No. 103/3

EDUCATIONAL QUALITY AND ASSESSMENT PROGRAMME

Scoring Rubric 2021

South Pacific Form Seven Certificate

CHEMISTRY

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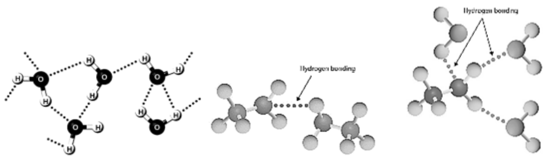
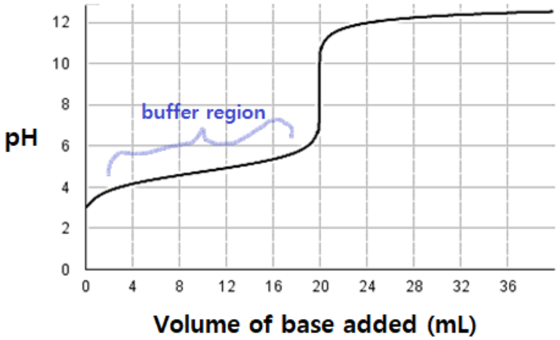
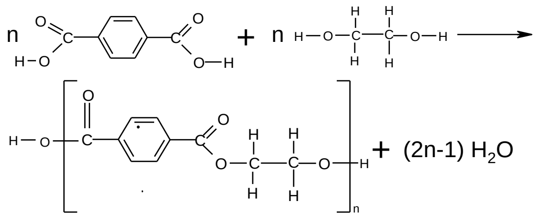
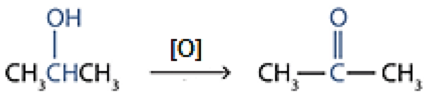
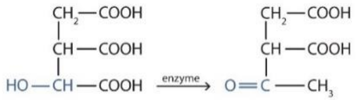
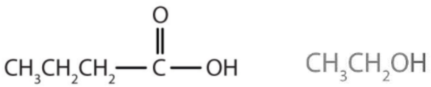
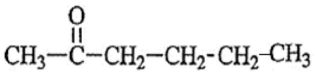
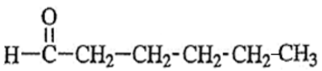
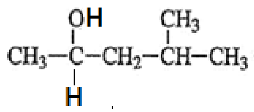
SLO	Q. No.	SL	Evidence	Student Response Level			
				Extended Abstract 4	**Relational 3**	**Multistructural 2**	**Unistructural 1**
Strand 1: Atomic Structure, Bonding and Related Properties							
CHE1.1.1.1	1.1	1	C				C
CHE1.1.3.1	1.2	3	With the [Ar]$3d^4 4s^2$ configuration, the 3d orbital is partially filled while the 4s is fully filled. With the [Ar]$3d^5 4s^1$ configuration, the 3d orbital is half filled while the 4s orbital is also half filled. **Since half-filled d orbitals have extra stability than partially filled d orbitals, Cr assumes the [Ar]$3d^5 4s^1$ configuration to attain the extra stable state.**		Two or more ideas are correctly given which are linked, as the example given in bold i.e. the stabilities of both electron configurations are mentioned and compared.	Two independent ideas are correctly given. For example, the stability of each electronic configuration is mentioned separately but not linked.	Any one correct idea is given. e.g. half-filled orbitals are more stable than partially filled orbitals.
CHE1.1.2.2	1.3	2	• The nuclear charge of an atom. • The shielding effect of electrons in an atom.			Two correct ideas/ factors are given.	One correct idea/factor is given.
CHE1.1.1.3	1.4a	1	Bent or 'V" shape				One correct idea is given.
CHE1.1.4.1	1.4b	4	Firstly, water and ethanol are both polar due to their bent and tetrahedral shapes, respectively. The polarity results in strong intermoleculer forces of attraction (hydrogen bonds) between water and ethanol molecules in their pure solutions. Furthermore, in pure form, water has open spaces between its molecules arising from its shape and hydrogen bonding. However, when the water and ethanol are mixed, hydrogen bonds between the water and ethanol also forms that draws the different molecules close together. The open space structure of liquid water is disrupted, and the empty space becomes less. The two different molecules pack closer together than in pure solution, resulting in a reduction of volume. 	Two or more ideas are correctly given which are linked, and an important conclusion is derived, e.g. • the compounds form hydrogen bonds in between their molecules in their pure form, and • the two compounds form hydrogen bonds in between each other's molecules in the mixture. • This leads to disruption in the open space structure of water and closer packing of the molecules of the two compounds, • resulting in a reduction of volume.	Two or more ideas are correctly given which are linked, e.g. • the compounds form hydrogen bonds in between their molecules in their pure form, and • the two compounds form hydrogen bonds in between each other's molecules in the mixture. • This leads to disruption in the open space structure of water.	Two independent ideas are correctly given, e.g. • the compounds form hydrogen bonds in between their molecules in their pure form, and • the two compounds form hydrogen bonds in between each other's molecules in the mixture.	Any one correct idea is given, e.g. the compounds have hydrogen bonding between its molecules.
CHE1.2.1.3	1.5a	1	It is a positively charged particle.				One correct idea is given.
CHE1.2.1.1	1.5b	1	A process where the nucleus of an atom is split into two or more smaller nuclei.				One correct idea is given.
CHE1.2.3.3	1.5c	3	20.0 g to 10.0 g is one half-life. 10.0 g to 5.0 g is another half-life. 5.0 g to 2.5 g is another half-life. Therefore, total of 3 half-lives. Time = 245,000 × 3 = 735,000 years		Two correct ideas are given and linked e.g. the mass after each half-life is determined, three half-lives are determined as the time for decay to 2.5 g and the total time is calculated from	Two independent correct ideas are given, e.g. the mass after each half-life is determined and three half-lives are determined as the time for decay.	One correct idea is given, e.g. the mass after one half-life is determined.

