No. 103/3

EDUCATIONAL QUALITY AND ASSESSMENT PROGRAMME

Assessment Schedule 2017

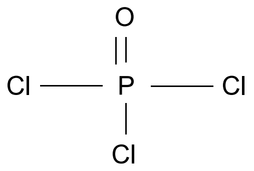
South Pacific Form Seven Certificate

CHEMISTRY

3 Luke Street, Nabua, Private Mail Bag, Suva, Fiji.
Telephone: (679) 3370733 Fax: (679) 3370021

YR13 CHEMISTRY EXAM PAPER ASSESSMENT CRITERIA

LO	QN	SL	EVIDENCE	STUDENT RESPONSE LEVEL			
				Extended Abstract 4	**Relational** 3	**Multistructural** 2	**Unistructural** 1
CheA/STRAND 1: ATOMIC STRUCTURE AND BONDING AND RELATED PROPERTIES							
13CHE1.1.1.1	1.1a	1	The description of the distribution of the electrons in an atom in different energy levels, energy sub-levels and orbitals.				Mention distribution of electrons, atoms or ions, energy levels and orbitals/sub-levels..
13CHE1.1.2.1	1.1b	2	Se - $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^4$ Zn^{2+} - $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}$			Both correct Correct energy levels. Correct number of electrons per sub-orbital 3d and 4s may be reversed.	Correct for atom but Incorrect for ion. (or vice versa)
13CHE1.1.2.3	1.2a	2	The number of protons increases across the period therefore the pull for shared electrons also increases by the atom. This means that the greater the pull the greater the electronegativity.			Electronegativity related to attraction for shared electron. Increased attraction as one goes across the period due to increased number of protons.	One point is missing.

13CHE1.1.4.1	1.2b	4	The valence electrons of methane, ammonia and water all form four electron pairs pointing to the corners of a tetrahedron. Each element-hydrogen bond is polar, but CH_4 is symmetrical resulting in a non-polar molecule with weak intermolecular Hydrogen bonds (Should be Van der Waal or London forces) Both ammonia and water are non-symmetrical, with ammonia having one lone pair of electrons which is used to form one intermolecular hydrogen bond, while water has two lone pairs and forms two intermolecular hydrogen bonds giving it the highest boiling points.	4 electron pairs around central atoms resulting in Tetrahedral skeleton for all. No. of lone pairs of electrons on central atom. Ability to form , and/or relative strength of intermolecular H-bonds Number of intermolecular hydrogen bonds that form.	Only three of the ideas are discussed.	Only two of the ideas are discussed.	Only one idea discussed.
13CHE1.1.3.3	1.3	3	Dots representing electrons missing from O and Cl atoms. 		Correct position of atoms Correct number of bonds to P by each of the atoms. Correct number of non-bonding electrons on all or most surrounding atoms.	Only two of the ideas shown.	Only one of the ideas is correct.
13CHE1.1.1.3	1.4a	1	Tetrahedral shape				Tetrahedral shape must be given for the score.
13CHE1.1.1.4	1.4b	1	Instantaneous or temporary dipole attractions / London forces/ dispersion forces	.			One of the following: Instantaneous or temporary dipole attractions / London forces/ dispersion forces or a description of the terms.

13CHE1.1.1.2	1.5a	1	N - $1s^2 2s^2 2p^3$ O - $1s^2 2s^2 2p^4$				Correct number of electrons filled in the correct sub-orbital, must be given for the score.
13CHE1.1.2.4	1.5b	2	The ionization energy of nitrogen involves the removal of an electron from a stable half-full 2p orbital, while that for oxygen involves the removal of an electron from a less stable 2p orbital, as it is being removed from an existing pair.			1^{st} ionisation energy involves removal of first electron. Idea that pairing gives instability as electrons are repelling, so easier to remove one electron from the pair in O, than from the half-filled stable state of N.ss	Explanation only involves one of the atoms; no comparison. Explanation fails to relate the ease of removal of the electron to the stability of the electron status.
13CHE1.2.1.1	1.6a	1	Nuclear fusion is the combining of two small nuclei into a larger one with the release of large amounts of energy.				Must mention combining of nuclei and release of energy. No score if only one is mentioned.
13CHE1.2.1.3	1.6b	1	Alpha particles or ${}^{4}_{2}\mathrm{He}$				Must mention alpha particles or He atom.

