

MARKER CODE

Pacific
Community
Communauté
du Pacifique

Student Personal Identification Number

South Pacific Form Seven Certificate

CHEMISTRY

2016

QUESTION and ANSWER BOOKLET

Time allowed: Two and a half hours

INSTRUCTIONS

Write your **Student Personal Identification Number (SPIN)** in the space provided on the top right hand corner of this page.

Answer **ALL QUESTIONS**. Write your answers in the spaces provided in this booklet.

If you need more space for answers, ask the Supervisor for extra paper. Write your SPIN on all extra sheets used and clearly number the questions. Attach the extra sheets at the appropriate places in this booklet.

Major Learning Outcomes (Achievement Standards)	Skill Level Band			Weight /Time
	1 <i>Basic</i>	2 <i>Proficient</i>	3 <i>Advanced</i>	
CheA: Interpret information about selected properties of elements and compounds in relation to atomic structure	12 items	3 items	1 item	21% 48 min
CheB: Use thermochemical data to determine energy changes in chemical and physical processes	3 items	1 item	1 item	8% 19 min
CheC: Relate the properties of aqueous solutions to the nature and concentration of dissolved species	3 items	1 item	1 item	8% 19 min
CheD: Apply oxidation-reduction principles to electrochemical cells and compare the relative strength of oxidants	4 items	1 item	1 item	9% 20 min
CheE: Use information about the structure and reactions of organic molecules to solve problems in organic chemistry	12 items	2 items	1 item	19% 44 min
TOTAL	34 items	8 items	5 items	65% 150 min

Check that this booklet contains pages 1-15 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

A4	<p>(a) Complete the table by drawing the Lewis structures for the SOCl_2 molecule and the SF_5^- ion.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <tr> <td style="width: 15%;"></td> <td style="width: 35%; text-align: center;">SOCl_2 (S is the central atom)</td> <td style="width: 50%; text-align: center;">SF_5^-</td> </tr> <tr> <td style="text-align: center;">(i)</td> <td style="text-align: center;">Number of electrons</td> <td></td> </tr> <tr> <td style="text-align: center;">(ii)</td> <td style="text-align: center;">Lewis structure</td> <td></td> </tr> </table>		SOCl_2 (S is the central atom)	SF_5^-	(i)	Number of electrons		(ii)	Lewis structure		<table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <tr><th colspan="2" style="background-color: #cccccc;">Skill Level 1</th></tr> <tr><td style="width: 80%;">Basic</td><td></td></tr> <tr><td>Weak</td><td></td></tr> <tr><td>NR</td><td></td></tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><th colspan="2" style="background-color: #cccccc;">Skill Level 1</th></tr> <tr><td style="width: 80%;">Basic</td><td></td></tr> <tr><td>Weak</td><td></td></tr> <tr><td>NR</td><td></td></tr> </table>	Skill Level 1		Basic		Weak		NR		Skill Level 1		Basic		Weak		NR	
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Basic																											
Weak																											
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Basic																											
Weak																											
NR																											
A5	<p>The Lewis structure for the molecule XeOF_2 is given below</p> <div style="text-align: center; margin: 10px 0;"> </div> <p>Describe the shape of this molecule and give a reason for your answer. Explain why the XeOF_2 molecule is polar.</p> <p>Description: _____</p> <p>Reason:</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <p>Explanation:</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><th colspan="2" style="background-color: #cccccc;">Skill Level 3</th></tr> <tr><td style="width: 80%;">Advanced</td><td></td></tr> <tr><td>Proficient</td><td></td></tr> <tr><td>Basic</td><td></td></tr> <tr><td>Weak</td><td></td></tr> <tr><td>NR</td><td></td></tr> </table>	Skill Level 3		Advanced		Proficient		Basic		Weak		NR														
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Advanced																											
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A6

(a) There are three types of intermolecular forces that can operate between molecules in a liquid:

- ① Instantaneous or temporary dipole attractions (London or dispersion forces), ② Permanent dipole forces and ③ Hydrogen bonds

Complete the table by giving ALL the intermolecular forces present in each of the following liquids. Use the numbers ①, ② and ③ to identify the forces. An example is given.

