PENANG SANGAM HIGH SCHOOL
P.O.BOX 44, RAKIRAKI

LESSON NOTES

Subject: Chemistry **Year/Level:** 12

Week 15

Strand	3 Quantitative Chemistry
Sub Strand	3.3 Physical Chemistry
Content Learning Outcome	To identify reactions at chemical equilibrium, discuss Le Chatelier's principle and how changes can be brought using concentration and temperature.

Chemical Equilibrium

- Reactions can proceed in one direction or both directions.
- Reactions which proceed in one direction go to completion while reactions which proceed in **both directions** (forward and backward) are often reversible.

*When a system is in dynamic equilibrium, **the rate of the forward reaction is equal to the rate of the backward reaction.**

Note: reversible reactions can be made to go to completion by changing the position of the equilibrium and is always represented by ⇌.

This change can be brought about by the **Le Chatelier's principle**.

*Le Chatelier's Principle - **states that if a change is applied to a system at dynamic equilibrium, the position of the equilibrium shifts to counteract the change and re-establish equilibrium.**

Change in a system can be brought about by changes in concentration, temperature and pressure.

Factors that change the position of the equilibrium

1. Concentration

Consider the reaction: $A + B \rightleftharpoons C + D$.

- Increasing the conc of any reactants or both (A or B) at equilibrium, then **forward reaction will be favoured.** Therefore, the rate of forward reaction will increase. The equilibrium will **shift from left to right.** Hence**, more products.**

- If the **conc of the reactants is decreased**, the concentration of the products (C or D) decreases. This **favours the backward reaction**. Equilibrium shifts from right to left.

- Increase in concentration of the products (C or D), increases the reactants, and thus favours the backward reaction. Equilibrium shifts from right to left.

- Decrease in concentration of products (C or D) decreases the reactants, thus favors the forward reaction. Equilibrium shifts from left to right.

2. Temperature

- **An increase in temperature favours endothermic reaction (+ enthalpy change)**. This is because the system counteracts the change made by absorbing the extra heat.

- **A decrease in temperature favours the exothermic reaction (- enthalpy change)**. This is because the system counteracts the change made by producing more heat.

Catalyst

Adding a catalyst will only **increase the rate of the reaction** but it will **never** affect the amount of products formed.

Activity

1. Discuss Le Chatelier's principle.

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2. Explain what do you understand by the statement that 'the system is at dynamic equilibrium'.

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3. Consider the reaction given below.

$$4NO_{(g)} + 6H_2O_{(l)} \rightleftharpoons 4NH_{3(g)} + 5O_{2(g)} \qquad \Delta H = +1170\ kJ$$

   a) State if the forward reaction will be favoured if temperature is increased with reason.

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   b) If the concentration of one of the reactants is increased, what will be the equilibrium shift? Also, explain how this will affect the products?

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   c) Will adding a catalyst have any effect on the amount of oxygen gas formed?

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