Government of **Western Australia**
Curriculum Council

WACE
Western Australian Certificate of Education

CHEMISTRY

Stage 3

Sample WACE Examination 2010

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2010/4683

3A	Sample 2010 Question/ Section	Sample 2010 Marks	2010 Question/ Section	2010 Marks	2011 Question/ Section	2011 Marks
Macroscopic properties of matter						
• interpret observations, such as the colour changes, of physical and chemical systems at equilibrium						
• use observable properties, such as the colour of ions, to help predict and explain the formation of products in chemical processes (see data sheet)						
• use the Kinetic Theory to explain the concept of absolute zero.	12/1	1				
Solutions						
• apply the solubility rules to predict if a precipitate will form when two dilute ionic solutions are mixed (see data sheet)						
• perform concentration calculations (mol L^{-1}, g L^{-1}, ppm, percentage composition)						
• calculate the concentration of ions in solution for strong electrolytes						
• perform the calculation of concentration and volume involved in the dilution of solutions and the addition of solutions.						
Atomic structure and bonding						
Atomic structure and Periodic Table						
• explain the structure of the atom in terms of protons, neutrons and electrons						
• write the electron configuration using the shell model for the first twenty elements e.g. Na. 2, 8, 1						
• explain trends in ionisation energy, atomic radius and electronegativity across periods and down groups (for main group elements) in the Periodic Table	3/1 4/1 5/1 43/3	1 1 1 6				
• describe and explain the relationship between the number of valence electrons and an element's ▪ bonding capacity ▪ position on Periodic Table ▪ physical and chemical properties.	1/1 2/1 43/3	1 1 6				

	Sample 2010		2010		2011	
3A	**Question/ Section**	**Marks**	**Question/ Section**	**Marks**	**Question/ Section**	**Marks**
Bonding						
• describe and apply the relationships between the physical properties and the structure of ionic, metallic, covalent network and covalent molecular substances	6/1	1				
• use the Valence Shell Electron Pair Repulsion (VSEPR) theory and Lewis structure diagrams to explain and predict and draw the shape of molecules and polyatomic ions (octet only)	34/2	6				
• explain polar and non-polar covalent bonds in terms of the electronegativity of the atoms involved in the bond formation						
• use the relationship between molecule shape and bond polarity to predict and explain the polarity of a molecule	20/1	1				
• explain the differences between intermolecular and intramolecular forces						
• describe and explain the origin and relative strength of the following intermolecular interactions for molecules of a similar size: ▪ dispersion forces ▪ dipole-dipole attractions ▪ hydrogen bonds ▪ ion-dipole interactions such as solvation of ions in aqueous solution	21/1 22/1 33/2 35/2	1 1 1 8				
• explain the relationships between physical properties such as melting and boiling point, and the types of intermolecular forces present in substances of similar size						
• apply an understanding of intermolecular interactions to explain the trends in melting and boiling points of hydrides of groups 15, 16 and 17 accounting for the anomalous behaviour of NH_3, H_2O and HF						
• explain and describe the interaction between solute and solvent particles in a solution	39/3	4				
• use the nature of the interactions, including the formation of ion-dipole and hydrogen bonds to explain water's ability to dissolve ionic, polar and non-polar solutes.	33/2 37/2	2 2				

