No. 103/3

EDUCATIONAL QUALITY AND ASSESSMENT PROGRAMME

CHEMISTRY

Scoring Rubric 2022

South Pacific Form Seven Certificate

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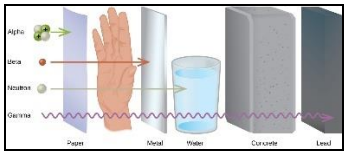
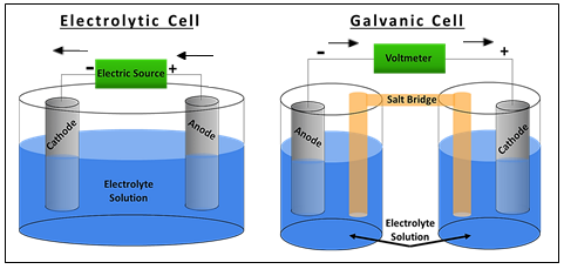
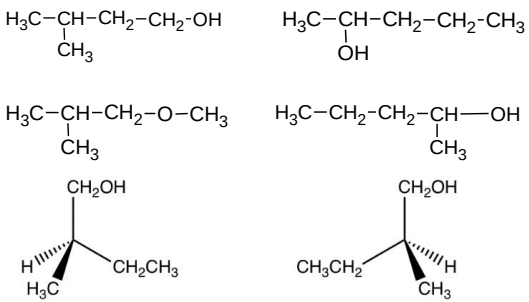
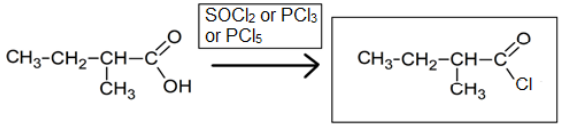
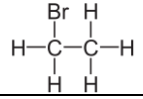
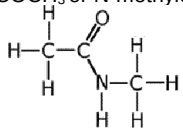
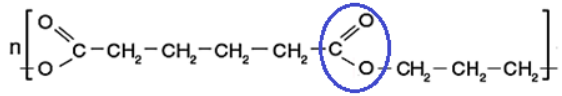
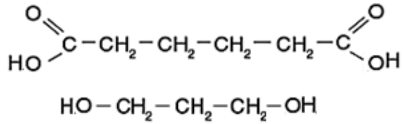
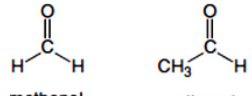
SLO	Item No.	SL	Evidence	Student Response Level			
				Extended Abstract 4	Relational 3	Multistructural 2	Unistructural 1
Strand 1: Atomic Structure, Bonding and Related Properties							
Che1.1.1.2	1.1a	1	D				D
Che1.1.1.3	1.1b	1	A				A
Che1.1.3.6	1.1c	3	The N-H bonds in NH_3 are polar. It also has an unsymmetrical shape. **The dipole moments do not cancel out due to the asymmetrical shape (has a net dipole moment), resulting in the overall molecule as polar.**		Two or more correct ideas are given which are linked, e.g., the bolded texts in evidence.	At least two independent correct ideas are given, e.g., the N-H bonds in NH_3 are polar **and** NH_3 has an asymmetrical shape.	One correct idea is given, e.g., the N-H bonds in NH_3 are polar.
Che1.1.3.8	1.1d	3	HCl, HBr and HI have both, permanent dipole-dipole forces of and London dispersion forces. For similar substances like HCl, HBr and HI, London dispersion forces increases with increasing molecular mass. **Therefore, more energy is required to overcome the London dispersion forces in HI than HBr and HCl. However, due to very high electronegativity of F, HF is most polar and has hydrogen bonding present it. Hence, it has the highest boiling point.**		Two or more correct ideas are given which are linked, e.g., the bolded texts in evidence.	At least two independent correct ideas are given, e.g., London dispersion forces increase with increasing molecular mass **and** HF has hydrogen bonding present in it.	One correct idea is given, e.g., London dispersion forces increase with increasing molecular mass.
Che1.2.1.1	1.2a	1	A reaction where two light nuclei merge to form a single heavier nucleus.				Correct definition is given.
Che1.2.1.3	1.2b	1	$^{14}_{7}N$				Correct product is given.
Che1.2.4.1	1.2c	4	The more material the radiation can pass through, the greater the penetration power and the more dangerous they are. As penetrating depends on the size of particles, bigger the size lesser the penetration power. Alpha particles have the least penetration power and can be stopped by a thick sheet of paper, a layer of clothes or outer layer of dead skin on people. Beta particles are much smaller than alpha particles and therefore, their small size gives them much greater penetration power. They can be stopped by a one-quarter inch thick sheet of aluminum. Gamma rays have the greatest penetration power. They may pass all the way through a human body without striking anything. They require several inches of dense material (like lead) to shield them.  *Source: https://chem.libretexts.org/* Radiation can have destructive effects but can also be used in medicine, industry and electricity generation. For example, the medium penetrating power of beta particles provides a range	Ideas are correctly generalised to everyday life situations, e.g., comparing and contrasting the penetrating ability of radiations based on their properties, but uses examples to justify real life application.	Two or more correct ideas are given which are linked, e.g., comparing and contrasting the penetrating ability of radiations based on their properties.	At least two independent correct ideas are given, e.g., penetrating abilities of two or more radiations.	One correct idea is given, e.g., penetrating ability of one of the radiations.

