Kennedy Baptist College

ATAR CHEMISTRY UNITS 3 & 4
SEMESTER ONE EXAM REVISION

SEMESTER ONE EXAM IS WEIGHTED 20% OF THE YEAR MARK

Time allowed for this paper
Reading time before commencing work: ten minutes
Working time for paper: three hours

Materials required/recommended for this paper
To be provided by the supervisor
This Question/Answer Booklet
Multiple-choice Answer Sheet
Chemistry Data Booklet

To be provided by the candidate
Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters
Special items: up to three non-programmable calculators approved for use in the WACE examinations

Important note to candidates: No other items may be taken into the examination room. It is your responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room.

Section	Suggested working time	Number of questions available	Number of questions to be attempted	Percentage of paper	Marks
ONE Multiple Choice	50 minutes	25	25	25	50
TWO Short Answer	60 minutes			35	70
THREE Extended Answer	70 minutes			40	80
			Total	100	200

1. Answer the questions according to the following instructions.
   Section One: Answer all questions on the separate Multiple-choice Answer Sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.
   Sections Two and Three: Write your answers in this Question/Answer Booklet.
2. When calculating numerical answers, show your working or reasoning clearly. Express numerical answers to the appropriate number of significant figures and include appropriate units where applicable.

3. You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.
4. Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
   - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
   - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question that you are continuing to answer at the top of the page.

Unit Content Covered

Chemical Equilibrium Systems

- collision theory can be used to explain and predict the effects of concentration, temperature, pressure, the presence of catalysts and surface area of reactants on the rates of chemical reactions
- chemical systems include physical changes and chemical reactions and may be open (which allow matter and energy to be exchanged with the surroundings) or closed (which allow energy, but not matter, to be exchanged with the surroundings)
- observable changes in chemical reactions and physical changes can be described and explained at an atomic and molecular level
- over time, in a closed system, reversible physical and chemical changes may reach a state of dynamic equilibrium, with the relative concentrations of products and reactants defining the position of equilibrium
- the characteristics of a system in dynamic equilibrium can be described and explained in terms of reaction rates and macroscopic properties
- the reversibility of chemical reactions can be explained in terms of the activation energies of the forward and reverse reactions
- the effect of changes of temperature on chemical systems initially at equilibrium can be predicted by considering the enthalpy changes for the forward and reverse reactions; this can be represented on energy profile diagrams and explained by the changes in the rates of the forward and reverse reactions
- the effects of changes in concentration of solutions and partial pressures of gases on chemical systems initially at equilibrium can be predicted and explained by applying collision theory to the forward and reverse reactions
- the effects of changes in temperature, concentration of species in solution, partial pressures of gases, total volume and the addition of a catalyst on equilibrium systems can be predicted using Le Châtelier's Principle
- equilibrium law expressions can be written for homogeneous and heterogeneous systems; the equilibrium constant (K), at any given temperature, indicates the relationship between product and reactant concentrations at equilibrium
- the relative amounts of reactants and products (equilibrium position) can be predicted qualitatively using equilibrium constants (K_c)
- levels of carbon dioxide in the atmosphere are rising and have a significant impact on global systems, including surface temperatures. The increasing level of carbon dioxide in the

atmosphere causes more carbon dioxide to dissolve in the ocean producing carbonic acid and leading to increased ocean acidity. This is predicted to have a range of negative consequences for marine ecosystems such as coral reefs. Calcification is the process which results in the formation of calcium carbonate structures in marine organisms. Acidification shifts the equilibrium of carbonate chemistry in seawater, decreasing the rate and amount of calcification among a wide range of marine organisms.

- the United Nations Kyoto Protocol and the Intergovernmental Panel on Climate Change aim to secure a global commitment to reducing greenhouse gas emissions over the next few decades.

Revision Materials:

Lucarelli Essential Chemistry
Set 1: Review: Energy Change and Reaction Rate
Set 2: Chemical Equilibrium
WACE Study Guide: Chemistry
Chemical Equilibrium 1.1 – 1.6
Trial Test 1
STAWA Exploring Chemistry
Set 4: Reaction Rate and Energy
Set 5: Equilibrium Constant Expressions
Set 6: Equilibrium Systems
Set 7: Equilibrium

Acids and Bases

- models and theories are contested and refined or replaced when new evidence challenges them, or when a new model or theory has greater explanatory scope.
- Davy initially proposed that acids were substances that contained replaceable hydrogen (hydrogen that could be partly or totally replaced by metals) and bases were substances that reacted with acids to form salts and water.
- Arrhenius model, which includes only soluble acids and bases, identified acids as substances which produce hydrogen ions in solution and bases as substances which produce hydroxide ions in solution
- the Brønsted-Lowry model describes acid-base behaviour in terms of proton donors and proton acceptors. This approach includes a wider range of substances and can be more broadly applied.
- acids are substances that can act as proton (hydrogen ion) donors and can be classified as monoprotic or polyprotic, depending on the number of protons available for donation
- the relationship between acids and bases in equilibrium systems can be explained using the Brønsted-Lowry model and represented using chemical equations that illustrate the transfer of protons between conjugate acid-base pairs
- the strength of acids is explained by the degree of ionisation at equilibrium in aqueous solution which can be represented by chemical equations and acidity constants (K_a)
- the hydrolysis of salts of weak acids and weak bases can be represented using equations; the Brønsted-Lowry model can be applied to explain the acidic, basic and neutral nature of salts derived from bases and monoprotic and polyprotic acids
- water is a weak electrolyte; the self-ionisation of water is represented by $K_w = [H^+][OH^-]$ where $K_w = 1.0 \times 10^{-14}$ at 25 °C

