

# Test Review Unit 8: Equilibrium

Name: Key

## Collision Theory

1. Explain collision theory.

Reactions ~~will~~ will occur only with random collisions that have enough energy and are in the correct orientation. You can change the speed of a reaction by altering the temp, concentration, surface area, add a catalyst, orientation, and nature of reactants.

2. What are the two things that must take place in order for a reaction to take place between molecules or atoms?

- enough energy
- correct orientation

3. What will alter the rate of a chemical reaction?

- temp
- concentration
- surface area
- catalyst

4. What is a catalyst and how will it speed up a chemical reaction?

ex. enzyme

→ a substance that alters the rate a reaction can occur based on lowering the activation energy.

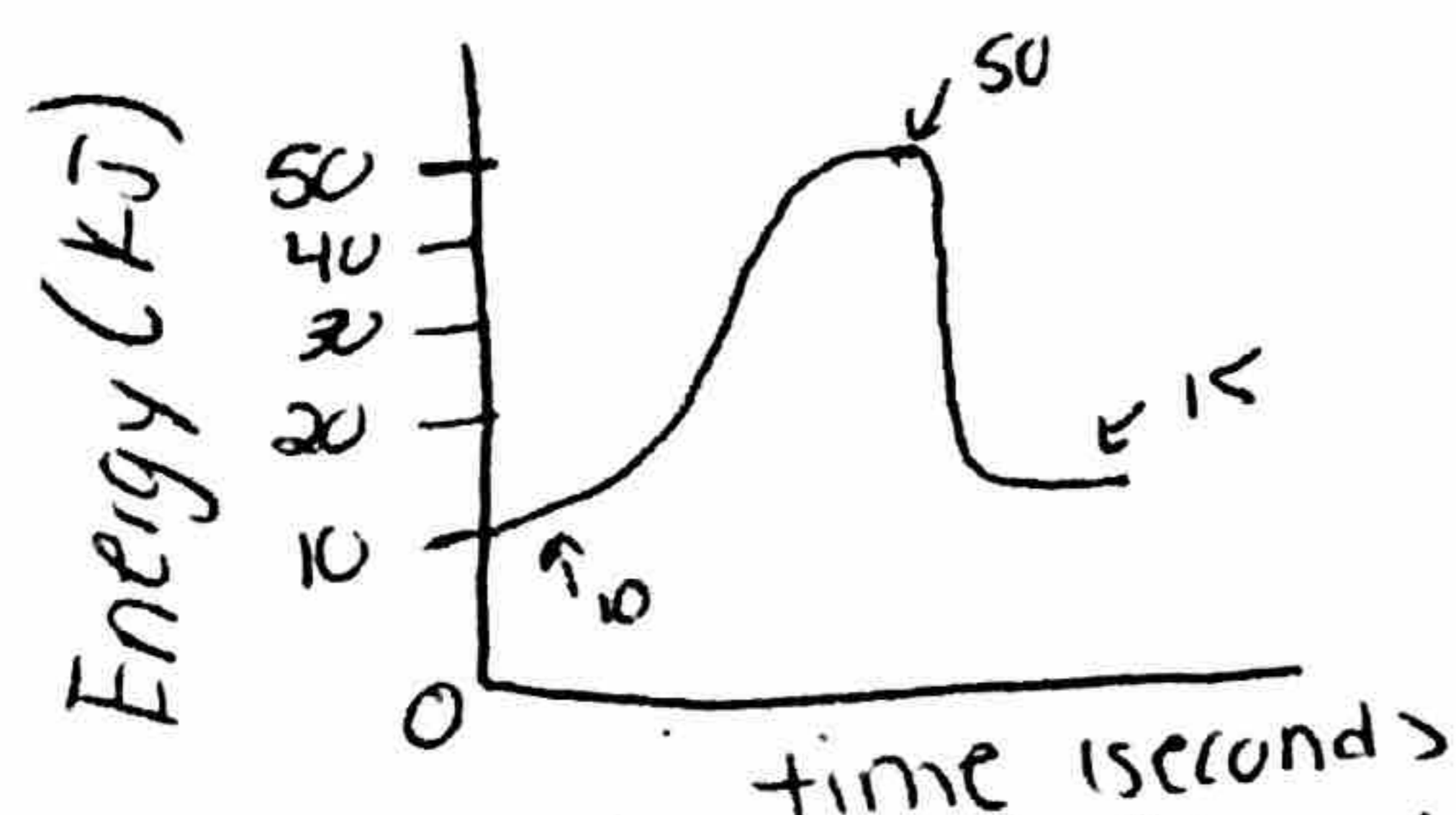
5. Explain why all reactions have an activation energy using collision theory?

