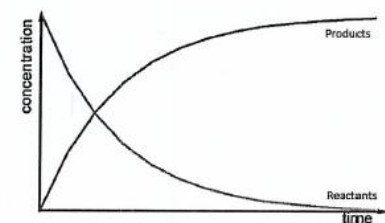


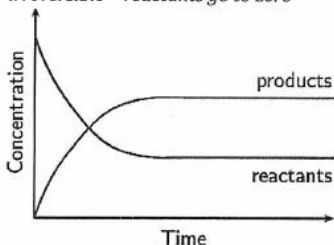
## Chemistry 30 – Equilibrium – Unit Homework

### Reversible Reactions

- State of a closed system when a reversible reaction has forward and reverse reactions occurring at the same rate, so the overall composition of the system is not changing
- Volume of gas/liquid is constant, colour is no longer changing



irreversible – reactants go to zero



- reversible – reactants and products become constant but not at zero
- Matter needs to be contained within the system so that, as reactants are converted to products, the product are still present to react in the reverse reaction. Additionally contaminants from the surroundings may affect equilibrium.

### Equilibrium Constant

- Write equilibrium expressions:

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

b.  $K_{eq} = \frac{[NH_3]^2}{[N_2][H_2]^3}$

c.  $K_{eq} = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$

d.  $K_{eq} = [Ca^{2+}][NO_3^-]^2$

e.  $K_{eq} = [O_2]$

f.  $K_{eq} = [NH_3][HCl]$

- temperature
- they do not have "concentration"
- 0.13
- 0.67 mol/L
- 3.0

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

b. 0.288 mol/L

- May vary due to measurement errors, temperature change or if the reaction was not quite at equilibrium when measurement was taken

Trial	$K_{eq}$
1	5.09
2	5.09
3	5.20
4	5.09
5	5.08

### ICE Tables

- a. 0.195 mol/L b.  $6.37 \times 10^{-4}$

- 

a.  $K_{eq} = \frac{[N_2][O_2]}{[NO]^2}$

b.

Species	2 NO	$N_2$	$O_2$
I	0	0.242	0.242
C	+2x	-x	-x
E	2x	0.242 - x	0.242 - x

- a. [A] = 2.70 mol/L; [C] = 7.17 mol/L

b. 4450

- 0.0026

- [H<sub>2</sub>] = [Br<sub>2</sub>] = 0.24 mol/L, [HBr] = 0.0039 mol/L

- [CO<sub>2</sub>] = [H<sub>2</sub>] = 0.0760 mol/L; [CO] = [H<sub>2</sub>O] = 0.0240 mol/L

### Le Chatelier's Principle

- If a stress is put on a system at equilibrium, the system will shift to accommodate the change and will reach a new equilibrium
- Temperature, concentration, pressure/volume (for gases)
- No – they do not have "concentrations"
- a. no change b. left c. no change

23. a. left b. left c. left  
 24. a. right b. right c. left d. left e. left f. right  
 g. right h. no change

25. a. left b. right b. right

26. a. right b. right c. left d. left

27.

a.  $K_{eq} = \frac{[CO_2][H_2]}{[CO][H_2O]}$

b.  $K_{eq} = 31.4$

c. right

d.  $[CO] = 0.08 M, [CO_2] = 5.44 M, [H_2] = 6.22 M$

29. left

30. left

31. reaction will shift right, so more Fe than FeO

32. a.  $[NH_3] = 0.800 \text{ mol/L}; [N_2] = 0.100 \text{ mol/L}$

b. 0.00422

c. left

d. shift left

33. a. left b. right

### Reaction Quotient

28.

a.  $K_{eq} = \frac{[CO_2][H_2]}{[CO][H_2O]}$

b.  $K_{eq} = 31.4$

c.  $Q_c < K_{eq}$ , so the reaction will shift right

d.

	CO	H <sub>2</sub> O	CO <sub>2</sub>	H <sub>2</sub>
I	0.250	0.250	0.500	0.500
C	-x	-x	+x	+x
E	0.250 - x	0.250 - x	0.500 + x	0.500 + x