FINAL
Alternative Assessment

(COVER PAGE)

Session	:	**April 2021**
Programme	:	Foundation in Science (CFSI)
Course	:	**CHM1204: Chemistry 2**
Date of Examination	:	28 July 2021 (Wednesday)
Time	:	9:00am – 11:30am Reading Time : Nil
Duration	:	2 hours + 30 minutes (uploading time)
Special Instructions	:	

This paper consists of **FOUR (4)** questions. Answer **ALL** questions.
All questions carry equal marks.

Materials permitted :

Non-programmable calculator

Materials provided :

Periodic Table

Examiner(s)	:	**Ms. Lim Sze Theng**
Chief Moderator	:	Ms. Mazlita Yahya

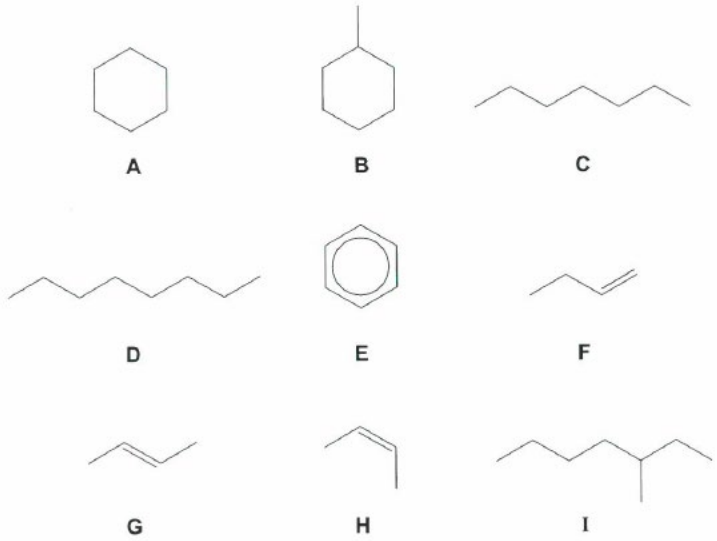
*This paper consists of **13** printed pages, including the cover page.*

FOUNDATION IN SCIENCE (CFSI)
CHM1204: CHEMISTRY 2
FINAL ALTERNATIVE ASSESSMENT: APRIL 2021 SESSION

Instructions: This paper consists of **FOUR (4)** questions. Answer **ALL FOUR (4)**. All questions carry equal marks.

Question 1

Crude oil is a source of many hydrocarbons.
The skeletal formulae of some of these hydrocarbons are shown below.



(a) Explain why compound **A** is both saturated and a hydrocarbon.

(2 marks)

(b) What is the empirical formula for compound **A**?

(1 mark)

(c) Give the letters, **A, B, C, D, E, F, G, H or I**, of two hydrocarbons that are structural isomers of each other.

(1 mark)

(d) The petroleum industry processes straight chain alkanes into cyclic hydrocarbons such as **A, B and E.**

(i) Explain why the petroleum industry processes straight chain alkanes into cyclic hydrocarbons.

(1 mark)

(ii) Hydrocarbon **C** can be processed into the cyclic hydrocarbon **B.**
Construct an equation for this reaction.

(1 mark)

(e) Explain why hydrocarbon **D** has a higher boiling point than hydrocarbon **C**.

(2 marks)

(f) Hydrocarbon **G** and **H** are stereoisomers of each other.
Explain what is meant by the term stereoisomerism.

(2 marks)

(g) Construct the equation for the **complete** combustion of hydrocarbon C.

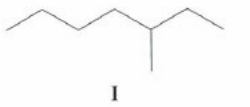
(2 marks)

(h) A hydrocarbon molecule, $C_{16}H_{34}$, is cracked to form an octane molecule and two molecules of but-2-ene.

Construct the equation for this reaction.

(1 mark)

(i) Compound I is 3-methylheptane.



I

(i) What is meant by the term functional group?