they have to have enough energy to get over the "hill" which is enough energy ( $E_a$ ) to get the reaction started



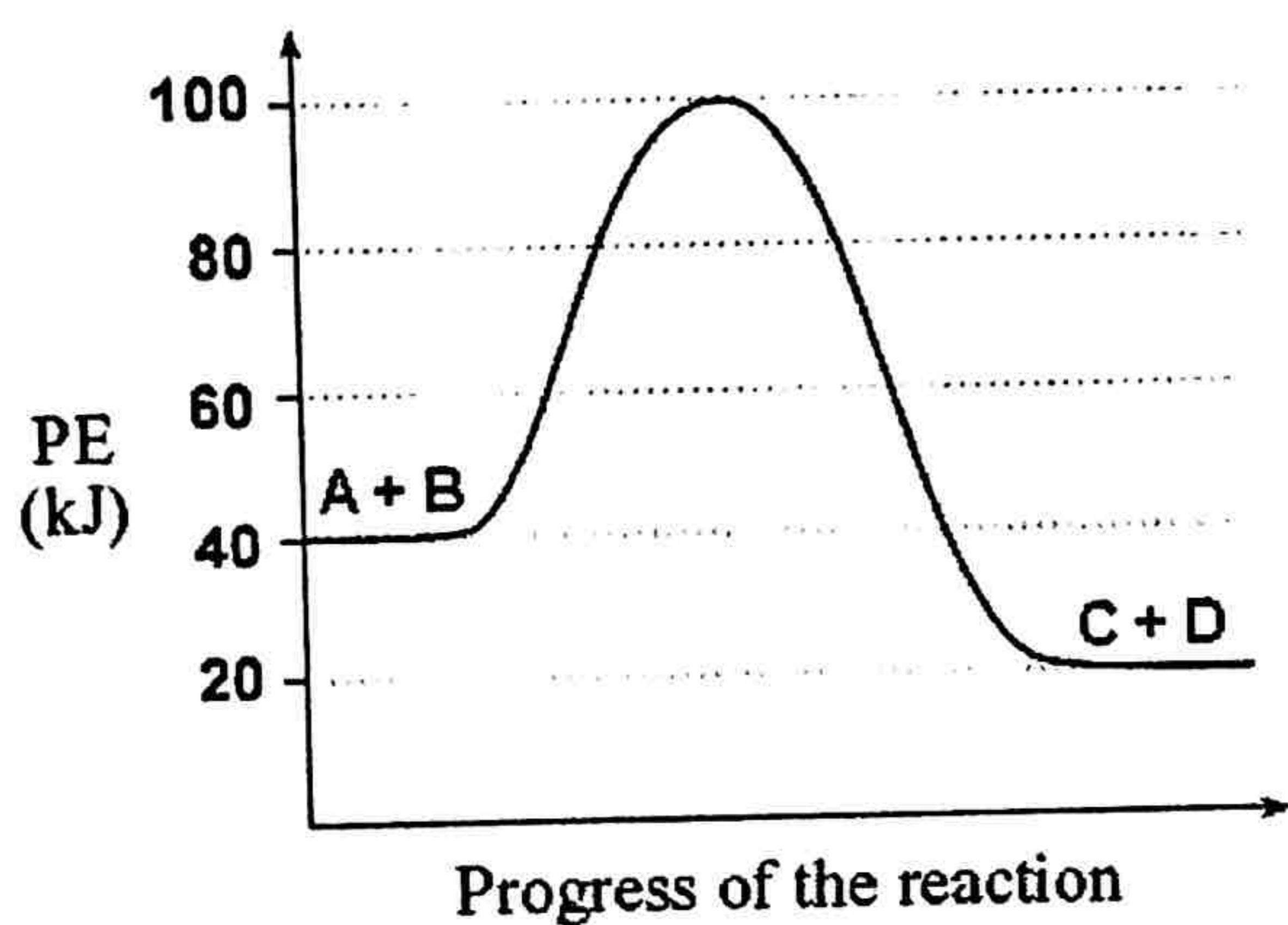
## Potential Energy Diagrams

6. Draw an energy diagram for the reaction  $\text{H}_2 + \text{I}_2 \rightarrow 2\text{HI}$  where the activation energy for the forward reaction is 40.0 kJ with a heat of reaction of +5.0 kJ.



$\Delta H = 5.0 \text{ kJ}$   
 \* products need to be 5 kJ higher than reactants

7. Show how the curve in #1 would be affected by the addition of a catalyst.



8. For the above potential energy diagram answer the following questions.

A. Is it endothermic or exothermic?

exothermic

B. What is the potential energy of the reactants?

40 kJ

C. What is the potential energy of the products?

20 kJ

