ANSWER KEY

EXTRA PRACTICE: Le Chatelier's Principle Practice #2

Name:_____

Match the stress change to the equilibrium system below with the letter of the appropriate response. Each letter can be used once, more than once, or not at all.

$$2\ SO_{2\,(g)} + O_{2\,(g)} \leftrightarrows 2\ SO_{3\,(g)} + \text{Heat}$$

A 1. O_2 is added to the system. (Right)

A 2. SO_3 is removed from the system. (Right)

B 3. Temperature of the system is increased. (Left)

A 4. The volume is decreased. (Right)
↳ ↑P = ↓V (Boyle's Law)

a. The equilibrium shifts to the right.

b. The equilibrium shifts to the left.

c. There is no change in the equilibrium position.

If the statement is true, write "true." If it is false, change the underlined word or words to make the statement true. Write your answer on the line provided.

$$NH_4Cl_{\,(s)} + \text{Heat} \leftrightarrows NH_{3\,(g)} + HCl_{\,(g)}$$

Endothermic 5. The above reaction is exothermic

Decrease 6. Production of ammonia from ammonium chloride will increase at higher temperature
↑T = ↓ Solubility for ALL gases ONLY!

True 7. At equilibrium, an increase in the concentration of HCl causes a decrease in ammonia concentration

8. Consider the following equilibrium reaction: $CO_{(g)} + H_2O_{(g)} \leftrightarrows CO_{2\,(g)} + H_{2\,(g)} + \text{Heat}$

Predict the direction of equilibrium shift *(right, left, or no shift)* if the following stresses are applied:

a.) The addition of more H_2O Right

b.) The removal of some H_2 Right

c.) Raising the temperature Left

d.) Decreasing the pressure No Shift (#moles of gas is equal on both sides)
↳ ↓P = ↑V

9. What would be the effect of each of the following on the concentration of **CO** *(increase, decrease, or no effect)* when the following stresses are applied to the equilibrium involving the synthesis of methanol?

$$CO_{(g)} + 2\,H_{2\,(g)} \leftrightarrows CH_3OH_{(g)}$$

a.) The removal of CH_3OH — Decrease

b.) Lowering the concentration of H_2 — Increase

c.) Addition of CO — No effect

d.) Increasing the pressure — Decrease

10. A small percentage of nitrogen gas and oxygen gas in the air combine at the high temperatures found in automobile engines to produce NO(g), an air pollutant.

$$N_{2\,(g)} + O_{2\,(g)} + \text{Heat} \leftrightarrows 2\,NO_{(g)}$$

Higher engine temperatures are used to minimize carbon monoxide production. What effect do higher engine temperatures have on the production of NO? Why? ↑T = ↓Solubility of Gas ∴ $NO_{(g)}$ Production Decreases

11. According to Le Chatelier's Principle, when has a chemical reaction established equilibrium?

@Equilibrium ⇒ Rate of Forward Rxn (Products) = Rate of Reverse Rxn (Reactant)

12. What factors alter the equilibrium position in chemical reactions?

Concentration
Temperature
Pressure

13. If more reactant is added to an equilibrium system, what happens to the equilibrium constant (K), and to the equilibrium position for the reaction?

EQ shifts toward Product (Right) & EQ Constant Remains Constant
↳ Only Temperature changes "K" constant

14. What is the effect of temperature on the equilibrium constant (K)?

Temperature will change (Increase or Decrease) EQ Constant (K) depending on concentrations of reactants & products

15. You are asked to produce $HI_{(g)}$ from $H2_{(g)}$ and $I2_{(g)}$. Write the equilibrium expression for this reaction. How would you go about maximizing the concentration of $HI_{(g)}$ produced? $1H_{2(g)} + 1I_{2(g)} \rightleftharpoons 2HI_{(g)}$

$$K = \frac{[HI]^2}{[H_2][I_2]}$$ → Increasing concentrations of $[H_2]$ & $[I_2]$ will increase/maximize production of [HI].

↳ Temperature effect unknown as reaction is unknown to be endothermic or exothermic

↳ Pressure has No effect as # moles of gas is equal on both sides