					the number of half-lives and $t_{½}$.		
CHE1.3.2.1	1.6a	2	• Shows variable oxidation states • Forms coloured ions or compounds • Forms stable complexes			Two ideas/ characteristics are correctly given.	One correct idea/ characteristic is given.
CHE1.3.1.1	1.6b	1	Iron or Fe				One correct idea is given.
CHE1.3.1.2	1.7	1	Tetraamminecopper(II) ion				One correct idea is given.
Strand 2: Energy Changes in Chemical and Physical Processes							
CHE2.1.1.1	2.1	1	C				One correct idea is given.
CHE2.1.1.2	2.2	1	Standard enthalpy of ionisation				One correct idea is given.
CHE2.1.1.3	2.3a	1	Enthalpy of combustion or combustion				One correct idea is given.
CHE2.1.2.3	2.3b	2	$CH_{4\,(g)} + 2O_{2\,(g)} \rightarrow CO_{2\,(g)} + 2H_2O_{\,(g)}$ ΔH = -890 kJ/mol			At least two correct ideas are given e.g. balanced equation with negative enthalpy change value. Or able to list down **both** the products and reactants correctly.	One correct idea is given, e.g. unbalanced equation with negative enthalpy change value. Or able to identify **either** the products or reactants correctly
CHE2.1.3.4	2.4	3	The heat or enthalpy of the reaction is calculated using Hess's Law: $\Delta H^o_{rxn} = \sum \Delta H^o_f$ (products) − $\sum \Delta H^o_f$ (reactants) -179.4 kJ/mol = ΔH^o_f $(NH_4)_2SO_{4\,(s)}$ – {[2 × ΔH^o_f $NH_{3\,(g)}$] + ΔH^o_f $H_2SO_{4\,aq)}$} -179.4 kJ/mol = ΔH^o_f $(NH_4)_2SO_{4\,(s)}$ – {[2(−45.9 kJ/mol)] + (-909.3) kJ mol^{-1})} ΔH^o_f $(NH_4)_2SO_{4\,(s)}$ = −1180.5 kJ/mol		Two or more correct ideas are given and linked e.g. Hess's law equation is stated and ΔH^o_f values are used for calculation after linking with the chemical equation.	At least two independent correct ideas are given e.g. Hess's law equation is stated and given ΔH^o_f values are used for calculation.	One correct idea is given, e.g. Hess's law equation is stated.
Strand 3: Aqueous Equilibrium Systems							
CHE3.1.1.1	3.1a	1	B				One correct idea is given.
CHE3.1.3.1	3.1b	3	$K_c = [CH_3OH] / [CO].[H_2]^2$ [CO] = 0.20 moles/2 litres = 0.10 mol $[H_2]$ = 0.20 moles/2 litres = 0.10 mol 10.5 = $[CH_3OH]$ / (0.10) $(0.10)^2$ $[CH_3OH]$ = 0.105 M		Two or more correct ideas are given and linked e.g. K_c expression is stated, reactant concentrations are calculated and used to determine the $[H_3OH]$.	At least two independent correct ideas are given e.g. K_c expression is stated and reactant concentrations are calculated. Able to see the "DIVISION by 2 litres" 0.20 moles/2 litres	One correct idea is given, e.g. K_c expression is stated. Or Able to state **ONE** of the expressions of either [CO] = 0.20 moles or $[H_2]$ = 0.20 moles
CHE3.1.1.2	3.2a	1	Hydrofluoric acid				One correct idea is given.
CHE3.1.3.2	3.2b	3	$K_a = [F^-].[H_3O^+] / [F]$ $F_{(aq)} + H_2O_{(l)} \rightleftharpoons F^-_{(aq)} + H_3O^+_{(aq)}$		Two or more correct ideas are given and linked e.g.	At least two independent correct ideas are given e.g.	One correct idea is given, e.g. K_a expression is stated.

