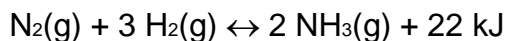


Le Chatelier's Principle Worksheet #2

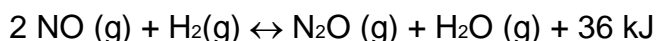


- 1) In the following reaction, will the $[H_2]$ increase or decrease when equilibrium is reestablished after these stresses are applied?



$NH_3(g)$ is added shift L, H₂ incr. $N_2(g)$ is removed shift L, H₂ incr.
 pressure is increased shift R, 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?



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: $CO_2(g) + H_2(g) + \text{heat} \leftrightarrow CO (g) + H_2O (g)$

Is heat absorbed or released by the forward reaction? Absorbed

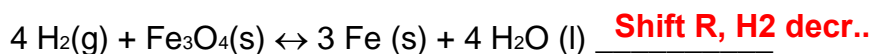
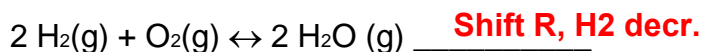
In which direction will the equilibrium shift if these changes are made?

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: $2 NO (g) + H_2(g) \leftrightarrow N_2O (g) + H_2O (g) + \text{heat}$
 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.

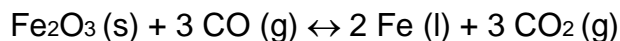
5) How would an increase in pressure affect the [H₂] in the following reactions?



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 is reduced to iron metal:



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 CO₂ (g) Forward (to R)

Adding Fe₂O₃ (s) No change

8) For the reaction, $\text{PCl}_5(\text{g}) \leftrightarrow \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$ $\Delta H_{\text{rxn}} = +111 \text{ kJ}$.

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,
add catalyst	no change, just gets to equilibrium faster but doesn't change where equilibrium is

energy is a reactant

9) For the reaction: $2\text{HI}(\text{g}) \leftrightarrow \text{H}_2(\text{g}) + \text{I}_2(\text{g})$ $\Delta H_{\text{rxn}} = -51.8 \text{ kJ}$

Fill in the following table:

Change	Shifts Reaction Which Way?
add H ₂	L
remove HI	L
add Ne	No change no change, same # moles gas
increase V (decrease P)	same # moles gas
decrease T	R b/c exothermic so energy is a product