	Liquid	Formula	Molar Mass / g mol ⁻¹	Intermolecular Forces
Example	methanol	CH ₃ OH	32.0	① ② ③
(i)	propan-1-ol	CH ₃ CH ₂ CH ₂ OH	60.1	
(ii)	pentane	CH ₃ CH ₂ CH ₂ CH ₂ CH ₃	72.2	
(iii)	butanone	$\begin{array}{c} \text{CH}_3 - \text{C} - \text{CH}_2 - \text{CH}_3 \\ \parallel \\ \text{O} \end{array}$	72.1	

(b) Butanone has a higher boiling point than pentane.

Identify the intermolecular force responsible for this observation.

(c) Explain, in terms of intermolecular forces, why propan-1-ol has a higher boiling point than methanol.

Skill Level 1

Basic	
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Skill Level 1

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Skill Level 1

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Skill Level 1

Basic	
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Skill Level 2

Proficient	
Basic	
Weak	
NR	

A7	(a) Determine the unknown isotope X in the equation below: ${}^B_A X + {}^1_0 n \rightarrow {}^{249}_{97} \text{Bk} + {}^0_{-1} e \quad X = \underline{\hspace{2cm}}$	<table border="1"> <thead> <tr> <th colspan="2">Skill Level 1</th> </tr> </thead> <tbody> <tr> <td>Basic</td> <td></td> </tr> <tr> <td>Weak</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Skill Level 1		Basic		Weak		NR	
	Skill Level 1									
	Basic									
Weak										
NR										
(b) It takes 5.2 minutes for a 1.00 g sample of ${}^{210}\text{Fr}$ to decay to 0.03125 g. Determine the half-life of ${}^{210}\text{Fr}$ <hr/> <hr/> <hr/>	<table border="1"> <thead> <tr> <th colspan="2">Skill Level 1</th> </tr> </thead> <tbody> <tr> <td>Basic</td> <td></td> </tr> <tr> <td>Weak</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Skill Level 1		Basic		Weak		NR		
Skill Level 1										
Basic										
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(c) Radioisotopes can be injected into the human body and used as diagnostic tools for some diseases. Explain why it is important to use gamma (γ) and not be alpha (α) emitters for this technique. <hr/> <hr/> <hr/>	<table border="1"> <thead> <tr> <th colspan="2">Skill Level 1</th> </tr> </thead> <tbody> <tr> <td>Basic</td> <td></td> </tr> <tr> <td>Weak</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Skill Level 1		Basic		Weak		NR		
Skill Level 1										
Basic										
Weak										
NR										

C2 Manganese hydroxide, $\text{Mn(OH)}_2(\text{s})$, is a sparingly soluble salt.

$$K_s(\text{Mn(OH)}_2) = 1.6 \times 10^{-13}$$

(a) Write the equilibrium equation for Mn(OH)_2 dissolving in water.

(b) Write the expression for $K_s(\text{Mn(OH)}_2)$ in terms of the concentrations of the ions.

(c) Determine the solubility of Mn(OH)_2 in pure water in mol L^{-1} .

Skill Level 1	
Basic	
Weak	
NR	

Basic	
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Skill Level 1	
Basic	
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Basic	
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Skill Level 2	
Proficient	
Basic	
Weak	
NR	

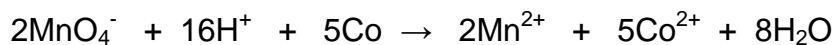
Proficient	
Basic	
Weak	
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CheD: Oxidation-Reduction

Apply oxidation-reduction principles to electrochemical cells and compare the relative strength of oxidants.

Assessor's use only

- D1 An electrochemical cell is formed by linking two half-cells with a salt bridge. A cell is set up to investigate the reaction between acidified potassium permanganate and cobalt metal. The equation for the reaction is:

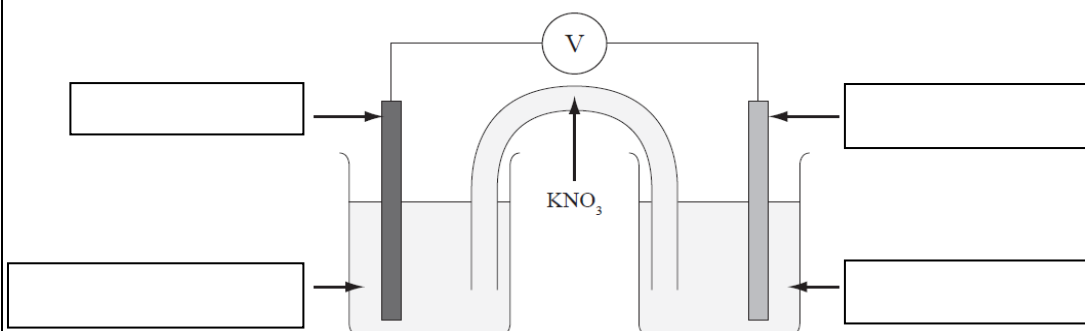


- (a) The following chemicals are available to construct the cell:

