

Assessment Schedule – 2015**Chemistry: Demonstrate understanding of the properties of selected organic compounds (91165)****Evidence Statement**

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)(i)	$\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$ $\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3-\text{CH}_2-\text{CH}-\text{C} \\ \quad \quad \quad \backslash \\ \text{Cl} \quad \quad \quad \text{OH} \end{array}$ 3-methylhexan-2-ol 2-bromo-2-methylpropane or 2-bromomethylpropane	<ul style="list-style-type: none"> • Draws one structure AND names one structure. 		
(ii)	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3\text{CH}_2\text{CHC}=\text{CH}_2 \\ \\ \text{Cl} \end{array}$ Numbering of the chain starts from the end that carries the main functional group, the double bond. Once counted from this end, the number of the double bond and chlorine change. 2-chloro-3-methylpent-1-ene.	<ul style="list-style-type: none"> • Identifies an aspect of the incorrect nomenclature. OR Names the structure correctly. 	<ul style="list-style-type: none"> • Explains the incorrect nomenclature and names the structure correctly. 	

(b)(i)	A constitutional (structural) isomer has the same molecular formula, but a different arrangement of atoms / different structural formula.	<ul style="list-style-type: none"> Defines a structural isomer. 	<ul style="list-style-type: none"> Draws three other isomers of C₄H₁₀O 	
(ii)	$\begin{array}{c} \text{CH}_3-\text{CH}_2-\text{CH}-\text{CH}_3 \\ \\ \text{OH} \\ \text{butan-2-ol} \end{array}$ $\begin{array}{c} \text{CH}_3-\text{CH}-\text{CH}_2-\text{OH} \\ \\ \text{CH}_3 \\ \text{2 methylpropan-1-ol} \end{array}$ $\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3-\text{C}-\text{CH}_3 \\ \\ \text{OH} \\ \text{2 methylpropan-2-ol} \end{array}$	<ul style="list-style-type: none"> Draws 2 other structural isomers of C₄H₁₀O. 	<ul style="list-style-type: none"> Explains the classification of the secondary alcohol. 	
(iii)	Butan-2-ol is secondary because the carbon atom that is attached to the OH group is bonded to either two other carbon atoms or to only one hydrogen atom.	<ul style="list-style-type: none"> Correctly selects the secondary alcohol with reason. 		
(c)	<p>Three liquids will be identified and the fourth will be the 'last one'. The tests used to identify the liquids include:</p> <p>Cr₂O₇²⁻ / H⁺ which will turn from orange to green when the ethanol is oxidised to ethanoic acid.</p> <p>Ethanoic acid can be identified by an acid-base reaction with sodium carbonate. Bubbles of gas will be produced. Sodium ethanoate / ethanoate ion is formed.</p> <p>Hex-2-ene can be identified by an addition reaction with bromine water, which turns from red / brown to colourless straightaway when added to the alkene. It will form 2,3-dibromohexane</p> <p>Hexan-1-amine will be the chemical left over that will not react with any of the given reagents.</p>	<ul style="list-style-type: none"> Identifies TWO types of reactions occurring. OR States TWO correct observations. OR Identifies TWO organic products correctly. 	<ul style="list-style-type: none"> Links appropriate provided reagents to observations correctly for TWO liquids. OR Links appropriate provided reagents to the correct type of reaction for TWO liquids. 	<ul style="list-style-type: none"> Outlines a valid procedure which correctly identifies each liquid using appropriate provided reagents AND Identifies the type of reaction and products of each reaction.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response: no relevant evidence	1a	2a	3a	4a	2m	3m	1e with minor error / omission.	1e

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
TWO (a)(i)	$ \begin{array}{cccccc} \text{H} & \text{Cl} & \text{H} & \text{Cl} & \text{H} & \text{Cl} \\ & & & & & \\ \text{---C} & \text{---C} & \text{---C} & \text{---C} & \text{---C} & \text{---C} \text{---} \\ & & & & & \\ \text{H} & \text{Cl} & \text{H} & & \text{Cl} & \text{H} & \text{Cl} \end{array} $	<ul style="list-style-type: none"> • Polymer correctly drawn (name is not required). 		
(ii)	<p>1,1-dichloroethene cannot exist as a geometric isomer because, although there is a double bond, the atoms / groups on each of the carbons of the double bond are the same (2 Cl on one C and 2 H on the other C).</p>	<ul style="list-style-type: none"> • States a reason for 1,1-dichloroethene not being a geometric isomer. 	<ul style="list-style-type: none"> • Explains why it cannot be a geometric isomer 	
(iii)	$ \begin{array}{ccc} \begin{array}{c} \text{Cl} & \text{Cl} \\ \diagdown & / \\ \text{C} & = & \text{C} \\ / & \diagdown \\ \text{H} & \text{H} \end{array} & & \begin{array}{c} \text{Cl} & \text{H} \\ \diagdown & / \\ \text{C} & = & \text{C} \\ / & \diagdown \\ \text{H} & \text{Cl} \end{array} \\ \textit{cis} & & \textit{trans} \\ \text{1,2 dichloroethene} & & \end{array} $	<ul style="list-style-type: none"> • Draws 1,2-dichloroethene. 	<p>AND</p> <p>draws and names the correct form for both <i>cis</i> and <i>trans</i>.</p>	