			of useful applications which include: • thickness detectors for the quality control of thin materials i.e., paper • treatment of eye and bone cancers, strontium-90 or strontium-89 are commonly used • Tritium is used in some phosphorescent lighting typically for emergency lighting as it requires no power • Fluorine-18 is commonly used as a tracer for positron emission tomography (PET).				
Che1.3.1.2	1.3a	1	Tetrachlorocuprate(II) ion				Correct name is given.
Che1.3.2.2	1.3b	2	• Partially filled d orbitals • Unpaired d electrons • Type of ligand • Splitting of d-orbitals • d-d electronic transitions • Ability to absorb and re-emit light of different wavelengths			Two or more independent correct ideas are given, e.g., as given in evidence.	One correct idea is given, e.g., type of ligand.
Che1.3.3.2	1.3c	3	In water, $CuSO_4$ forms a light blue aquo complex of $[Cu(H_2O)_6]^{2+}$. When ammonia solution is added into this solution, as a weak base it forms hydroxide ion: $NH_{3\,(aq)} + H_2O_{\,(l)} \rightleftharpoons NH_4^{+}{}_{(aq)} + OH^{-}{}_{(aq)}$ The hydroxide ion reacts with $[Cu(H_2O)_6]^{2+}$ to form the insoluble, pale blue copper hydroxide precipitate, $Cu(OH)_2$. It is sufficient to represent this reaction as: $Cu^{2+}{}_{(aq)} + 2OH^{-}{}_{(aq)} \rightleftharpoons Cu(OH)_{2\,(s)}$ The precipitate then dissolves in excess ammonia to form a deep blue solution of $[Cu(NH_3)_4]^{2+}$ complex. It is sufficient to represent this reaction as: $Cu^{2+}{}_{(aq)} + 4NH_{3\,(aq)} \rightleftharpoons Cu(NH_3)_4{}^{2+}{}_{(aq)}$		Two or more correct ideas are given which are linked, e.g., equations for the formation of different species responsible for the observations, given and related in a logical order.	At least two independent correct ideas are given, e.g., equations for the formation of two or more species responsible for the observations.	One correct idea is given, e.g., balanced equation for the formation of a species responsible for one of the observations.
Strand 2: Energy Changes in Chemical and Physical Processes							
Che2.1.1.3	2.1a	1	A				A
Che2.1.1.2	2.1b	1	C				C
Che2.1.1.1	2.1c	1	B				B
Che2.1.2.2	2.1d	2	$C_2H_5OH_{\,(\ell)} \rightarrow C_2H_5OH_{\,(g)}$ $\Delta_{vap}H° = 42.3$ kJ mol^{-1}			At least two independent correct ideas are given, e.g. $C_2H_5OH_{\,(\ell)} \rightarrow C_2H_5OH_{\,(g)}$ **and** $\Delta_{vap}H° = 42.3$ kJ mol^{-1}.	One correct idea is given, e.g. $C_2H_5OH_{\,(\ell)} \rightarrow C_2H_5OH_{\,(g)}$
Che2.1.3.4	2.1e	3	Reverse the first equation as well as the sign on ΔH.		Two or more correct ideas are given and linked e.g.	At least two independent correct ideas are given,	One correct idea is given, e.g., the first equation is