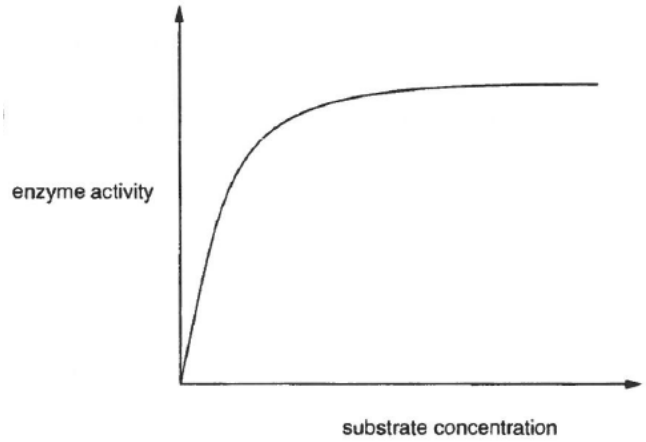
(1 mark)

(ii) Compound I reacts with chlorine in the presence of ultraviolet radiation to give several structural isomers of $C_8H_{17}Cl$.

How many **structural** isomers could be formed in this reaction?

(1 mark)

(j) The following figure shows how the activity of an enzyme varies with substrate concentration.



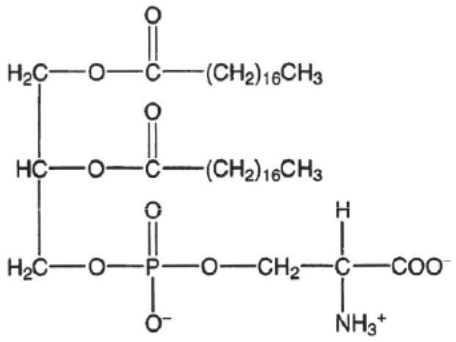
(i) Explain why the curve reaches a maximum value.

(2 marks)

(ii) On above figure draw the curve you would expect if a non-competitive inhibitor were present.

(2 marks)

(k) This question is about the phospholipid shown below.



(i) On the diagram draw a ring around an ester group.

(1 mark)

(ii) On the diagram indicate, with asterisks*, **two** chiral (asymmetric) carbon atoms.

(2 marks)

(iii) What is the overall charge on this phospholipid?

(1 mark)

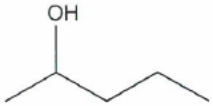
(iv) Show with a diagram how phospholipids are assembled into bimolecular layers.

(2 marks)

(TOTAL: 25 MARKS)

Question 2

(a) Pentan-2-ol, shown below, is a secondary alcohol.



Pentan-2-ol can be converted into three alkenes, A, B and C, by the dehydration of water.

- Two of alkenes, A and B, are stereoisomers.
- The third alkene, C, is a structural isomer of both A and B.

This dehydration often uses a catalyst.

(i) What is a suitable catalyst for this reaction?

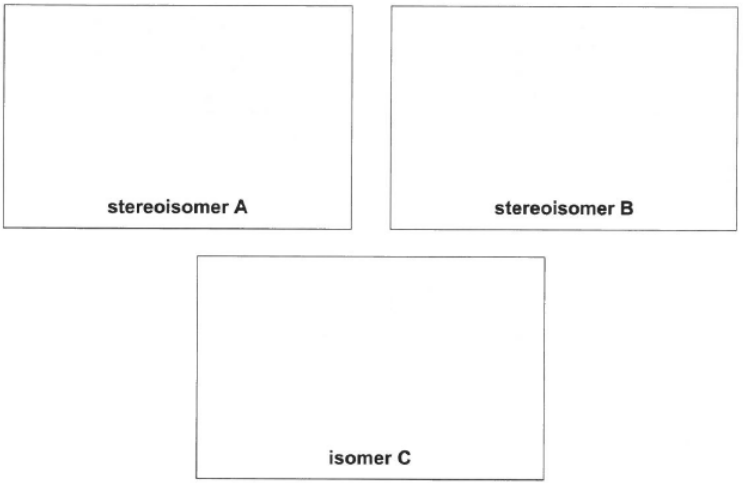
(1 mark)

(ii) Construct an equation, using molecular formulae, for the dehydration if water from pentan-2-ol.

(1 mark)

(iii) In the boxes below:

- Draw the structures of stereoisomers A and B
- Draw the structure of isomer C.



(3 marks)

(iv) Stereoisomers A and B show geometrical isomerism.

State two features of these molecules that enable them to show geometrical isomerism.

(2 marks)

(b) Pentan-2-ol can be oxidised by heating under reflux with acidified aqueous potassium dichromate (VI).

Complete the equation for this oxidation.

