Honors Chemistry- Equilibrium Podcasts 1-3 (2022)

1. Sulfur dioxide gas and oxygen gas are placed into a sealed flask where they react to produce gaseous sulfur trioxide. When equilibrium is achieved, the gaseous product is being produced at a rate of 0.0082 mol/s. Write and balance the reaction and answer the following:

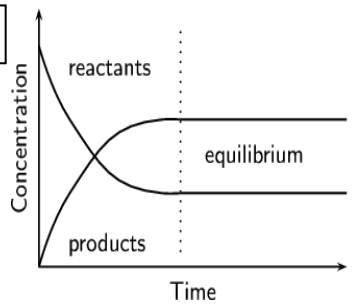
a). How many moles of the product are consumed each second?

b). How many moles of the oxygen gas are produced each second?

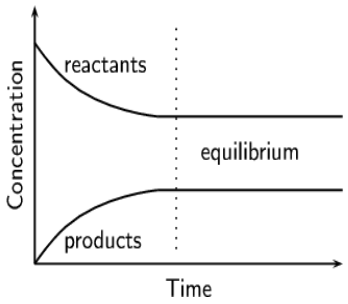
c). How many grams of the oxygen gas are consumed each second?

2. Write a sentence for each of the three graphs below (A-C), which represent chemical systems in dynamic equilibrium. In your response, be sure to compare and contrast the reactants and products. Label any points of interest on each graph (e.g., intersections, curves, slope =0, etc.).

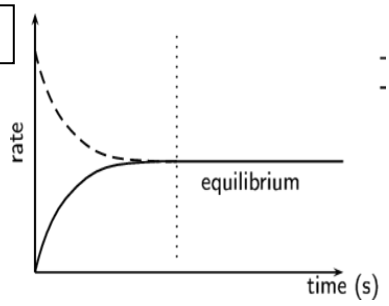
A



B

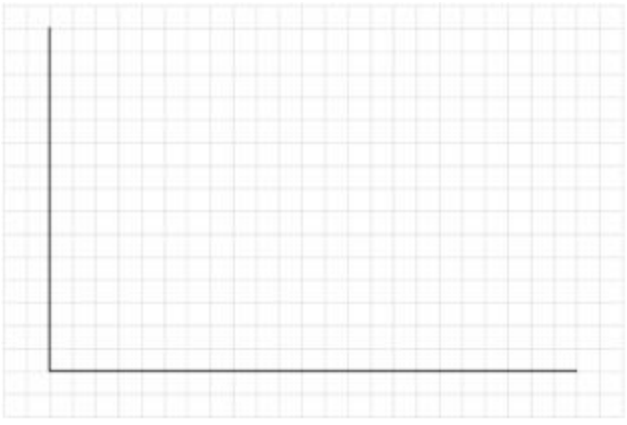


C



b). For graphs A and B, predict if the value for K_{eq} would be less than 1, equal to 1, or greater than 1.

3. Hydrogen gas is mixed with gaseous iodine to yield hydrogen iodide gas. The enthalpy of reaction is +52 kJ/mol. Write and balance the thermochemical reaction:



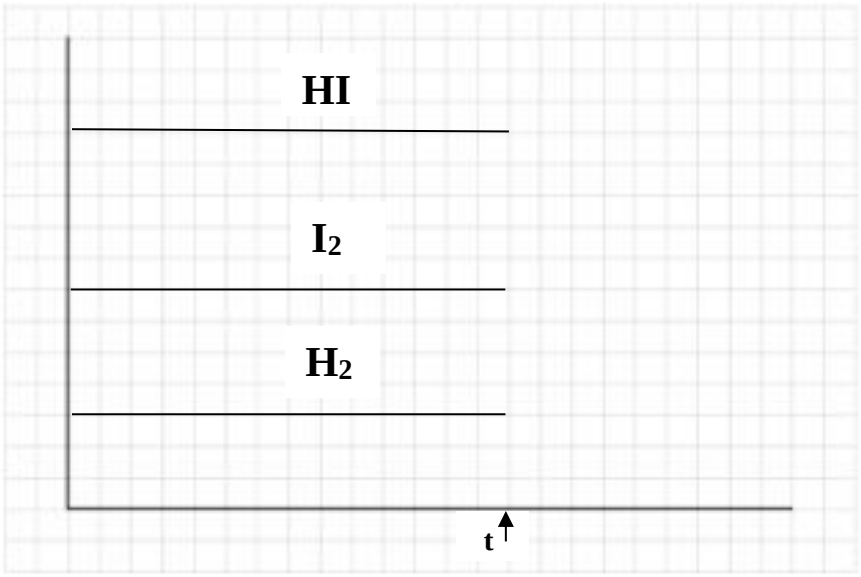
a). Sketch a graph for this reaction showing the potential energy (kJ) as a function of time (s). On your graph label the activation energy (E_a) and the enthalpy of reaction (ΔH_{rxn}).

b). What would happen to the reaction if more hydrogen gas was added?

c). What would happen to the reaction if heat were removed?

d). What happens to the reaction when the volume of the reaction vessel is decreased?

e). Examine the graph of the pressure as a function of time for the chemical system in equilibrium. At some time, t, extra I_2 is added to the reaction. Sketch a continuation on the graph indicating how all three substances would respond to the perturbation.



f). Write an equilibrium expression (K_{eq}) for this reaction in question 3.

g). An instant after time = t, do you predict the value for K_{eq} would be less than 1, equal to 1, or greater than 1? Justify your answer.

4. When $H_2(g)$ is mixed with $CO_2(g)$ at 2,000 K, equilibrium is achieved according to the equation below.

$$H_2(g) + CO_2(g) \rightleftarrows H_2O(g) + CO(g)$$

a). In one experiment, the below equilibrium concentrations were measured. Calculate the K_{eq}.

$[H_2] = 0.20$ mol/L; $[CO_2] = 0.30$ mol/L; $[H_2O] = 0.55$ mol/L; $[CO] = 0.55$ mol/L

b). The system is then cooled to a much lower temperature, 0.25 mol/L of the CO(g) is converted back to $CO_2(g)$. Calculate the value of K_{eq} at this lower temperature. You will need to use an ICE table:

$$H_2(g) + CO_2(g) \rightleftarrows H_2O(g) + CO(g)$$

I				
C				
E				

c). Does the new K_{eq} value you calculated in part b make sense based on what you would expect from this perturbation and subsequent shift in equilibrium?

5. For the reaction $H_2(g) + F_2(g) \rightleftharpoons 2HF(g)$ calculate the equilibrium concentrations of all species if 3.00 mol of each reactant was added to a 1.5-L flask. At equilibrium [HF] = 1.5 M and the K_c at the temperature of the reaction is 1.44. Make your own ICE table to solve this one.