13CHE1.2.2.3	1.6c	2	These are high energy particles or high energy electromagnetic waves produced by the disintegration of unstable atomic nuclei either by fission or by fusion. They are often dangerous to their surroundings because they have the ability to ionize the materials that absorb them. In so doing they start chemical reactions that lead to biological damage.			High energy particles or high energy electromagnetic waves. AND Danger is related to their ability to ionize the materials that absorb them.	High energy particles or high energy electromagnetic waves. OR Danger is related to their ability to ionize the materials that absorb them.
13CHE1.3.1.3	1.7a	1	Tetraamminecopper (II) ion				Tetraamminecopper (II) ion
13CHE1.3.2.4	1.7b	2	$Cu(SO_4)_{(aq)} + NH_4OH_{(aq)} \rightarrow [Cu(NH_3)_4]^{2+}_{(aq)} + SO_4^{2-}_{(aq)} + H_2O_{(l)}$ OR $Cu(OH)_{2(s)} + 4NH_{3(aq)} \rightarrow [Cu(NH_3)_4]^{2+}_{(aq)} + 2OH^-_{(aq)}$			Correct balanced equation;	Incomplete equation /
13CHE1.3.1.4	1.8	1	Iron (II) thiocyanate or ferrous thiocyanate				Iron (II) thiocyanate or ferrous thiocyanate. Must show oxidation state of iron in Roman numerals and in brackets.
CheB/STRAND 2: ENERGY CHANGES IN CHEMICAL AND PHYSICAL PROCESSES							

13CHE2.1.1.1	2.1	1	The minimum energy required to remove an electron from an isolated atom in the ground state.				The minimum energy required to remove an electron from an isolated atom in the ground state.
13CHE2.1.1.2	2.2	1	Shielding effect, nuclear attraction, stability of the orbital from which the electron is being removed indicated by the number of electrons present. (Any 2)				Shielding effect, nuclear attraction, stability of the orbital from which the electron is being removed indicated by the number of electrons present. (Any 2)
13CHE2.1.1.3	2.3	1	Enthalpy of fusion; $\Delta_{fus}H^o$ (H_2O)				Both must be present and correct for the score.
13CHE2.1.2.4	2.4	2	$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$ $\frac{1}{2} N_{2(g)} + 3/2H_{2(g)} \longrightarrow NH_{3(g)}$			Elements must be in the correct ground states. Equation must be balanced	Elements not in the correct ground states. OR Equation not balanced
13CHE2.1.2.5	2.5	2	Enthalpy change ΔH = specific heat of water x mass of water x temp change = 4.2 $JK^{-1} g^{-1}$ .x 100g x (52-27) = 10,600 Joules			Correct equation Correct substitution Correct answer(10,600 Joules or 10.6 kJ) Correct unit for ans.	Wrong equation but correct substitution Or Correct equation but wrong substitution. OR wrong answer Or wrong unit.