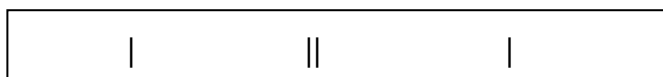
Cobalt (Co) and carbon (C) electrodes

0.1 mol L⁻¹ solutions of the ions Co²⁺, Mn²⁺ and MnO₄⁻

Complete the diagram below by labelling the electrodes and solutions so that the cell is set up according to the notation given.



- (b) In the box below write the cell notation for the cell drawn in (a).



- (c) (i) Calculate the voltage on the voltmeter, when the cell is operating, using the electrode potentials given below.

$$E^\circ(\text{MnO}_4^-/\text{Mn}^{2+}) = +1.51 \text{ V} \quad E^\circ(\text{Co}^{2+}/\text{Co}) = -0.28 \text{ V}$$

- (ii) Determine the direction of the electron flow

Circle your answer and give a reason.

Left to right

Right to left

Reason

Skill Level 1	
Basic	
Weak	
NR	

Skill Level 1	
Basic	
Weak	
NR	

- (iii) Determine whether a permanganate solution, MnO_4^- (aq) will further oxidise the Co^{2+} ions formed to Co^{3+} ions.

$$E^\circ(\text{Co}^{3+}/\text{Co}^{2+}) = +1.82 \text{ V}$$

Skill Level 3	
Advanced	
Proficient	
Basic	
Weak	
NR	

- D2 Lithium iodine batteries are rechargeable and used extensively in heart pacemakers. These batteries consist of two half cells separated by a nickel mesh that allows ions to pass through.

The anode in the batteries is lithium metal and the cathode is solid iodine, I_2 .

When the cell is operating, lithium iodide is formed.

- (a) Write the equation for the cell reaction

- (b) Explain the oxidation-reduction process taking place in the lithium iodine battery by identifying the species being oxidised or reduced at the anode or cathode and describing the movement of electrons in the cell.

- (c) When two inert electrodes are placed into a molten solution of lithium iodide an electrolysis reaction occurs. Describe what would be observed at the cathode and at the anode during this electrolysis process.

Cathode: _____

Anode: _____

Skill Level 1	
Basic	
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Skill Level 2	
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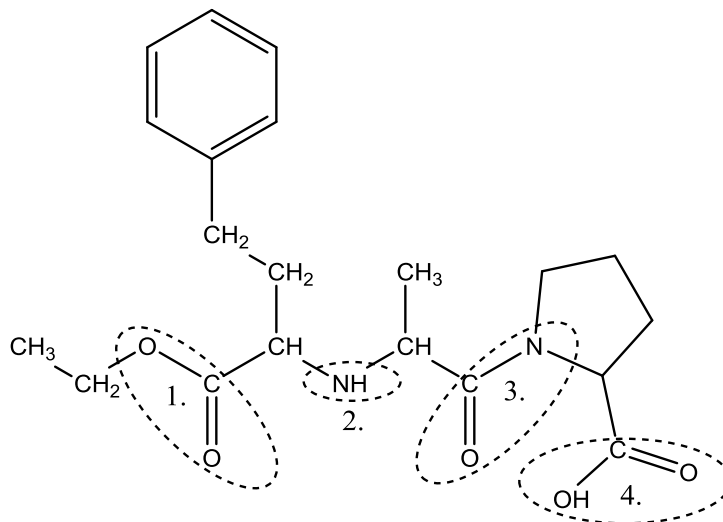
Skill Level 1	
Basic	
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CheE: Organic Chemistry

Use information about the structure and reactions of organic molecules to solve problems in organic chemistry.

Assessor's use only

- E1 The structure of the molecules in the drug *Enalapril* is shown below. *Enalapril* is used to treat high blood pressure, heart failure and to improve survival after a heart attack.



- (a) Give the name of the FOUR functional groups circled in the molecule above.