			Initial 0.60 M 0 M ~0 M Change –x +x +x Equil. 0.60-x x x $7.1 \times 10^{-4} = x.x / (0.60-x)$ $7.1 \times 10^{-4} = x^2 / 0.60$ (Assume that x is much smaller than 0.60 M, so that 0.60 M − x ≃ 0.60 M) x = 0.0206 M = $[H_3O^+]$		K_a expression is stated, concentrations of species are determined with the relevant assumption and used to determine the $[H_3O^+]$.	K_a expression is stated and reactant concentrations of species are determined.	
CHE3.1.1.4	3.3	1	The buffer region is labelled clearly e.g.  				One correct idea is given. Or buffer region is correctly labeled.
CHE3.1.2.5	3.4	2	$[H^+]$ = Excess amount of HCl after neutralisation / total volume of solution = [(0.025 L × 0.10 *M* HCl) – (0.015 L × 0.10 *M* NaOH)] / (0.025 L + 0.015 L) = (0.0025 mol – 0.0015 mol) / 0.040 L = 0.025 mol/L pH = -log [0.025] = 1.6			At least two correct ideas are given e.g. excess HCl concentration is determined and pH is calculated.	One correct idea is given, e.g. excess HCl concentration is determined or Correct formula for pH is stated.
CHE3.2.1.1	3.5a	1	It is the equilibrium constant for a solid substance dissolving in an aqueous solution.				One correct idea is given.
CHE3.2.2.2	3.5b	2	$Mg(OH)_{2\,(s)} \rightleftharpoons Mg^{2+}{}_{(aq)} + 2OH^-{}_{(aq)}$ $K_{sp} = [Mg^{2+}].[OH^-]^2$			At least two correct ideas are given e.g. equilibrium equation and K_{sp} expression are stated.	One correct idea is given, e.g. equilibrium equation is stated.
Strand 4: Oxidation–Reduction Reactions							
CHE4.1.2.2	4.1a	2	It converts chemical energy to electrical energy through an electron transfer process between the anode and cathode in an spontaneous redox reaction. OR The anode will undergo oxidation and the cathode will undergo reduction. The two electrodes allow a flow of electrons that leave the metal of the anode and flow through the external circuit to the surface of the cathode.			At least two correct ideas are given.	One correct idea is given.