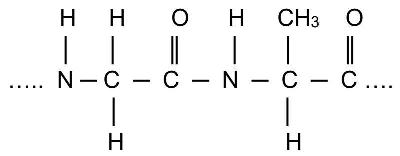
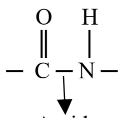
13CHE2.1.4.1	2.6	4	Reverse eqn 1; $C_2H_5OH(l) \rightarrow 2C(s) + 3H_2(g) + ½ O_2(g)$. Δ_fH = +278 kJmol^{-1} Multiply eqn 2 by 2; $2C(s) + 2O_2(g) \longrightarrow 2CO_2(g)$; Δ_fH = -788 kJmol^{-1} Multiply eqn 3 by 3; $3H_2(g) + 1½ O_2(g) \longrightarrow 3H_2O(g)$ Δ_fH = -858 kJmol^{-1} Cancel like terms on opposite sides of the equations, resulting in required eqn. Add the ΔH values; Total becomes **-1368kJmol^{-1}**	Reverse equation Multiply equation by a factor Cancel like terms and add rest. Correct addition of ΔH values.	Initial treatment of one of the 3 equations was incorrect, but Correct cancelation of like terms and correct addition of resulting equations, giving an incorrect answer.	Initial treatment of one of the 3 equations was incorrect, but Correct cancelation of like terms and correct addition of resulting equations, giving an incorrect answer.	Initial treatment of one of the 3 equations was correct, OR Correct cancelation of like terms and correct addition of resulting equations, giving an incorrect answer.
CheC/STRAND 3: Aqueous Equilibrium Systems							
13CHE3.1.1.3	3.1a	1	A solution containing a weak acid or base, and its conjugate base or acid, and is able to resist changes in pH when small amounts of acid or base are added.				A solution containing a weak acid or base, and its conjugate base or acid, **(Correct components)** and is able to resist changes in pH when small amounts of acid or base is added. (**Correct action description)**
13CHE3.1.2.3	3.1b	2	$pH = pKa + \log \frac{[\text{conjugate base}]}{[\text{acid}]}$ $= 6.34 + \log \frac{0.0117}{0.001}$ = 6.34 + log 11.7 = 6.34 + 1.07 = **7.41**			Correct equation and/or substitution. Correct calculation giving correct answer.	Correct equation and/or substitution. OR Correct calculation giving correct answer

13CHE3.1.3.5	3.1c	3	The weak acid, H_2CO_3. forms HCO_3^{-1} in solution. When small amounts of acid (H^+) is added, it combines with the conjugate base, HCO_3^{-1} , to produce H_2CO_3, which is already present in the system. Introduced H^+ is absorbed into the system and pH is retained. $HCO_3^{-1}{}_{(aq)} + H^+{}_{(aq)} \rightarrow H_2CO_{3(aq)}$		H_2CO_3. and HCO_3^{-1} already present in buffer. H^+ is absorbed by HCO_3^{-1} Correct equation to show this action.	One of the following absent or incorrect: H_2CO_3. and HCO_3^{-1} already present in buffer. H^+ is absorbed by HCO_3^{-1} Correct equation to show this action.	Two of the following are absent or incorrect: H_2CO_3. and HCO_3^{-1} already present in buffer. H^+ is absorbed by HCO_3^{-1} Correct equation to show this action.
13CHE3.1.1.1	3.2a	1	$Ka = \frac{[CH_3COO^{-1}][H_3O^+]}{[CH_3COOH]}$				$Ka = \frac{[CH_3COO^{-1}][H_3O^+]}{[CH_3COOH]}$ Must give correct equation
13CHE3.1.2.4	3.2b	2	$1.74 \times 10^{-5} = \frac{[CH_3COO^{-1}][H_3O^+]}{0.1}$ $1.74 \times 10^{-5} \times 0.1 = [CH_3COO^{-1}][H_3O^+]$ and $[CH_3COO^{-1}] = [H_3O^+]$ Let $x = [H_3O^+]$ Since $x^2 = 1.74 \times 10^{-6}$ then $x = \sqrt{1.74 \times 10^{-6}}$ $= \underline{1.32 \times 10^{-3} \text{ mol l}^{-1}}$			Correct substitution of values into equation Recognition that $[CH_3COO^{-1}] = [H_3O^+]$ Correct calculation.	Chemistry is correct although Maths in wrong. This shows correct chemical principle: $1.74 \times 10^{-5} \times 0.1 = [CH_3COO^{-1}][H_3O^+]$ and $[CH_3COO^{-1}] = [H_3O^+]$

