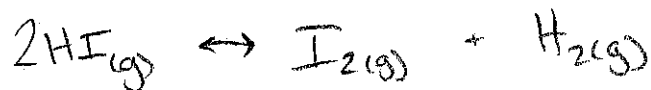


5.1 - Reversible Reactions and Equilibrium KEY

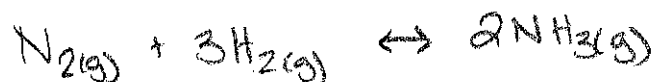
5.1 Assignment KEY

1. Write reversible reactions for each of the following situations (be sure to balance your equations):

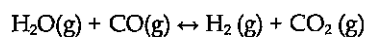
- a. Hydrogen iodide gas (HI) decomposes into its elements.



- b. Hydrogen and nitrogen gases combine to form ammonia gas, NH_3 .



2. If the system represented by the following equation is found to be at equilibrium at a specific temperature, which of the following statements is true? Explain your answers.



- a. All species must be present in the same concentration.
- b. The rate of the forward reaction equals the rate of the reverse reaction. TRUE
- c. We can measure continual changes in the reactant concentrations.
3. Which of the following are equilibrium systems and which are steady state systems?
- a. A playing football team and a bench of reserve players. The number of players on the field is constant and the number of players on the bench is constant. (EQUILIBRIUM)
- b. A well fed tiger in a cage. The weight of the tiger is constant. (STEADY STATE)
- c. The Nipawin Dam and Codette Lake behind the dam. The water level is constant. (STEADY STATE)
- d. The liquid alcohol and alcohol vapor in a thermometer. The temperature is constant. (EQUILIBRIUM)
- e. A block of wood floating on water. (STEADY STATE)
4. Which of the following are chemical equilibria and which are physical equilibria systems?
- a. sublimation of dry ice (solid carbon dioxide) PHYSICAL
- b. a saturated magnesium chloride solution CHEMICAL
- c. the partial dissociation of 2 moles of HI molecules into 1 mole H_2 and 1 mole of I_2 molecules CHEMICAL

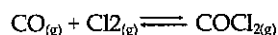
5.1 - Reversible Reactions and Equilibrium KEY

5.1 Assignment

5. Which of the following reactions are reversible?

- a. the evaporation of water (REVERSIBLE)
- b. the combustion of coal (IRREVERSIBLE)
- c. the magnetization of an iron bar (REVERSIBLE)

6. A chemist wished to prepare pure phosgene ($\text{COCl}_{2(g)}$) by reacting carbon monoxide and chlorine gas according to the reaction:



Why will this reaction NOT produce pure phosgene? If the chemist could somehow obtain a sample of pure $\text{COCl}_{2(g)}$, would it remain pure? Why?

-It will NOT produce pure phosgene because the product would be breaking down once it is produced as it is a reversible reaction. Even if they obtained a pure product, it would not remain pure because equilibria can be approached from the reactants or products.

7.

- (a) The colour does not change, so $\text{NO}_2(g)$ is being made at the same rate that it is destroyed.
- (b) Temperature CAN affect an equilibrium – the colour became lighter or darker when the temperature was changed, meaning more or less $\text{NO}_2(g)$ was present.
- (c) The colour does not change while the tube full of gas remains at a constant 100°C . The colour would become very dark red-brown if the temperature were raised above 100°C .
- (d) The reaction is endothermic as written: $\text{N}_2\text{O}_4(g) + \text{energy} \rightleftharpoons 2 \text{NO}_2(g)$. As heat is added the forward reaction should occur to a greater extent and produce more of the red-brown $\text{NO}_2(g)$, which is exactly what occurred.
- (e) $\text{N}_2\text{O}_4(g)$ predominated at low temperatures (colourless).
 $\text{NO}_2(g)$ predominated at high temperatures (dark red-brown).
At room temperature the content of the tube was a mixture of $\text{N}_2\text{O}_4(g)$ and $\text{NO}_2(g)$.
- (f) The tubes should become the same colour. A tube containing mostly $\text{N}_2\text{O}_4(g)$ at low temperatures and another tube containing mostly $\text{NO}_2(g)$ at high temperatures eventually became the same colour at room temperature.