wrkst

(6) (a) $K_{eq} = \frac{[NO_2]^2}{[N_2O_4]} = \frac{(.12)^2}{(.1)} = 0.144$

(b) The system is <u>not</u> at equilibrium

(c) $[NO_2]$ must increase

(d)

	N_2O_4	$\rightleftharpoons$	$2NO_2$
I	.1		.12
C	$-x$		$+2x$
E	$(.1-x)$		$(.12+2x)$

$$K_{eq} = \frac{[NO_2]^2}{[N_2O_4]}$$

$$.212 = \frac{(.12+2x)^2}{(.1-x)}$$

$$.212(.1-x) = (.12+2x)^2$$

$$0.0212 - 0.212x = 0.0144 + .48x + 4x^2$$

$$0 = 4x^2 + .692x - .0068$$

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

$$= \frac{-.692 \pm \sqrt{(.692)^2 - 4(4)(-.0068)}}{2(4)}$$

$$= \frac{-.692 \pm .7666}{8} = -0.\cancel{182}, \ 0.009$$

(more than what we started with)

$[N_2O_4] = .1 - .009 = \underline{0.09}$ mol/L $\quad [NO_2] = .12 + 2(.009) = \underline{0.14}$ mol/L

(7) (a) $K_{eq} = \dfrac{[CO_2]}{[O_2]}$

(b) $K_{eq} = [CO_2]$

(c) $K_{eq} = [CO_2][H_2O]$

(d) $K_{eq} = \dfrac{[CO_2]}{[CO]}$

(e) $K_{eq} = \dfrac{[H_2]^4}{[H_2O]^4}$