13CHE3.2.1.2	3.2c	1	An increase in concentration of $CH_3COOH(l)$ would lead to an increase of its aqueous ions CH_3COO^{-1} and H_3O^+, which will re-combine to form $CH_3COOH(l)$. When equilibrium is re-established the value of Ka remains the same.				An increase of its aqueous ions CH_3COO^{-1} and H_3O^+, which will re-combine to form $CH_3COOH(l)$. Value of Ka remains the same. (This is the required answer for level 1. The reason why this happens is not necessary
CheD/STRAND 4: OXIDATION-REDUCTION REACTIONS							
13CHE4.1.1.1	4.1a	1	A devise that uses a spontaneous redox reaction to produce an electric current.				A devise that uses a spontaneous redox reaction to produce an electric current.
13CHE4.1.2.2	4.1b	2	$Zn(s) / Zn^{2+}(aq, 0.1\ mol\ L^{-1}) // Cu^{2+}(aq, 0.1\ mol\ L^{-1}) / Cu(s)$			Correct notation, states and conc. Of solutions given) Conc is not necessary, but state is.	Correct notation but some states left out or incorrect.
13CHE4.1.1.2	4.1c	1	**From Zinc to Copper** Zinc is oxidized and loses Electrons which travel to the copper half cell to be picked up by Cu^{2+} ions which are in turn reduced.				**From Zinc to Copper** (this is the expected answer for L1. The explanation is not necessary. Zinc loses electrons which Move through the wire to Cu.

13CHE4.1.3.3	4.2	3	1st equation has a large E° value therefore reduction will occur. 2nd equation has a smaller E° value therefore oxidation will occur. Leave 1st equation as written, reverse 2nd equation. Cancel like terms and add E° values. Final equation becomes; $PbO_2(s) + Pb(s) + 4H^+(aq) + 2SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2H_2O(l)$ EMF $= E^o_{(red)} - E^o_{(ox)}$ $= 1.69\ V - -0.36\ V$ $= 2.05\ V$ Since the voltage of the battery is positive (2.05V) the reaction is spontaneous		Oxidation and reduction processes must be determined from the E° values. Equations written accordingly and like terms cancelled. EMF calculated.as 2.05 V Thus rxn is spontaneous.	Determination of oxidation and reduction processes is incorrect but rest of calculations is done correctly using the wrong presumption.	Correct conclusion with no explanation or logical steps to support the conclusion.

13CHE4.1.2.4	4.3	2	<u>Electrochemical cell:</u> i. The two half-cells are set up in different containers, being connected through the salt bridge or porous partition. ii.The anode is negative and cathode is the positive electrode. The reaction at the anode is oxidation and that at the cathode is reduction iii.The electrons are supplied by the species getting oxidized. They move from anode to the cathode in the external circuit. iv. Redox reaction is spontaneous and is responsible for the production of electrical energy. v.Converts chemical energy into electrical energy. <u>Electrolytic cell:</u> i. Both the electrodes are placed in a same container in the solution of molten electrolyte. ii. The anode is positive and cathode is the negative electrode. The reaction at the anode is oxidation and that at the cathode is reduction. iii.The external battery supplies the electrons. They enter through the cathode and come out through the anode. iv.Redox reaction is not spontaneous and electrical energy has to be supplied to initiate the reaction. v.Converts electrical energy into chemical energy.			Any two differences between the two cells, on the same aspect.	Only one difference given.