CHE4.1.2.3	4.1b	2	$Mg_{(s)} \rightarrow Mg^{2+}_{(aq)} + 2e^-$ $Ni^{2+}_{(aq)} + 2e^- \rightarrow Ni_{(s)}$ $Mg_{(s)}$ I $Mg^{2+}_{(aq)}$ II $Ni_{(s)}$ I $Ni^{2+}_{(aq)}$			At least two correct ideas are given, e.g. both half-cell reactions are stated.	One correct idea is given, e.g. one half-cell reaction is stated.
Strand 5: Organic Chemistry							
CHE5.1.1.1	5.1a	1	Enantiomerism				One correct idea is given.
CHE5.1.3.11	5.1b	3	Butan-2-amine 1. Identifying the functional group: The compound is an amine with single bonds between the carbon atoms. It will have a suffix of -amine. 2. Finding the longest carbon chain: There are four carbon atoms in the longest chain. The prefix of the compound will be butan-. 3. Number the carbon atoms in the longest chain The numbering is done to ensure the carbon with amine group has the lowest number, which is the second carbon (2). 4. Combine the elements of the name into a single word. The name of the compound is butan-2-amine.		At least two correct ideas are given and linked, e.g. IUPAC naming steps/rules are logically stated in order to arrive at the name of the compound.	At least two correct ideas are given, e.g. IUPAC name and naming steps/rules are stated.	One correct idea is given, e.g. common or non-IUPAC name stated.
CHE5.2.1.3	5.2a	1	Amide functional group				One correct idea is given.
CHE5.2.1.4	5.2b	1	A water molecule is removed/eliminated during the reaction. OR It is called a condensation reaction. OR It undergoes step growth polymerisation. OR A peptide bond is formed.				One correct idea/ characteristic is given.
CHE5.2.2.11	5.3	2				At least two correct ideas are given, e.g. products are identified and equation is balanced.	One correct idea is given, e.g. products are identified.
CHE5.2.4.1	5.4	4	The oxidation of alcohols is an important reaction in organic chemistry and everyday life. For example, secondary alcohols can be oxidised to give ketones. 	The response should have correctly and clearly described any one common reaction of alcohols with chemical equation, and discussed the application of the reaction to a real life	At least two correct ideas are given, which are clearly linked, e.g. one reaction of alcohols is described with reaction conditions and product and mention of its application to everyday life.	At least two correct ideas are given, e.g. one reaction of alcohols is described with reaction conditions and product.	Any one correct idea is given, e.g. one reaction of alcohol is stated.

			In labs, secondary alcohols can be oxidised by heating them with a solution of sodium or potassium dichromate acidified with dilute sulphuric acid. Alcohols and ketones are very common features in biological molecules. Converting between these compounds is a frequent event in many biological pathways. For example, enzyme-controlled oxidation reactions provide the energy cells need to do useful work. One step in the metabolism of carbohydrates involves the oxidation of the secondary alcohol group in isocitric acid to a ketone group: 	situation with a suitable example.			
CHE5.2.1.1	5.5a	1	Aldehyde				One correct idea is given.
CHE5.2.1.2	5.5b	1	• It is acidic in nature. • It has high boiling point. • It is soluble in water.				One correct idea/property is given.
CHE5.2.2.6	5.5c	2	• Oxidising reagents such as potassium dichromate • Presence of dilute sulphuric acid			At least two correct ideas are given, e.g. reagent and acidic condition is mentioned.	Any one correct idea is given, e.g. reagent is mentioned.
CHE5.2.2.10	5.6	2	Butanoic acid and ethanol 			At least two correct ideas are given, e.g., both products are drawn correctly.	Any one correct idea is given, e.g., one product is drawn correctly (either Butanoic Acid OR ethanol)
CHE5.1.2.2	5.7a	2	Many isomers are possible, e.g.:  Constitutional isomer OR  Functional group isomer			At least two correct ideas are given, e.g. one structure of isomer and the isomer type.	Any one correct idea is given, e.g. either one structure of isomer or the type of isomer.
CHE5.2.2.7	5.7b	2	• Reagent could be $LiAlH_4$ or $NaBH_4$ • Product is a secondary alcohol:			At least two correct ideas given, e.g. reagent and product	Any one correct idea given, e.g. reagent or product

							
CHE5.2.2.5	5.7b	2	$CH_3CHBrCH_3 \xrightarrow[\text{heat}]{\text{KOH/EtOH}} CH_3CH{=}CH_2$			At least two correct ideas given, e.g. reactant and product	Any one correct idea given, e.g. reactant