1		3	
2		4	

- (b) The molecule drawn above is optically active and is able to form *enantiomers*.

- (i) Draw a * on a carbon atom in the structure above that is responsible for the molecule being able to form enantiomers

Explain why you chose this carbon atom.

- (ii) Explain what the term *enantiomers* means.

- (c) Describe a simple test that could be used to distinguish between molecules which contain functional group (2) and those which contain functional group (3).

Skill Level 1

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Skill Level 1

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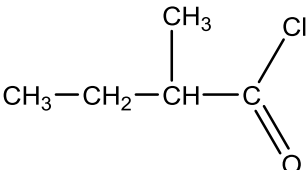
Skill Level 1

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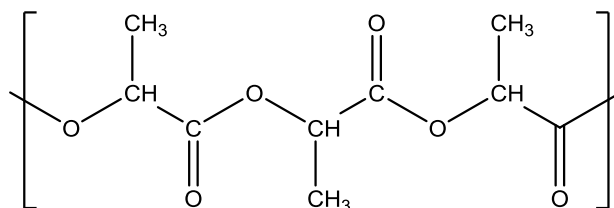
Skill Level 1

Basic	
Weak	
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- E2 (a) Complete the table below by giving the IUPAC systematic name or the structural formula for the given compound.

(i)	
(ii)	2-chloro-3-methylhexanal

- (b) Polylactide is a biodegradable polymer which is sometimes used in the manufacture of supermarket carrier bags. The diagram below shows a section of the polylactide polymer.



- (i) In the box draw the monomer from which this polymer is made.



- (ii) Explain why the formation of polylactide is referred to as a 'condensation reaction'.

Skill Level 1

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Skill Level 1

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Skill Level 1

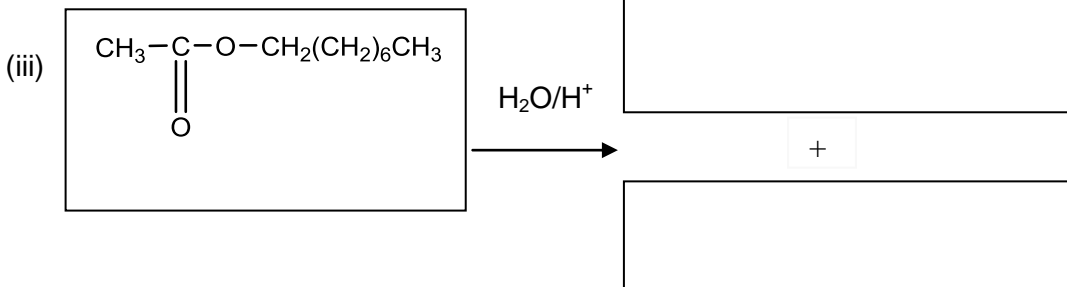
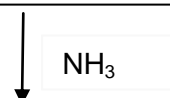
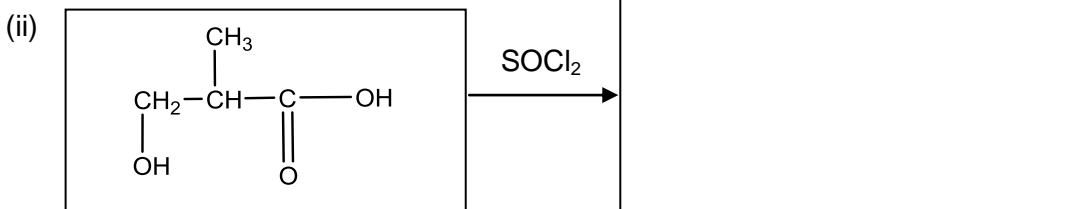
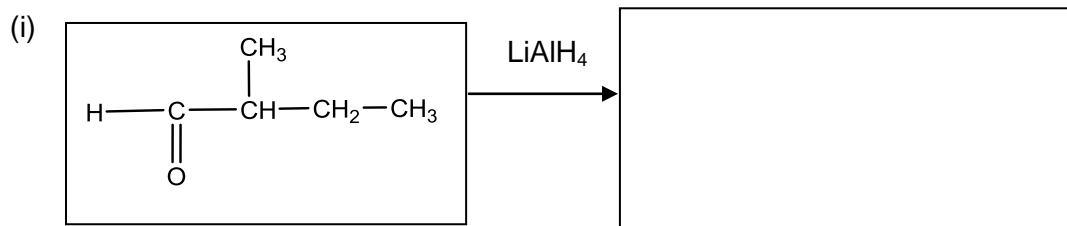
Basic	
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Skill Level 1

Basic	
Weak	
NR	

E3

(a) Complete the following reaction equations by writing the structural formula of the reaction product(s).