D. What is the activation energy of the forward reaction?

$$E_a = E_{ac} - E_R = 100 - 40 = 60 \text{ kJ}$$

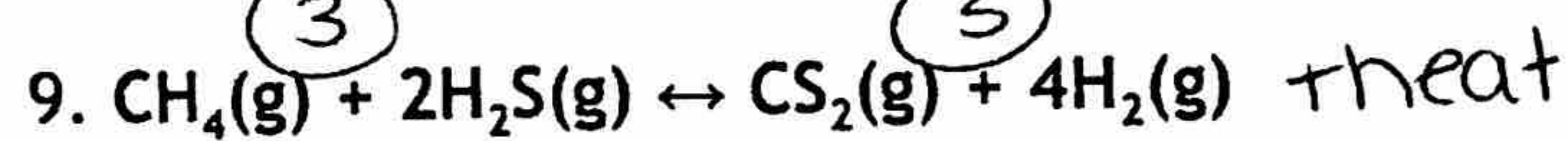
E. What is the activation energy of the reverse reaction?

$$E_a' = 100 - 20 = 80 \text{ kJ}$$

D. What is the heat of reaction?

$$\Delta H = \text{products} - \text{reactants} = 20 - 40 = -20 \text{ kJ}$$

Le Chatelier's Principle For the reaction below, which direction will the reaction shift?



(a) Decrease the concentration of dihydrogen sulfide. ←

(b) Increase the pressure on the system. ←

(c) Increase the temperature of the system. ←

(d) Increase the concentration of carbon disulfide. ←

(e) Decrease the concentration of methane. ( $\text{CH}_4$ ) ←

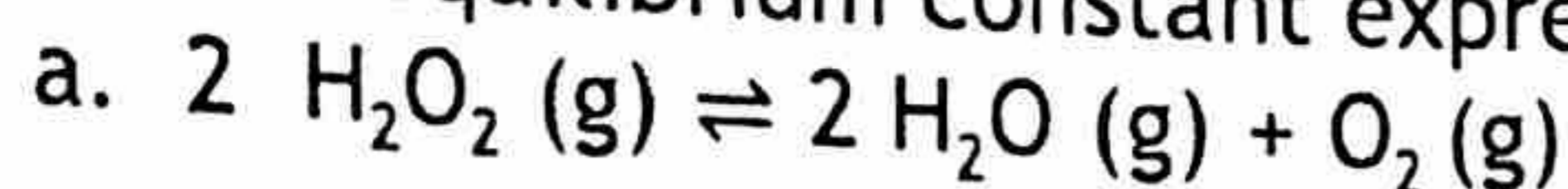
(f) Increase the volume of the system. (decrease pressure) →