- K_w can be used to calculate the concentration of hydrogen ions or hydroxide ions in solutions of strong acids or bases
- the pH scale is a logarithmic scale and the pH of a solution can be calculated from the concentration of hydrogen ions using the relationship pH = – log10 $[H^+]$
- acid-base indicators are weak acids, or weak bases, in which the acidic form is a different colour from the basic form
- buffer solutions are conjugate in nature and resist changes in pH when small amounts of strong acid or base are added to the solution; buffering capacity can be explained qualitatively; Le Châtelier's Principle can be applied to predict how buffers respond to the addition of hydrogen ions and hydroxide ions
- volumetric analysis methods involving acid-base reactions rely on the identification of an equivalence point by measuring the associated change in pH, using appropriate acid-base indicators or pH meters, to reveal an observable end point
- data obtained from acid-base titrations can be used to calculate the masses of substances and concentrations and volumes of solutions involved

Revision Materials:

Lucarelli Essential Chemistry

Set 3: Review: Acid-Base Properties
Set 4: Theories of Acid-Base Behaviour
Set 5: pH in Water and Aqueous Solutions
Set 6: Buffers
Set 7: Volumetric Analysis: Acid-Base Titrations

WACE Study Guide: Chemistry

Acids and Bases 2.1 – 2.6
Trial Test 2

STAWA Exploring Chemistry

Set 8: Acids and Bases
Set 9: Acid and Base Strength
Set 10: Hydrolysis
Set 11: Water Equilibrium
Set 12: Indicators and Their Use
Set 13: The pH Scale
Set 14: Buffers
Set 15: Acid-Base Titrations 1
Set 16: Acid-Base Titrations 2
Set 17: Acids and Bases in Action

Oxidation and Reduction

- the species being oxidised and reduced in a redox reaction can be identified using oxidation numbers

- oxidation-reduction (redox) reactions involve the transfer of one or more electrons from one species to another
- oxidation involves the loss of electrons from a chemical species, and reduction involves the gain of electrons by a chemical species; these processes can be represented using half-equations and redox equations (acidic conditions only)
- a range of reactions involve the oxidation of one species and reduction of another species, including metal and halogen displacement reactions, and combustion in both limited and excess oxygen environments
- the relative strength of oxidising and reducing agents can be determined by comparing standard electrode potentials, and can be used to predict reaction tendency
- electrochemical cells, including galvanic and electrolytic cells, consist of oxidation and reduction half-reactions connected via an external circuit through which electrons move from the anode (oxidation reaction) to the cathode (reduction reaction)
- galvanic cells produce an electric current from a spontaneous redox reaction
- the electric potential difference of a cell under standard conditions can be calculated from standard electrode potentials; these values can be used to compare the voltages generated by cells constructed from different materials
- electrochemical cells can be described in terms of the reactions occurring at the anode and cathode, the role of the electrolyte, salt bridge (galvanic cell), ion migration, and electron flow in the external circuit
- corrosion of iron is an electrochemical process that can be prevented by a range of techniques, including by exclusion of oxygen and/or water and through cathodic protection and sacrificial anodes
- cell diagrams can be used to represent electrochemical cells
- electrolytic cells use an external electrical potential difference to provide the energy to allow a non-spontaneous redox reaction to occur
- describe the use of electrolysis in electrolytic refining, including for purification of copper, and metal electroplating, including for silver
- spontaneous redox reactions can be used as a source of electrical energy, including primary cells (for example, the Leclanché cell), secondary cells (for example, the lead-acid accumulator) and fuel cells (for example, the hydrogen fuel cell). Fuel cells are a potential lower-emission alternative to the internal combustion engine and are already being used to power various modes of transport. Organisations, including the International Partnership for Hydrogen and Fuel Cells in the Economy, have been created to foster global cooperation on research and development, common codes and standards, and information sharing on infrastructure development.

Revision Materials:

Lucarelli Essential Chemistry

Set 8: Oxidation Numbers and Redox Reactions
Set 9: Balancing Half-Equations and Redox Reactions
Set 10: Understanding Galvanic Cells
Set 11: Electrolysis
Set 12: Electrochemistry in Action

WACE Study Guide: Chemistry
Oxidation and Reduction 3.1 – 3.7
Trial Test 3
STAWA Exploring Chemistry
Set 18: Oxidation Number
Set 19: Balancing Half-Equations
Set 20: Balancing Redox Equations
Set 21: Galvanic Cells
Set 22: Electrolytic Cells
Set 23: Oxidation and Reduction

Science Inquiry Skills (Covered Across All Unit Content)

- identify, research, construct and refine questions for investigation; propose hypotheses; and predict possible outcomes
- design investigations, including the procedure(s) to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics
- conduct investigations safely, competently and methodically for the collection of valid and reliable data, including: acid-base properties, using acid-base volumetric analysis techniques, effects of changes to equilibrium systems, and constructing electrochemical cells
- represent data in meaningful and useful ways, including using appropriate graphic representations and correct units and symbols; organise and process data to identify trends, patterns and relationships; identify and distinguish between random and systematic errors, and estimate their effect on measured results; discuss how the nature of the procedure and the sample size may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions
- interpret a range of scientific texts, and evaluate processes, claims and conclusions by considering the quality of available evidence, including confidence intervals in secondary data; and use reasoning to construct scientific arguments
- communicate to specific audiences and for specific purposes using appropriate language, nomenclature and formats, including scientific reports

Revision Materials:

STAWA Exploring Chemistry
Set 1: Significant Figures and Unit Conversions
Set 2: Errors
Set 3: Random and Systematic Errors