3A	Sample 2010		2010		2011	
	Question/ Section	Marks	Question/ Section	Marks	Question/ Section	Marks
Chemical reactions						
Reactions, equations and stoichiometry						
• describe, write equations for and interpret observations for the following reaction types: ▪ precipitation ▪ solvation of ions in aqueous solution ▪ physical and chemical equilibrium	11/1 18/1 30/2 31/2 32/2 38/3	1 1 4 2 3 3				
• write ionic equations appropriate to the chosen context using ions in the list provided in the syllabus:						
• perform calculations involving ▪ conversion between Celsius and Kelvin temperature scales ▪ mass, molar mass, number of moles of solute, concentration and volume of solution and gas volume using PV=nRT ▪ percentage purity of reactants or percentage yield in industrial processes ▪ a limiting reagent, including: o identification of limiting reagents o calculation of excess reagents.	13/1 36/2 38/3 42/3	1 3 6 14				
Chemical equilibrium						
• explain by applying the collision theory how changes in rates of reactions can be accomplished by: ▪ the presence of catalysts ▪ changes in temperature ▪ pressure of whole system concentration ▪ state of sub-division	39/3	5				
• describe and explain the characteristics of a system in dynamic chemical equilibrium						
• write equilibrium law expressions for homogeneous and heterogeneous systems	26/2	2				
• use K and equilibrium law expression to explain the relative proportions of products and reactants in a system in dynamic chemical equilibrium	19/1 32/2	1 2				

3A	Sample 2010		2010		2011	
	Question/ Section	Marks	Question/ Section	Marks	Question/ Section	Marks
• apply and explain how Le Châtelier's principle can be used to predict the impact of the following changes to a system initially at chemical equilibrium: ▪ changes in temperature ▪ changes in solution concentration ▪ changes in partial pressure of a gas ▪ addition of a catalyst.						
Applied chemistry						
• apply the concept of equilibrium in biological, environmental or laboratory situations where a system is in dynamic chemical equilibrium						
• explain the reasons for compromises between the ideal and actual conditions used in industrial processes that involve reversible reactions						
• write the chemical formulae for molecular compounds based on the number of atoms of each element present as inferred from the systematic names						
• write the molecular formulae of commonly encountered molecules that have non-systematic names						
• investigate real world problems in a laboratory setting, considering: ▪ sources of uncertainty in experimental measurements ▪ selection of the appropriate units of measurement of quantities such as volume and time						
• investigate a biological, environmental or industrial process applicable to context/s chosen. Include: ▪ a description of the chosen process and the chemical reactions occurring ▪ an explanation of the relationships between the chosen process and chemical models and theories ▪ where appropriate: o safe handling and disposal of any materials or specific chemicals involved in the process o discussion of sustainability of the process o discussion of the environmental impact of the process.						

3B	Sample 2010		2010		2011	
	Question/ Section	Marks	Question/ Section	Marks	Question/ Section	Marks
Chemical reactions						
Reactions, equations and stoichiometry						
• describe, write equations for and interpret observations for the following reaction types: ▪ neutralisation ▪ hydrolysis of salts of weak acids and weak bases ▪ oxidation and reduction equations in an acidic environment	16/1 31/2	1 2				
• perform volumetric analysis using either acid-base or redox context, and: ▪ give a description of procedures used and methods for minimising experimental error ▪ describe and explain the characteristics of primary standards and standard solutions ▪ demonstrate an understanding of end point and equivalence point to the selection of an appropriate indicator in an acid-base titration ▪ explain the choice of indicators (in acid-base only) or use of self-indicators (redox)	17/1 39/3	1 2				
• perform calculations based on acid-base and redox titrations	39/3	10				
• determine by calculation the empirical and molecular formulae and the structure of a compound from the analysis of combustion or other data.	40/3	11				
Acids and bases in aqueous solutions						
• apply an understanding of the concept of an electrolyte to explain the self-ionisation of water						
• explain and apply the Arrhenius and Brønsted-Lowry models to describe acids and bases	8/1 33/2	1 3				
• apply the relationship between K_w and temperature to explain the pH value of a neutral solution at different temperatures	33/2	3				
• apply the relationship pH = - log $[H^+]$ to calculate the pH of: ▪ strong acid solutions ▪ strong base solutions ▪ the resulting solution when strong acid-base solutions are mixed	32/2 33/2	2 2				