(g) add a catalyst no change

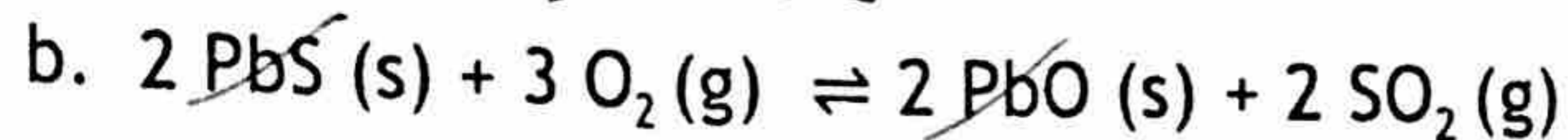


## Equilibrium Expressions

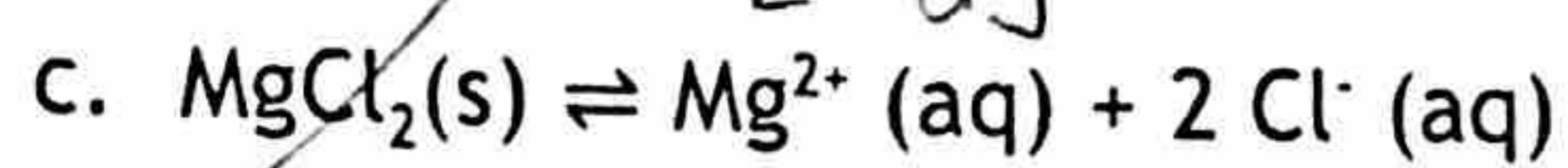
10. Write the equilibrium constant expression for each of the following reactions.



$$K_{eq} = \frac{[\text{H}_2\text{O}]^2 \cdot [\text{O}_2]}{[\text{H}_2\text{O}_2]^2}$$



$$K_{eq} = \frac{[\text{SO}_2]^2}{[\text{O}_2]^3}$$



$$K_{eq} = [\text{Mg}^{2+}] \cdot [\text{Cl}^-]^2$$

11. For each of the following solve for the missing piece and identify if the products or reactants are favored.

a. For the reaction "1a." determine the  $K_{eq}$  if you have  $[\text{H}_2\text{O}_2] = 4.5 \text{ M}$ ;  $[\text{H}_2\text{O}] = 3.0 \text{ M}$ ;  $[\text{O}_2] = 2.25 \text{ M}$ .

$$K_{eq} = \frac{[\text{H}_2\text{O}]^2 [\text{O}_2]}{[\text{H}_2\text{O}_2]^2} = \frac{[3.0 \text{ M}]^2 [2.25 \text{ M}]}{[4.5 \text{ M}]^2} = 1$$

b. For the reaction "1b." determine the concentration of  $\text{SO}_2$  if the  $K_{eq} = 4.56 \times 10^{-5}$ ;  $[\text{O}_2] = 0.75 \text{ M}$ .

$$K_{eq} = \frac{[\text{SO}_2]^2}{[\text{O}_2]^3} \rightarrow 4.56 \times 10^{-5} = \frac{x^2}{(0.75)^3}$$
$$\sqrt{x^2} = \sqrt{1.09 \times 10^{-5}}$$
$$x = 0.0044 \text{ M}$$

c. For reaction "1c" calculate  $K_{eq}$  if the magnesium chloride is dissolved into 4.0L of water and you have 3.75 moles  $\text{Mg}$  ions and 7.50 moles chloride ions.

$$K_{eq} = [\text{Mg}^{2+}] [\text{Cl}^-]^2$$

$$M = \frac{3.75 \text{ mol}}{4.0 \text{ L}} = 0.9375 \text{ M } \text{Mg}^{2+}$$

$$M = \frac{7.50 \text{ mol}}{4.0 \text{ L}} = 1.875 \text{ M } \text{Cl}^-$$

$$K_{eq} = [0.9375] [1.875]^2$$

$$K_{eq} = 3.3$$