9.3 The Acidic Environment

Make a summary of The Acidic Environment by working through the following instructions based on the Biology Stage 6 syllabus.

Remember:

- Both word and balanced chemical equations should be given where appropriate
- Diagrams and tables can be used to help with your responses.
- Use appropriate responses for the glossary verbs.

9.3.1 Indicators were identified with the observation that the colour of some flowers depends on soil composition

Classify common substances as acidic, basic or neutral (use the table below)

Name of substance	Formula	Acidic/Basic/ Neutral

Identify that indicators such as litmus, phenolphthalein, methyl orange and bromothymol blue can be used to determine the acidic or basic nature of a material over a range, and that the range is identified by change in indicator colour

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Identify and describe some everyday uses of indicators including the testing of soil acidity/basicity

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9.3.2 While we usually think of the air around us as neutral, the atmosphere naturally contains acidic oxides of carbon, nitrogen and sulfur. The concentrations of these acidic oxides have been increasing since the Industrial Revolution.

Identify oxides of non-metals which act as acids and describe the conditions under which they act as acids

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Analyse the position of these non-metals in the Periodic Table and **outline** the relationship between position of elements in the Periodic Table and acidity/basicity of oxides

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Define Le Chatelier's principle

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Identify factors which can affect the equilibrium in a reversible reaction

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Describe the solubility of carbon dioxide in water under various conditions as an equilibrium process and **explain** in terms of Le Chatelier's principle

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Identify natural and industrial sources of sulfur dioxide and oxides of nitrogen using the table below

	Formula	Natural Sources	Industrial Sources
Sulfur Dioxide			
Oxides of Nitrogen			

Describe, using equations, examples of chemical reactions which release sulfur dioxide and chemical reactions which release oxides of nitrogen

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Assess the evidence which indicates increases in atmospheric concentration of oxides of sulfur and nitrogen

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Calculate volumes of gases given masses of some substances in reactions, and calculate masses of substances given gaseous volumes, in reactions involving gases at 0°C and 100kPa or 25°C and 100kPa

Explain the formation of acid rain

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Explain the effects of acid rain

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9.3.3.Acids occur in many foods, drinks and even within our stomachs

Define acids as proton donors and **describe** the ionisation of acids in water (use a diagram and equations to illustrate your answer)

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Identify acids including acetic (ethanoic), citric (2-hydroxypropane-1,2,3-tricarboxylic), hydrochloric and sulfuric acid (give formula and lewis dot diagram)

Describe the use of the pH scale in comparing acids and bases

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Describe acids and their solutions with the appropriate use of the terms strong, weak, concentrated and dilute identify pH as $-\log_{10}[H^+]$

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and **explain** that a change in pH of 1 means a ten-fold change in $[H^+]$

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Compare the relative strengths of equal concentrations of citric, acetic and hydrochloric acids and **explain** in terms of the degree of ionisation of their molecules

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Describe the difference between a strong and a weak acid in terms of an equilibrium between the intact molecule and its ions

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9.3.4 Because of the prevalence and importance of acids, they have been used and studied for hundreds of years. Over time, the definitions of acid and base have been refined

Outline the historical development of ideas about acids including those of:

Lavoisier ……

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Davy ..……

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Arrhenius ……

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Outline the Brönsted-Lowry theory of acids and bases

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Describe the relationship between an acid and its conjugate base and a base and its conjugate acid

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Identify a range of salts which form acidic, basic or neutral solutions and **explain** their acidic, neutral or basic nature

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Identify conjugate acid/base pairs (illustrate your answer with an equation)

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Identify amphiprotic substances and **construct** equations to **describe** their behaviour in acidic and basic solutions

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Identify neutralisation as a proton transfer reaction which is exothermic

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Describe the correct technique for conducting titrations and preparation of standard solutions

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Qualitatively describe the effect of buffers with reference to a specific example in a natural system

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9.3.5 Esterification is a naturally occurring process which can be performed in the laboratory

Describe the differences between the alkanol and alkanoic acid functional groups in carbon compounds

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Identify the IUPAC nomenclature for describing the esters produced by reactions of straight-chained alkanoic acids from C1 to C8 and straight-chained primary alkanols from C1 to C8

Explain the difference in melting point and boiling point caused by straight-chained alkanoic acid and straight-chained primary alkanol structures

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Identify esterification as the reaction between an acid and an alkanol and **describe**, using equations, examples of esterification (illustrate with a suitable labelled diagram of the processes involved)

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Describe the purpose of using acid in esterification for catalysis

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Explain the need for refluxing during esterification (use a diagram to illustrate your response)

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Outline some examples of the occurrence, production and uses of esters

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PracticalTasks

9.3.1 Indicators were identified with the observation that the colour of some flowers depends on soil composition

- perform a first-hand investigation to prepare and test a natural indicator
- identify data and choose resources to gather information about the colour changes of a range of indicators
- solve problems by applying information about the colour changes of indicators to classify some household substances as acidic, neutral or basic

9.3.2 While we usually think of the air around us as neutral, the atmosphere naturally contains acidic oxides of carbon, nitrogen and sulfur. The concentrations of these acidic oxides have been increasing since the Industrial Revolution

- identify data, plan and perform a first-hand investigation to decarbonate soft drink and gather data to measure the mass changes involved and calculate the volume of gas released at 25°C and 100kPa
- analyse information from secondary sources to summarise the industrial origins of sulfur dioxide and oxides of nitrogen and evaluate reasons for concern about their release into the environment

9.3.3 Acids occur in many foods, drinks and even within our stomachs

- solve problems and perform a first-hand investigation to use pH meters/probes and indicators to distinguish between acidic, basic and neutral chemicals
- plan and perform a first-hand investigation to measure the pH of identical concentrations of strong and weak acids
- gather and process information from secondary sources to write ionic equations to represent the ionisation of acids
- use available evidence to model the molecular nature of acids and simulate the ionisation of strong and weak acids
- gather and process information from secondary sources to explain the use of acids as food additives
- identify data, gather and process information from secondary sources to identify examples of naturally occurring acids and bases and their chemical composition
- process information from secondary sources to calculate pH of strong acids given appropriate hydrogen ion concentrations

9.3.4 Because of the prevalence and importance of acids, they have been used and studied for hundreds of years. Over time, the definitions of acid and base have been refined

- gather and process information from secondary sources to trace developments in understanding and describing acid/base reactions
- choose equipment and perform a first-hand investigation to identify the pH of a range of salt solutions
- perform a first-hand investigation and solve problems using titrations and including the preparation of standard solutions, and use available evidence to quantitatively and qualitatively describe the reaction between selected acids and bases
- perform a first-hand investigation to determine the concentration of a domestic acidic substance using computer-based technologies
- analyse information from secondary sources to assess the use of neutralisation reactions as a safety measure or to minimise damage in accidents or chemical spills

9.3.5 Esterification is a naturally occurring process which can be performed in the laboratory

- identify data, plan, select equipment and perform a first-hand investigation to prepare an ester using reflux
- process information from secondary sources to identify and describe the uses of esters as flavours and perfumes in processed foods and cosmetics