3B	Sample 2010 Question/ Section	Sample 2010 Marks	2010 Question/ Section	2010 Marks	2011 Question/ Section	2011 Marks
• apply the Brønsted-Lowry model to the hydrolysis of salts to predict and explain the acidic, basic or neutral nature of salts derived from monoprotic and polyprotic acids, and bases	9/1 10/1	1 1				
• describe and explain the conjugate nature of buffer solutions ▪ explain using Le Châtelier's Principle how buffers respond to the addition of H^+ and OH^-	7/1 29/2	1 2				
• explain qualitatively the concept of buffering capacity.	29/2	4				
Oxidation and reduction						
• apply the table of Standard Reductions Potentials to determine the relative strength of oxidising and reducing agents to predict reaction tendency	35/2 41/3	2 2				
• apply oxidation numbers to identify redox equations and/or oxidants and reductants ▪ identify by name and/or formula common oxidising and reducing agents including O_2, $C\ell_2$, MnO_4^-, $Cr_2O_7^{2-}$, $C\ell O^-$, H^+, concentrated sulfuric acid, concentrated nitric acid and common reducing agents (reductants) including Zn, C, H_2, Fe^{2+}, $C_2O_4^{2-}$	14/1	1				
• describe and explain the role of the following in the operation of an electrochemical (galvanic) cell: ▪ anode processes ▪ cathode processes ▪ electrolyte ▪ salt bridge and ion migration ▪ electron flow in external circuit	15/1	1				
• describe the electrical potential of a galvanic cell as the ability of a cell to produce an electric current						
• describe and explain how an electrochemical cell can be considered as two half-cells						
• describe the role of the hydrogen half-cell in the table of Standard Reduction Potentials						
• describe the limitations of Standard Reduction Potentials table.						

3B	Sample 2010		2010		2011	
	Question/ Section	**Marks**	**Question/ Section**	**Marks**	**Question/ Section**	**Marks**
Organic chemistry						
• write balanced equations for the following reactions of hydrocarbons: ▪ substitution reactions of alkanes ▪ addition reactions of alkenes ▪ combustion						
• draw and name structural isomers of alkanes and structural and geometric isomers of alkenes						
• recognise the functional groups—alcohols, aldehydes, ketones, carboxylic acids and esters and name simple straight chain examples to C_8	23/1 41/3	1 2				
• explain the relationship between the presence of a functional group and chemical behaviour						
• alcohols: ▪ name simple straight chain examples to C_8 ▪ draw simple structural formula for primary, secondary and tertiary alcohols ▪ explain physical properties of alcohols such as melting and boiling points and solubility in polar and non-polar solvents in terms of the intermolecular interactions ▪ describe, write equations for and predict and interpret observations for the following reactions of alcohols: ○ with carboxylic acids ○ with acidified $Cr_2O_7^{2-}$ and MnO_4^- to produce: - aldehydes - ketones - carboxylic acids	24/1 25/1 28/2	1 1 6				
• amines: ▪ recognise primary amines ▪ name and draw simple structural formulae for primary amines only	37/2	1				
• α amino acids: ▪ recognise general structural formula for α amino acids.						

3B	Sample 2010		2010		2011	
	Question/ Section	Marks	Question/ Section	Marks	Question/ Section	Marks
Applied chemistry						
• describe the chemistry of common organic substances such as soaps, detergents, amino acids and trans-fatty acids						
• apply and explain the concept of polymerisation such as polypeptides, silicones or plastics	27/2	4				
• investigate real world problems in a laboratory setting, considering: ▪ sources of uncertainty in experimental measurements ▪ selection of the appropriate units of measurement of quantities such as volume and time	41/3	7				
• investigate a biological, environmental or industrial redox process applicable to context/s chosen e.g. metal extraction, commercial electrochemical cells, corrosion etc. Include: ▪ a description of the chosen process and the chemical reactions occurring ▪ an explanation of the relationships between the chosen process and chemical models and theories ▪ where appropriate ○ safe handling and disposal of any materials or specific chemicals involved in the process ○ discussion of the sustainability of the process ○ discussion of the environmental impact of the process.	35/2	5				