Le Chatelier's Principle Worksheet #2

1) In the following reaction, will the [H_2] increase or decrease when equilibrium is reestablished after these stresses are applied?

$$N_2(g) + 3\ H_2(g) \leftrightarrow 2\ NH_3(g) + 22\ kJ$$

$NH_3(g)$ is added **shift L, H2 incr.** $N_2(g)$ is removed **shift L, H2 incr.**

pressure is increased **shiftR, H2 decr** Temperature is increased **shift L, H2 incr.**

2) In which direction, left or right, will the equilibrium shift if the following changes are made?

$$2\ NO\ (g) + H_2(g) \leftrightarrow N_2O\ (g) + H_2O\ (g) + 36\ kJ$$

NO is added **R** The system is cooled **R**

H_2 is removed **L** Pressure is increased **R**

N_2O is added **L** H_2 is removed **L**

3) In this reaction: $CO_2(g) + H_2(g) + heat \leftrightarrow CO\ (g) + H_2O\ (g)$

Is heat absorbed or released by the forward reaction? **Absorbed**

In which direction will the equilibrium shift if these changes are made?

CO is added **L** Temperature is increased **R**

CO_2 is added **R** System is cooled **L**

H_2 is removed **L** Pressure is increased **no change! same # mol gas on each side of rxn**

Catalyst is added **no change!**

4) In this reaction: $2\ NO\ (g) + H_2(g) \leftrightarrow N_2O\ (g) + H_2O\ (g) + heat$

What will happen to the [H_2O] when equilibrium is reestablished after these stresses are applied?

Temperature is increased **Shift L, H2O decr.**

A catalyst is added **no change!**

Pressure is decreased **Shift L, H2O decr.**

NO is added **Shift R, H2O incr.**

N_2O is removed **Shift R, H2O incr.**

5) How would an increase in pressure affect the [H_2] in the following reactions?

$2\ H_2(g) + O_2(g) \leftrightarrow 2\ H_2O\ (g)$ **Shift R, H2 decr.**

$4\ H_2(g) + Fe_3O_4(s) \leftrightarrow 3\ Fe\ (s) + 4\ H_2O\ (l)$ **Shift R, H2 decr..**

$H_2(g) + Cl_2(g) \leftrightarrow 2\ HCl\ (g)$ **no change, same # mol gas on each side**

6) State Le Chatelier's Principle in your own words.

When a reaction is stressed and the rate forward and backwards are not equal, the reaction will shift where the equilibrium is to undo that stress so the rate forward and backward can be equal again.

7) The reaction of iron(III) oxide with carbon monoxide occurs in a blast furnace when iron ore it reduced to iron metal:

$Fe_2O_3\ (s) + 3\ CO\ (g) \leftrightarrow 2\ Fe\ (l) + 3\ CO_2\ (g)$

Use Le Chatelier's Principle to predict the direction of reaction when an equilibrium mixture is disturbed by :

Adding CO (g) **Forward (to R)** Removing CO_2 (g) **Forward (to R)**

Adding Fe_2O_3 (s) **No change**

8) For the reaction, $PCl_5\ (g) \leftrightarrow\ PCl_3\ (g) + Cl_2\ (g)$ $\Delta H_{rxn} = +111$ kJ.

Fill in the following table.

Change	Shifts Reaction Which Way?
add PCl_5	**R to use it up**
remove Cl_2	**R to make more**
add Ar	**no change, noble gas**
decrease V (or increase P)	**L, fewer gas moles**
increase T	**R, use up energy b/c it is endothermic, energy is a reactant**
add catalyst	**no change, just gets to equilibrium faster but doesn't change where equilibrium is**

9) For the reaction: $2HI(g) \leftrightarrow H2(g) + I2(g)$ $\Delta Hrxn = -51.8kJ$

Fill in the following table:

Change	Shifts Reaction Which Way?
add H_2	**L**
remove HI	**L**
add Ne	**No change no change,**
increase V (decrease P)	**same # moles gas**
decrease T	**R b/c exothermic so energy is a product**