(b)	<p>To convert propan-2-ol to propene, add concentrated sulfuric acid (which is a dehydrating agent). It is an elimination reaction because OH and H are removed from adjacent carbon atoms and a double bond is created to form an alkene.</p> <p>To convert propene to propan-2-ol, add dilute (sulfuric) acid. This is an addition reaction because the double bond is broken forming a C-C (single) bond, allowing H and OH from water to bond to the C atoms that were double bonded together.</p> <p>Reaction 1 forms only one product because the carbon atom from which the H is removed (C1 or C3) does not affect the structure of the product as propan-2-ol is symmetrical.</p> <p>Reaction 2 produces two products because an asymmetric reagent (H-OH) adds onto an asymmetric alkene ($\text{CH}_3\text{CH}=\text{CH}_2$). There are two carbons that the H or OH can bond with (C1 and C2), so there are two possible combinations. We can predict which will be the major product by using Markovnikov's rule, which states that the carbon with the most hydrogens gains more hydrogens. This means that most of the time, C1 will get another hydrogen while C2 will get the OH in this reaction. Propan-2-ol will be the major product and propan-1-ol the minor product.</p>	<ul style="list-style-type: none"> Identifies elimination and addition reactions. Identifies a reagent for one reaction. 	<ul style="list-style-type: none"> Links reagents for both reactions to the reaction type. Explains why there is only one product for Reaction 1 OR why there are two products for Reaction 2 AND Explains why Reaction 1 is an elimination reaction OR Reaction 2 is an addition reaction. 	<ul style="list-style-type: none"> Analyses both reactions by explaining why each reaction is a different type and has a different number of products.
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NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response: no relevant evidence	1a	2a	3a	4a	2m	3m	1e with a minor error or omission.	1e

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
THREE (a)(i)	<p>A</p> <pre> H H H - C - C - C // \ H H O OH </pre> <p>B</p> <pre> H H H H - C - C - C - N / \ H H H H H </pre> <p>C</p> <pre> Cl H - C - C - C - H H H H </pre> <p>D</p> <pre> H H H H - C - C - C - H H H H </pre>	<ul style="list-style-type: none"> • Draws structural formulae for TWO organic products. <p>AND</p> <p>Circles ONE of the functional groups.</p> <p>OR</p> <p>Identifies ONE reagent correctly.</p>	<ul style="list-style-type: none"> • Draws structural formulae for all FOUR organic products. <p>AND</p> <p>Circles THREE functional groups.</p> <p>AND</p> <p>Identifies ONE reagent correctly.</p>	
(ii)	Functional groups circled.			
(iii)	Reagent X is concentrated sulfuric acid, conc H ₂ SO ₄ , or c.H ₂ SO ₄ . Reagent Y is alcoholic potassium hydroxide, KOH (<i>alc</i>). or alcoholic sodium hydroxide, NaOH (<i>alc</i>).			

<p>(b)</p>	<p>Ethene reacts with aqueous KMnO_4 to form a diol, ethan-1,2-diol.</p> $\text{CH}_2=\text{CH}_2 \xrightarrow{\text{KMnO}_4} \begin{array}{c} \text{CH}_2-\text{CH}_2 \\ \quad \\ \text{OH} \quad \text{OH} \end{array}$ <p>This is an oxidation or addition reaction in which the double bond is broken and two $-\text{OH}$ groups attach to each C atom of the double bond. The purple KMnO_4 turns brown (or colourless)</p> <p>Ethene reacts with dilute acid, $\text{H}_2\text{O} / \text{H}^+$, to form ethanol.</p> $\text{CH}_2=\text{CH}_2 \xrightarrow{\text{H}_2\text{O} / \text{H}^+} \text{CH}_3-\text{CH}_2-\text{OH}$ <p>This is an addition reaction as once again the double bond is broken. However, in this reaction one $-\text{OH}$ group and one $-\text{H}$ atom attach to each C atom of the double bond. No colour changes are observed in this reaction.</p> <p>When ethene reacts with hydrogen bromide, bromoethane is formed. Again there is no colour change observed.</p> $\text{CH}_2=\text{CH}_2 \xrightarrow{\text{HBr}} \text{CH}_3-\text{CH}_2-\text{Br}$ <p>This reaction is an addition reaction, as the double bond is broken and two atoms are added to each C atom of the double bond. In this reaction one H and one Br atom are added.</p> <p>All three reactions involve the breaking of the double bond. All three reactions involve addition. Two of these reactions are addition reactions and one is an oxidation reaction. Only one of the reactions gives a colour change that is easily observed.</p>	<ul style="list-style-type: none"> Identifies colour change with KMnO_4. Writes equations for TWO of the reactions showing structural formulae. Identifies the reaction type for TWO of the reactions. 	<ul style="list-style-type: none"> Explains the reaction type for each of the reactions. Links reaction type to the correct equation for each of the reactions. 	<ul style="list-style-type: none"> Compares and contrasts ALL THREE reactions.
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NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence	1a	2a	3a	4a	2m	3m	Compares OR contrasts all THREE reactions	Compares AND contrasts all THREE reactions

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 12	13 – 18	19 – 24