(b) (i) Circle the statement which best describes reaction (a) (i)

Substitution Elimination Reduction Oxidation

Give a reason for your answer:

(ii) Circle the statement which best describes the reactions in (a) (ii)

Substitution Elimination Reduction Oxidation

Give a reason for your answer:

Skill Level 1	
Basic	
Weak	
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Basic	
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Skill Level 2	
Proficient	
Basic	
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Skill Level 2	
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Skill Level 1	
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Skill Level 1	
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E4

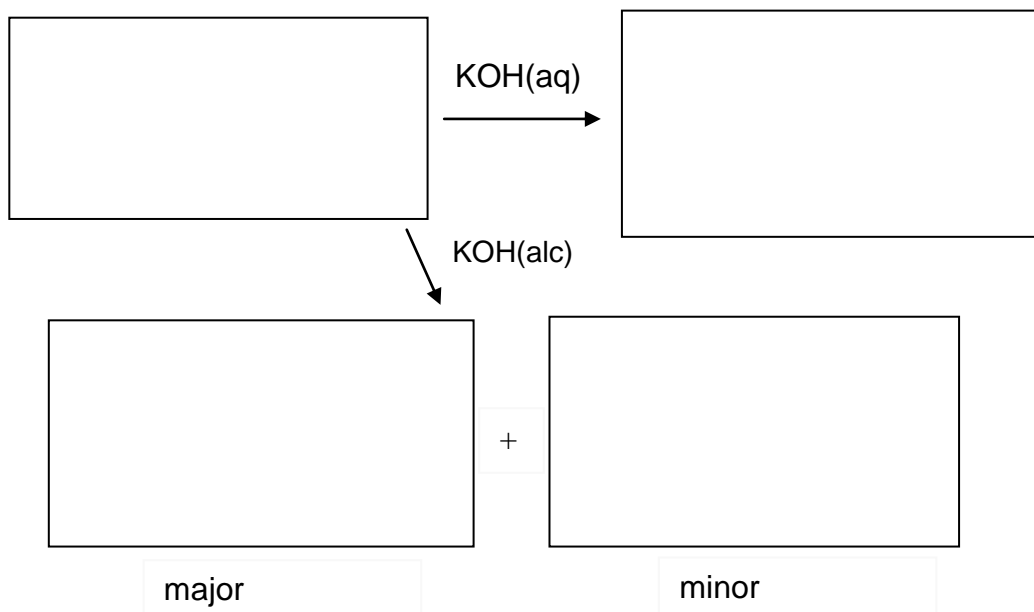
When the compound 2-chloro-3-methylpentane is reacted with potassium hydroxide (KOH), dissolved in alcohol, there are two possible products formed, which are constitutional (structural) isomers. There is only one product formed when dissolved in water.

- (a) The table below shows the formula for 2-chloro-3-methylpentane. Draw a constitutional isomer that has a tertiary chlorine atom.

2-chloro-3-methylpentane	A constitutional isomer that has a tertiary chlorine atoms
$ \begin{array}{ccccccc} & & \text{CH}_3 & & & & \\ & & & & & & \\ \text{CH}_3 & - & \text{CH} & - & \text{CH} & - & \text{CH}_2 & - & \text{CH}_3 \\ & & & & & & & & \\ & & \text{Cl} & & & & & & \end{array} $	

- (b) (i) 2-chloro-3-methylpentane can react with KOH in different solvents to give different products. When it is reacted with aqueous KOH there is only one product. When it is reacted with alcoholic KOH there are two products, one that is formed in greater amounts known as the major product.

Complete the reaction scheme below by writing the structural formulae for the products of the reaction of 2-chloro-3-methylpentane with KOH in different solvents.



- (ii) Identify the reaction product that can form *cis* and *trans* isomers and draw structural formulae for these isomers in the box below.

Skill Level 1

Basic	
Weak	
NR	

Skill Level 3

Advanced	
Proficient	
Basic	
Weak	
NR	