

26 possible

Name STURMAN key  
Date \_\_\_\_\_ Per \_\_\_\_\_

### REACTION RATES AND EQUILIBRIUM QUIZ

Also,  
chem. equilibrium

reversible reaction	equilibrium constant	concentration
reaction quotient ✓	reaction rate	activation energy
catalyst	collision theory	LeChatelier's principle ✓

Choose from the above terms to fill in the best choice for the statements below.

1. The minimum energy colliding particles must have in order to react is called activation energy.
2. The ratio of product concentrations to reactant concentrations at equilibrium, with each concentration raised to a power equal to coefficients in the balanced equation is the equilibrium constant.
3. A substance that lowers the amount of energy needed for a reaction to occur and is not fully consumed in the reaction is a catalyst.
4. A reversible rxn. is where the reactants create products and the products reform reactants simultaneously.
5. Describes a system in dynamic equilibrium in which the system will change to relieve any stresses added to it is LeChatelier's principle.
6. The amount of reactant consumed in the reaction per unit of time is called the reaction rate.
7. In order for particles to react they must have enough kinetic energy and must bump into one another, this is a description of the collision theory.
8. The measurement used to determine quantitative values for equilibrium constants and reaction quotients is concentration.
9. The measurement used to determine if the reaction is at equilibrium is called the reaction quotient.

4) Catalysts: Speeds up chem rxn.

5) Nature of reactants: Some reactants require a lot of rearranging before forming products.

Answer the following questions thoroughly and concisely. Show all work for the problems.

10. Name <sup>three</sup> ~~four~~ factors that affect chemical reaction rates. Also, explain how these factors affect the reaction rate.

1) Temperature: ↑ temp ↑ # of particles that will collide w/ sufficient energy to react.

2) Concentrations: more reactants ∴ more collisions

3) Surface Area: greater SA means more molecule exposure for rxn.

11. Write the equilibrium expression for the combustion of ethane at high temperature.  $2C_2H_4(g) + 7O_2(g) \rightleftharpoons 4CO_2(g) + 6H_2O(g)$

$$K_{eq} = \frac{[CO_2]^4 [H_2O]^6}{[C_2H_4]^2 [O_2]^7}$$

12. At 527°C,  $K_{eq} = 5.10$  for the reaction  $CO(g) + H_2O(g) \rightleftharpoons H_2(g) + CO_2(g)$ . If  $[CO] = 0.15M$ ,  $[H_2O] = 0.25M$ ,  $[H_2] = 0.42$ , and  $[CO_2] = 0.37$ , calculate Q and determine how the reaction will proceed.

$$Q = \frac{[H_2][CO_2]}{[CO][H_2O]} = \frac{(0.42)(0.37)}{(0.15)(0.25)} = 4.144$$

$$4.144 < 5.10 \therefore Q < K_{eq}$$

the rxn will proceed to the right. Equilibrium favors products.

13. At 1000°C,  $K_{eq} = 1.0 \times 10^{-13}$  for the decomposition of hydrofluoric acid (HF) as described in the reaction  $2HF(g) \rightleftharpoons H_2(g) + F_2(g)$

If  $[HF] = 23.0M$ ,  $[H_2] = 0.540M$ , and  $[F_2] = 0.380M$ , determine the value of Q and predict how the reaction will proceed.

$$Q = \frac{[H_2][F_2]}{[HF]^2} = \frac{(0.540)(0.380)}{(23.0)^2} = 3.88 \times 10^{-4}$$

$$3.88 \times 10^{-4} > 1.0 \times 10^{-13}$$

∴  $Q > K_{eq}$  the rxn will proceed to the left. Equilibrium favors reactants.

14. For the following combustion reaction of carbon, predict which way the reaction will shift given the imposed conditions. Explain why you chose left or right.  $C(s) + O_2(g) \rightleftharpoons CO_2(g) \quad \Delta H = -393.5 \text{ kJ/mol}$

a) remove  $CO_2$  shift right to create more  $CO_2$ .

b) add carbon shift right to remove the carbon

c) increase pressure no shift. since 1 molecule (mole) on left and 1 molecule (mole) on right

9 poss  
> 26 A  
34 - 25 B  
24 - 23 C  
12 - 20 D  
≤ 17 E