Key

Unit 7 Kinetics and Equilibrium Test Review

Kinetics

1. Any change that happens over a period of time can be expressed as a rate.
2. What is reaction rate? rate at which reactants become products
3. Factors Affecting Reaction Rate
   a. True or False: One way to observe the rate of a reaction is to observe the changes in [products] over time.
   b. True or False: The rate of any reaction is a constant that does not changes when reaction conditions (temperature, concentration, etc.)
   c. Generally, an increase in temperature will increase the reaction rate.
   d. True or False: Storing milk in the fridge stops the reactions that would cause the milk to spoil. slows down, doesn't stop it completely.
   e. How does an increase in surface area affect the exposure or reactants to one another? How does that affect the reaction rate? more reactants available to react with one another which speeds up the rate.
   f. True or False: Increasing the concentration of reactants will generally slow down the reaction.
   g. True or False: A piece of material dipped in a concentrated dye solution will change color more quickly than in a dilute solution.
   h. Why does an increase in pressure speed up the rate of a reaction? reactants will collide more often & with more force & speed which speeds up a reaction.
   i. What is a catalyst? - a substance whose presence speeds up a reaction by lowering the activation energy
   j. True or False: Because a catalyst is quickly consumed in a reaction, it must be added to the reaction over and over again to keep the reaction going?
   k. In your own words, explain why lowering the temperature slows down a reaction. particles have less energy & slow down which leads to less effective collisions
   l. In your own words, explain why increasing the concentration of reactants will speed up a reaction? More particles can have more effective collisions

m. Complete the following table by writing either increase or decrease for the rate of the reaction.

Scenario	Increase or Decrease
Adding heat	↑
Removing heat	↓
Adding a catalyst	↑
Diluting a solution	↓
Removing an enzyme (catalyst)	↓
lowering the temperature	↓
decreasing the surface area	↓
increasing the concentration of a solution	↑
breaking a reactant down into smaller pieces	↑

n. Complete the following table by indicating which factor would have the greatest impact on the rate of the reaction. Choose from concentration, temperature, surface area, or catalyst.

Scenario	Factor that has the greatest impact
Blowing air on a campfire to help get it going.	concentration
Raw carrots are cut into thin slices for cooking.	surface area
Protein is broken down in the stomach by the enzyme pepsin.	catalyst
A woolly mammoth is found, perfectly preserved, near the Arctic Circle.	temperature
More bubbles appear when a concentrated solution of hydrochloric acid is added to a magnesium strip than when a dilute solution of acid is added.	concentration
Exhaust from a car engine passes through a catalytic converter changing most of the poisonous carbon monoxide to carbon dioxide.	catalyst
A dust explosion occurs in a saw mill.	surface are

Equilibrium

4. Write the equilibrium expression for the following reversible reactions.

a. $2N_2H_4\,(g) + 2NO_2\,(g) \leftrightarrow 3N_2\,(g) + 4H_2O\,(g)$ (A) $K_{eq} = \frac{[N_2]^3[H_2O]^4}{[N_2H_4]^2[NO_2]^2}$

b. $2NbCl_4\,(g) \leftrightarrow NbCl_3\,(g) + NbCl_5\,(g)$

(B). $K_{eq} = \frac{[NbCl_3][NbCl_5]}{[NbCl_4]^2}$

(C) $K_{eq} = \frac{[I]^2}{[I_2]}$

(D) $K_{eq} = [C_6H_6(g)]$

(E) $K_{eq} = \frac{[H_2O]^4}{[H_2]^4}$

c. $I_2(g) \leftrightarrow 2I(g)$

d. $C_6H_6(l) \leftrightarrow C_6H_6(g)$

e. $Fe_3O_4(s) + 4H_2(g) \leftrightarrow 3Fe(s) + 4H_2O(g)$

5. $PCl_5(g) \leftrightarrow PCl_3(g) + Cl_2(g)$
Calculate Keq when $[PCl_5] = 0.0189$ M, $[PCl_3] = 0.0222$M, and $[Cl_2] = 0.1044$M. Is the forward or reverse reaction favored?

6. $N_2(g) + O_2(g) \leftrightarrow 2NO(g)$
Calculate Keq when $[N_2] = 1.01$M, $[O_2] = 1.10$M, and $[NO] = 0.999$M.

7. $N_2(g) + O_2(g) \leftrightarrow 2NO(g)$
Keq = 6.2×10^{-4} and $[N_2] = 0.05200$M and $[O_2] = 0.00120$M. Calculate [NO].

8. $H_2(g) + CO_2(g) \leftrightarrow H_2O(g) + CO(g)$
Keq = 1.60. Calculate the $[H_2]$ when $[CO_2] = .320$M, $[H_2O] = .240$M, and [CO]. = .999M

See next page for answers

9. Using LeChatelier's Principle to fill in the chart. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) + q$ exothermic

Stress	$[N_2]$	$[H_2]$	$[NH_3]$	Equilibrium Shift
↑$[N_2]$	↓	↓	↑	Right
↑ $[H_2]$	↓	↓	↑	Right
↑ $[NH_3]$	↑	↑	↓	Left
↑ temperature	↑	↑	↓	Left
↓ $[N_2]$	↓	↓	↑	Right
↓volume	↓	↓	↑	Right
↓$[NH_3]$	↓	↓	↑	Right
↓ $[H_2]$	↑	↑	↓	Left
add a catalyst	—	—	—	No shift
↑ volume	↑	↑	↓	Left
↓ temperature	↓	↓	↑	Right

5. $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

$K_{eq} = \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{[.0222M][.1044M]}{[.0189M]} = .123\ M$

6. $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

$K_{eq} = \frac{[NO]^2}{[N_2][O_2]} = \frac{[.999M]^2}{[1.01M][1.10M]} = .898$

7. $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ $\quad K_{eq} = 6.2 \times 10^{-4}$

$K_{eq} = \frac{[NO]^2}{[N_2][O_2]}$ $\quad 6.2\times10^{-4} = \frac{[NO]^2}{[.0520M][.020M]}$

$6.24\times10^{-5} \cdot 6.2\times10^{-4} = \frac{[NO]^2}{6.24\times10^{-5}} \cdot 6.24\times10^{-5}$

$\sqrt{3.87\times10^{-8}} = \sqrt{[NO]^2}$

$1.97\times10^{-4}M = [NO]$

8. $H_2(g) + CO_2(g) \rightleftharpoons H_2O(g) + CO(g)$ $\quad K_{eq} = 1.60$

$K_{eq} = \frac{[H_2O][CO]}{[H_2][CO_2]}$ $\quad 1.60 = \frac{[.240M][.999M]}{[H_2][.320M]}$

$[H_2] \cdot 1.60 = \frac{.749}{[H_2]} \cdot [H_2]$

$\frac{[H_2]\cdot 1.60}{1.60} = \frac{.749}{1.60}$

$[H_2] = .468M$