			The other equations remain as it is. Add all the ΔH values to obtain ($\Delta_c H$) of magnesium: $MgCl_{2\,(aq)} + H_2O_{(\ell)} \rightarrow MgO_{(s)} + 2HCl_{(aq)}$ ΔH = +74.66 kJ $Mg_{(s)} + 2HCl_{(aq)} \rightarrow MgCl_{2\,(aq)} + H_{2\,(g)}$ ΔH = -427.99 kJ $H_{2\,(g)} + ½O_{2\,(g)} \rightarrow H_2O_{(\ell)}$ ΔH = -285.50 kJ $Mg_{(s)} + ½\,O_{2\,(g)} \rightarrow MgO_{(s)}$ $\Delta_c H$ = -638.83 kJ		relating the enthalpy of combustion of magnesium to the other three equations by rearranging the first equation and using the Hess's law to calculate $\Delta_c H$.	e.g. the first equation or sign on ΔH is reversed **and** all ΔH values are added.	reversed.
Strand 3: Aqueous Equilibrium Systems							
Che3.1.1.3	3.1a	1	C				C
Che3.1.2.6	3.1b	2	• The buffer will resist a decrease in pH upon addition of HCl. • HCl is strong acid - a source of H^+ ions. • NH_3 will react with the additional H^+ ions to form NH_4Cl. • $NH_{3\,(aq)} + H^+_{(aq)} \rightarrow NH^+_{4\,(aq)}$			At least two independent correct ideas are given, e.g., as given in evidence.	One correct idea is given, e.g., NH_3 will react with the additional H^+ ions to form NH_4Cl.
Che3.1.1.2	3.1c	1	C				C
Che3.1.3.2	3.1d	3	$K_a = [CH_3COO^-][H_3O^+]/[CH_3COOH]$ Let $[H_3O^+] = x$. Then: $1.8 \times 10^{-5} = \frac{(x)(x)}{0.667 - x} \cong \frac{x^2}{0.667}$ <u>*Note*</u>: x in the denominator is considered too small compared to 0.667, so it is ignored. Therefore, $x^2 = 1.2 \times 10^{-5}$ $x = 3.5 \times 10^{-3}$ $[H_3O^+] = 3.5 \times 10^{-3}\ M$ $pH = -\log(3.5 \times 10^{-3}) = 2.5$		Two or more correct ideas are given and linked e.g. Using the K_a expression, $[H_3O^+]$ from the ethanoic acid present in the vinegar is related to the pH of vinegar.	At least two independent correct ideas are given e.g. K_a expression is given **and** pH is calculated.	One correct idea is given, e.g., K_a expression is given.
Che3.1.1.5	3.1e	1	Neutral or pH = 7				One correct idea is given.
Che3.1.2.1	3.1f	2	$K_c = \frac{[COCl_2]}{[CO][Cl_2]}$ $1.23\times10^3 = \frac{[COCl_2]}{(0.012)(0025)}$ $[COCl_2] = (0.012)(0025)(1.23\times10^3)$ $[COCl_2] = 0.369\text{M}$			At least two independent correct ideas are given e.g. K_c expression is given **and** $[CoCl_2]$ is evaluated.	One correct idea is given, e.g., K_c expression is given.
Che3.2.1.1	3.2a	1	Solubility is the maximum amount of a solute that will dissolve in a given amount of solvent at a specified temperature or pressure (in the case of gaseous solutes).				Correct definition is given.
Che3.2.2.3	3.2b	2	Let molar solubility of $CaSO_4$ = s. Then:			At least two independent correct ideas are given, e.g. the correct K_{sp} expression is derived **and**	One correct idea is given, e.g., the correct K_{sp} expression is derived.

			$CaSO_4$ (s) ⇄ Ca^{2+} (aq) + SO_4^{2-} (aq) Initial (M): 0.00, 0.00 Change (M): $+s$, $+s$ Equilibrium (M): s, s $K_{sp} = [Ca^{2+}][SO_4^{2-}]$ 2.4×10^{-5} mol^2 L^{-2} = $s.s = s^2$ $s = 4.3 \times 10^{-3}$ mol L^{-1}			solubility is calculated.	
Che3.2.1.2	3.2c	1	• Solubility of $CaSO_4$ will decrease. • The presence of sulphate ions depresses the ionisation of calcium sulphate. • This will cause the equilibrium to shift to the left.				Any one correct idea is given.
Strand 4: Oxidation–Reduction Reactions							
Che4.1.2.2	4.1a	2				At least two independent correct ideas are given e.g. electron flow direction for galvanic and electrolytic cells are given.	One correct idea is given, e.g., electron flow direction for galvanic cell is given.
Che4.1.2.3	4.1b	2	Galvanic cell - Battery - Fuel cell Electrolytic cell - Electroplating - Electrolysis of NaCl, H_2O, etc - Recharging batteries			At least two independent correct ideas are given e.g. one application of each: galvanic and electrolytic cell.	One correct idea is given, e.g., one application of galvanic cell.
Strand 5: Organic Chemistry							
Che5.1.3.11	5.1a	3	1. Identifying the functional group: The compound is an alcohol. It will have a suffix of -ol. 2. Finding the longest carbon chain: There are four carbon atoms in the longest chain with single bonds between the carbon atoms. The prefix of the compound will contain butan-. 3. Number the carbon atoms in the longest chain The numbering is done to ensure the carbon with alcohol group has the lowest number, which is the first carbon (1). 4. There is a CH_3 (methyl) substituent on the third carbon. The substituent will be indicated as 2-methyl.		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 independent correct ideas are given e.g. IUPAC naming steps/rules are listed.	One correct idea is given, e.g., one IUPAC naming step/rules is stated.

