Name: Key
Blk: ____ Date: ____

Chemistry 12
EQUILIBRIUM Lesson #1

Equilibrium:
A reversible reaction is said to be at EQUILIBRIUM when the RATE of the forward reaction is equal to the RATE of the reverse reaction.

In order for EQUILIBRIUM to be possible the products must not be able to escape as they are needed for the REVERSE reaction. Therefore: In order for an equilibrium to exist the rxn must occur in a CLOSED SYSTEM.

A **CLOSED SYSTEM**: one in which nothing can enter or leave

TEACHER DEMONSTRATION:

TWO sealed glass tubes containing a mixture of a **red-brown gas (NO_2)** and a **colourless gas (N_2O_4)** are observed. The colour is an identical medium red-brown in each tube and there is no visible change in colour of the contents as time passes at room temperature.

When one tube is placed in a beaker of **boiling water** for a minute, the contents of the tube become much **darker red-brown** in colour. When the other tube is placed in a **beaker of ice cold water**, the colour quickly disappears and the contents of the tube remain **colourless**.

When the hot and cold tubes are taken out of the beakers and placed side by side, the tubes have an identical medium red-brown colour when they reach room temperature.

a . The gases are involved in this reversible reaction: $N_2O_4\ (g) <---> 2\ NO_2\ (g)$
What evidence exists that the forward and reverse rates are EQUAL at room temperature? The MEDIUM RED-BROWN COLOUR IS CONSISTANT (NO CHANGE) @ ROOM TEMPERATURE (~25°C)

b. Can temperature changes effect an equilibrium reaction? How do you know this? YES. Increase in temp shifts to dark brown a decrease in temp shifts to colourless.

c. What evidence shows that the forward reaction rates and the reverse rates are equal at 100 °C? If the temperature were raised above 100 °C what would you expect to happen to the colour?

COLOUR STAYS a dark brown colour! The increase in temp would cause the colour to darken further.

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$

colourless $\rightleftharpoons$ colour

d. The balanced equation in part (a) should also show ENERGY . Consider what happened to the colour when the tube was heated. Is the reaction endothermic or exothermic as written, explain.

The reaction is ENDOTHERMIC as the addition of energy (heat) causes a shift to the products (dark brown colour)

e. Which gas is predominantly present at low temperatures? Which gas is predominantly present at high temperatures? How would you describe the chemical composition in a tube when it was at room temperature?

N_2O_4 is dominant @ low temps while NO_2 is dominant @ high temps. Room temp [ ]'s are equal.

f. If one tube were filled with pure NO_2 (g) and another tube with pure N_2O_4 (g), what might be true of the colours you would expect to see in the tubes after they sit for a minute at the same temperature? What evidence do you have that your prediction should occur?

$NO_2(g)$ brown would become lighter

$N_2O_4(s)$ colourless would turn light-brown.

→ reach equilibrium @ room temp ←

THE FOLLOWING CONCLUSIONS CAN BE DRAWN FROM THE ABOVE DEMONSTRATION:

1. Temp. affects equilibrium (systems @) (shift left or right)
2. New equilibriums are attained @ new temps
3. You can reach equilibrium by starting with either products or reactants.
4. When @ equilibrium no MACROSCOPIC changes occur.

MACROSCOPIC → visible or "large scale" changes ie colour

MICROSCOPIC → small scale (not visible) ie motion of molecules

DYNAMIC EQUILIBRIUM: An equilibrium in which MICROSCOPIC changes occur but MACROSCOPIC DO NOT.!

*FROM NOW ON WHENEVER YOU SEE THE TERM **"EQUILIBRIUM"** IT IS IMPLYING A **"DYNAMIC EQUILIBRIUM"***

SEAT WORK/HOMEWORK : Exercises 1, 3-5 pgs 37 + 39

PLO's: D1, D4, D5 and D6.