CheE/STRAND 5: ORGANIC CHEMISTRY							
13CHE5.1.2.6	5.1a	2				At least both molecules forming a dimer. Ends must be dotted to show continuation.	One molecule correctly forming a dimer.
13CHE5.1.1.3	5.1b	1	 Circle whole group. Amide group (peptide bond)				Correct group circled or arrowed, and correct name given.
13CHE5.1.1.2	5.1c	1	A long molecule, formed by the removal of water, during the combination of small repeating units, OR A long molecule made by the removal of water molecules during the addition of many monomers.				Must mention removal of water molecules AND addition of small repeating units or monomers
13CHE5.1.3.15	5.2a	3	Isomer A is to show structure of <u>butan-1-ol</u> Isomer B – structure of <u>butan-2-ol</u> Isomer C –structure of <u>2-methylpropan-2-ol</u> Due to mistake is question paper, mark only for Isomer A. Bonus marks for Isomers B.		Both isomers correctly drawn and named. Isomer A correctly drawn and named. Accept condensed formulae.	2 correct drawings and/or naming. Isomer A correctly drawn or named. Accept condensed formulae.	Only 1 isomer correctly drawn or named. i.e. one correct idea provided Isomer A incorrectly drawn and incorrectly named. Accept condensed formulae.
13CHE5.2.1.2	5.2b	1	Acidified potassium dichromate changes colour from orange to green/ bluish green.				Must mention both halves of the colour change (i.e from orange to green).

13CHE5.1.3.1	5.2c	3	Optically active is butan-2-ol It has a chiral carbon (C atom #2). This carbon has 4 different groups of atoms attached to it, - C_2H_5, -H, -OH and –CH_3. It is therefore assymetrical. Bonus marks as it is not possible to answer this without the correct structure.		Correct name of isomer. Identify chiral or asymmetrical C atom. Identify 4 gps	Correct name of isomer. Identify chiral or asymmetrical C atom. OR Identify 4 gps	Correct name of isomer OR chiral C OR 4 correct groups. (only one is given)

13CHE5.2.4.2	5.3	4	***Any of the following two names*** Tri-,di- and tetrachloromethane; dichlorodifluoromethane (CFC 12), fluorotrichlorometane (CFC 11),.$CHClF_2$ (CFC 22); $CH_2F—CF_3$ (HFC 134a); $CBrF_3$ chloroethane (skin coolant); 2-bromo-2-chloro-1,1,1-trifluoroethane (anasthetic); Chloroethene and tetrafluoroethene These organic compounds are formed by the substitution reaction of methane or ethane with chlorine, fluorine or bromine. They are catalyzed by UV light or high temperatures. ***(Correct balanced equation)*** ***Uses & Reasons*** Are non-flammable and non-toxic so used in refrigerants, propellants for aerosols, for generating foamed plastics like expanded polystyrene or polyurethane foam, and as solvents for dry cleaning and for general degreasing purposes. $CBrF_3$ (favorite fire-extinguishing agent which is used in airplanes and for electrical components because it evaporates without leaving any residue). CH_3CH_2Cl (skin coolant); $F_3C—CHBrCl$ (anasthetic); Chloroethene used to make PVC; tetrafluoroethene is used to make Teflon, high heat and water resistant used to make linings for pots and pans. ***Diaadvantage*** They are a threat to ozone depletion. In the high atmosphere, the carbon-chlorine bonds break to give chlorine free radicals. It is these radicals which destroy ozone. CFCs are now being replaced by less environmentally harmful compounds such as HCFCs.	The following are to be written as a discussion: a. Any two names b. How they are formed c. Correct balanced equations d. Uses of named examples and reasons for their use. e. Negative impacts of the gases.	Not written as a discussion but all points correctly presented. a. Any two names b. How they are formed c. Correct balanced equations d. Uses of named examples and reasons for their use. e. Negative impacts of the gases.	One or two of the following points absent from the discussion a. Any two names b. How they are formed c. Correct balanced equations d. Uses of named examples and reasons for their use. e. Negative impacts of the gases.	Three or more points missing from the discussion or presentation. a. Any two names b. How they are formed c. Correct balanced equations d. Uses of named examples and reasons for their use. e. Negative impacts of the gases.