SUBJECT and GRADE	**Physical Sciences Grade 12**	
TERM 2	*Week 6*	
TOPIC	Chemical Equilibrium	
AIMS OF LESSON	Introducing the concept of Chemical Equilibrium and factors affecting the chemical equilibrium. Writing the mathematical relationship between the concentrations of all the compounds (solutions and gases) in a closed system that are in chemical equilibrium in an equation. The numerical value of this equation is called the equilibrium constant (Kc). Discussing Le Chateliers' Principle and the application of equilibrium principles.	
RESOURCES	***Paper based resources***	***Digital resources***
	Learners are referred to the: • *Chemical Equilibrium topic in the textbook or study guides (e.g. Answer Series) that learners will have on hand.* • *Examination Guideline (page 20)* • *Mind the Gap Chemistry book (pages 78-121)* • *Past NSC Examination papers (refer to question 6)*	*Refer to the relevant digital resources:* • *WCED ePortal* https://wcedeportal.co.za • *Past NSC Examination papers (refer to question 6)* https://wcedonline.westerncape.gov.za/grade-12-question-papers • *Telematics* https://wcedonline.westercape.gov.za/edumedia/revision-dvds-telematics • *Mind the Gap* https://wcedonline.westercape.gov.za/mind-gap • *HeyScience App for Physical Sciences on Play Store*
INTRODUCTION	• Concepts such as temperature, concentration and pressure should already be familiar to you from previous grades 10 and 11. Endothermic (energy absorbed) and exothermic (energy released) reactions were discussed in grade 11. Rates of Reactions were one of the topics that you were taught in grade 12. • The rates of reactions and the graphs of Rate of reaction vs Time discussed in a previous lesson will also be revisited in this section. • Without chemical equilibrium life as we know it would not have been possible. We will learn how chemical equilibrium can be described by the equilibrium constant (Kc) and how different factors (such as temperature, concentration and pressure) can affect the chemical equilibrium.	

CONCEPTS AND SKILLS	• Explain what is meant by the terms: open and closed systems, a reversible reaction(as per examination guideline page 20 and Mind the Gap (MTG) page 80) • Define the term chemical equilibrium (as per Examination guideline page 20) • List the three factors that influence the position of an equilibrium (MTG page 82) • List the factor that influences the value of the equilibrium constant, Kc. (MTG page 91) • Write down an expression for the equilibrium constant having been given the equation for the reaction. (MTG page 90-91) • Perform calculations based on Kc values. (MTG page 92-102) • Explain the significance of high and low values of the equilibrium constant. (MTG page 92) • State Le Chatelier's principle in words.(Examination guideline page 20 and MTG page 82) • Use Le Chatelier's principle to explain changes in equilibria qualitatively (in words). (MTG 82-87) • Interpret graphs of equilibrium, e.g. concentration/rate/number of moles/mass/volume versus time graphs. (MTG page 103-115) • Explain the use of rate and equilibrium principles in the Haber process and the Contact process. (MTG page 117-121) *Key points to consider when studying this topic:* • Chemical equilibrium will only be reached in a closed system when the rate of the forward reaction is equal to the rate of the reverse reaction in a reversible reaction. Concentration, pressure (for gases) and temperature will disturb the equilibrium. Le Chaterliers' Principle explains how a new equilibrium is established when the equilibrium has been disturbed in order for a new equilibrium to be established. Describe using Le Chateliers' Principle how the chemical equilibrium will be affected when one of the factors influencing the equilibrium is changed. • Only the concentrations of aqueous solutions (aq) and gases (g) appear in the Kc expression; Solids (s) and pure liquids (ℓ) are NOT included in the Kc expression. Kc for a specific reaction is constant at a specific temperature. We use squared brackets to in indicate concentration of a substance e.g. [CO_2]. The only factor that influence the value of the equilibrium constant, Kc, is temperature. Determine if the forward reaction is endothermic or exothermic and from there explain how the change in temperature affect the Kc value. If the change in the temperature of a closed equilibrium system favours the forward reaction: more products form, [products] increases; [reactants] decreases and Kc increases. • Perform calculations based on Kc values (A table will be mostly used to show each of the calculation steps). • Highlight and study definitions and principles from the examination guidelines (page 20).

	• Common mistakes made: Learners do not state definitions and principles as per examination guidelines. When a catalyst is added to a reaction at equilibrium, both the forward and reverse reactions are favoured and not just the one reaction. Learners do not use squared brackets [ ] when writing the Kc expressions. Learners are used to writing units with answers but when calculating the Kc value, the answers should not include a unit. • When performing Kc calculations it is important to write the Kc expression first. Draw a table to populate with the given information. Determine the unknown values in the moles (concentration) used/produced row of the table by using mole ratios. Solve the problem by determining the unknown value. • Remember when interpreting graphs of equilibrium that the concentration/number of moles/mass/ volume versus time graphs and rate versus time graphs look different. At equilibrium the rate of the forward reaction and the reverse reaction curves on the rate vs time graphs will equal and that is not necessarily the case for concentration/number of moles/mass/ volume versus time graphs. Identify what happens if there is a change in the rate/concentration of each substance, which is visible by a change in the shape of the graph.
ACTIVITIES/ ASSESSMENT	You are referred to *Chemical Equilibrium activities/assessment* t0 complete/do from your *Physical Sciences textbooks or Study guides.* *Informal assessment activities in Mind the Gap:* • Chemical equilibrium and factors affecting equilibrium: Activity 2-5 (page 84-90) • Equilibrium constant: Activity 6 Writing Kc expressions (page 91); Activity 7 Kc calculations (page 98); Activity 8 Factors that influence the equilibrium constant (page 101) • Application of equilibrium principles: Activity 11-13 Equilibria graphs (pages 111 -115); Activity 15 - 17 Haber and Contact processes (pages 119 - 121)
CONSOLIDATION	In this topic we have introduced the concept of Chemical Equilibrium and discussed the factors affecting the chemical equilibrium. We saw that when chemical equilibrium has been reached we can write the mathematical relationship between the concentrations of all the compounds (solutions and gases) in a closed system in an equation which gives us the equilibrium constant (Kc). Le Chateliers' Principle and the application of equilibrium principles were also discussed in this topic. We will refer to chemical equilibrium in the next chemistry lesson on Electrochemical reactions when galvanic cells (e.g. batteries) that become 'flat' are discussed.
VALUE	Without chemical equilibrium life as we know it would not be possible. We are surrounded by many examples of chemical equilibrium in our daily lives. One such example is a bottle of fizzy (gas) cooldrink where there is carbon dioxide (CO_2) dissolved in the liquid. There is also CO_2 gas in the space between the liquid and the cap. There is a constant movement of CO_2 from the liquid to gas phase and from the gas phase into the liquid but if you look at the bottle there does not appear to be any changes. The system is in equilibrium.