			5. Combine the elements of the name into a single word. The IUPAC name of the compound is 2-methylbutan-1-ol.				
Che5.1.1.1	5.1b	1	Molecules of the same formula but having a different arrangement of their atoms.				Correct definition is given.
Che5.1.2.2	5.1c	2	Several isomers (constitutional, functional and stereoisomers) are possible, however, at least two isomers must be given, e.g. 			At least two independent correct ideas are given, e.g., any two isomers of Compound A are given.	One correct idea is given, e.g., any one isomer of Compound A is given.
Che5.2.1.1	5.2a	1	Oxidation				Correct name of reaction is given.
Che5.2.1.2	5.2b	1	Any one of the following: - MnO_4^-/OH^- - CrO_3/H_2SO_4/acetone (Jones oxidation) - RuO_4 (ruthenium tetroxide) - PDC/DMF				One correct reagent is given.
Che5.2.2.8	5.2c	2				At least two independent correct ideas are given, e.g., the reagent for the reaction **and** the structure of the acyl chloride.	One correct idea is given, e.g., the reagent for the reaction.
Che5.2.2.4	5.2d	2	Reactant A is HCl or hydrogen chloride. Reactant B is CH_3CH_2Br or bromoethane, an alkyl halide. 			At least two independent correct ideas are given, e.g., name/ formula/ structure/ type of both Reactant A **and** B.	One correct idea is given, e.g., name/ formula/ structure/ type of Reactant A.
Che5.2.2.10	5.2e	2	Product C is $CH_3NHCOCH_3$ or N-methylethanamide, an amide.  Product D is HCl or hydrogen chloride.			At least two independent correct ideas are given, e.g., name/ formula/ structure/ type of Product C **and** D.	One correct idea is given, e.g., name/ formula/ structure/ type of Product C.

Che5.2.2.6	5.2f	2	Any one of the follwing tests: - $KMnO_4/H^+$: purple colour is changed to light pink or colourless with aldehyde but no change with ketone. - K_2CrO_4/H^+: yellow colour is changed to green with aldehyde but no change with ketone. - $K_2Cr_2O_7/H+$: orange colour is changed to green with aldehyde but no change with ketone. - Tollens' reagent: silver mirror is formed with aldehyde but no change with ketone. - Fehling's/Benedict's solution: A brick red colour is formed with aldehyde but no change with ketone.			At least two independent correct ideas are given, e.g., reagent is given **and** observation is stated.	One correct idea is given, e.g., reagent is given.
Che5.2.1.4	5.2g	1					The ester link is circled.
Che5.2.1.3	5.2h	1	A reaction where monomers possessing two or more kinds of functional groups react with each other in such a way that parts of these monomers combine to form a small molecule (often H_2O) which is eliminated in the process.				Correct definition is given.
Che5.2.2.11	5.2i	2				At least two independent correct ideas are given, e.g., both monomers are given.	Any one correct idea given, e.g., one monomer is given.
Che5.2.4.4	5.2j	4	Aldehydes are organic compounds which incorporate a carbonyl functional group, C=O. For example, methanal, ethanal, etc.  methanal ethanal Aldehydes are among the organic compounds which are easily oxidized. What is formed when aldehydes are oxidised depends on whether the reaction is done under acidic or alkaline conditions. Under acidic conditions, the aldehyde is oxidized to a carboxylic acid.  Ethanal is one of the chemicals responsible for the symptoms of a hangover. In a second step of the alcohol alcohol metabolism process, ethanal is further oxidised to ethanoic acid. The basic reaction is shown below. $CH_3CHO + NAD^+ + H_2O \longrightarrow CH_3COOH + NADH + H^+$	The response should have correctly justified the chemical properties of aldehydes and associated it with an everyday application.	At least two correct ideas are given, which are clearly linked, e.g., one reaction of aldehydes is given, and the reaction is related to an everyday application.	At least two independent correct ideas are given, e.g., one reaction of aldehyde **and** an everyday application of aldehydes.	Any one correct idea is given, e.g., one reaction of aldehyde is stated.