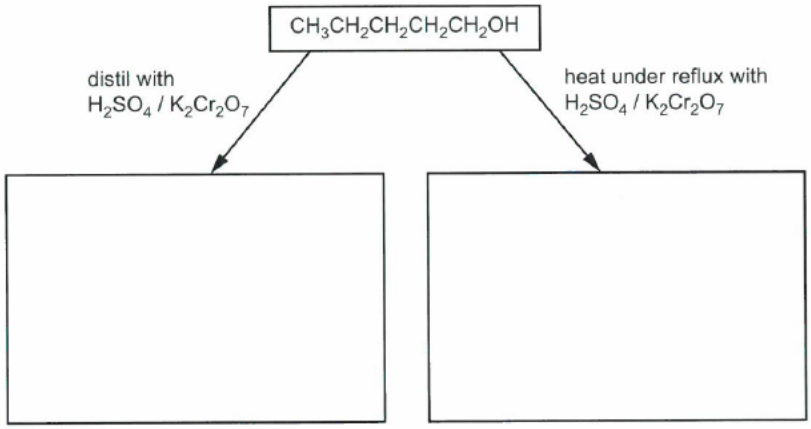
Use a line-angle structural formula for the organic product.

Use [O] to represent the oxidising agent.

(2 marks)

(c) Pentan-1-ol can also be oxidised but it gives different products.

Complete the flowchart below to show the structures of the two organic products formed.



(2 marks)

Enthalpy changes can be determined directly or indirectly.

(d) A student investigates the reaction between magnesium and dilute hydrochloric acid.

$Mg\ (s) + 2\ HCl\ (aq) \rightarrow MgCl_2\ (aq) + H_2(g)$

The student determines the enthalpy change for this reaction.

In her experiment, she reacts 0.486 g of magnesium with 50.0 cm^3 of 2.00 mol dm^{-3} HCl (aq). The HCl (aq) is in excess.

The temperature of the solution changes from 19.2°C to 32.0°C.

(i) Calculate the energy released, in kJ, during this reaction.
The specific heat capacity of the solution = 4.18 J g^{-1} K^{-1}.
The density of the solution is 1.00 g cm^{-3}.

(3 marks)

(ii) Calculate the amount, in moles, of magnesium used by the student.

(1 mark)

(iii) Calculate the enthalpy change of reaction.

Give your answer to three significant figures.

(3 marks)

(e) Chloroethene is used to make poly(chloroethene), PVC.

Write an equation, using **expanded structural formulae**, for the reaction to form poly(chloroethene) from its monomer.

(3 marks)

(f) Waste polymers are often disposed of by combustion. The heat released can be used to generate electricity.

(i) Hydrogen chloride, HCl, is a toxic waste product formed by combustion of PVC.

Suggest how the HCl can be removed from the gases produced during the combustion of PVC.

(1 mark)

(ii) Some waste polymers are put into landfill sites. This uses up a valuable resource.

State two ways, other than landfill and combustion, of processing waste polymers.

(2 marks)

(iii) Chemists are trying to minimise the environmental damage caused by the disposal of waste polymers by developing new types of polymers.

Give an example of a type of polymer being developed to minimise environmental damage.

(1 mark)

(TOTAL: 25 MARKS)

Question 3

(a) This question is about nucleic acids.

The sequence of twelve bases below is a portion of a single stranded RNA found in a virus. It can be directly translated by protein synthesis inside an invaded cell.

5' —UUCCCGAAAGGU—3'

(i) How can you tell that this fragment is a portion of RNA and not DNA?

(1 mark)

(ii) State **two** other ways in which DNA usually differs from RNA

(2 marks)

(iii) Use the table to work out the amino acid sequence coded by this portion of RNA.

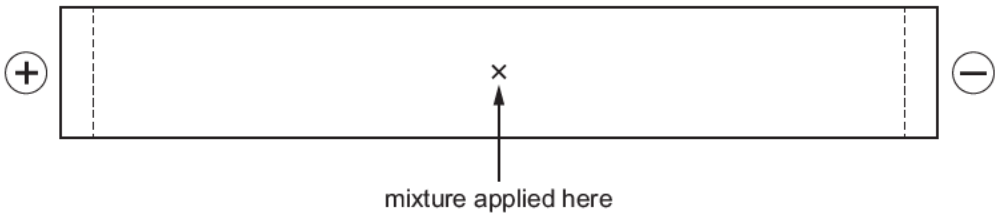
first base in triplet	second base in triplet				third base in triplet
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	Stop	Stop	A
	Leu	Ser	Stop	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

(2 marks)

(b) The isoelectric point is the pH at which an amino acid exists as a zwitterion. The isoelectric point of valine is 6.0 and of lysine is 9.8.

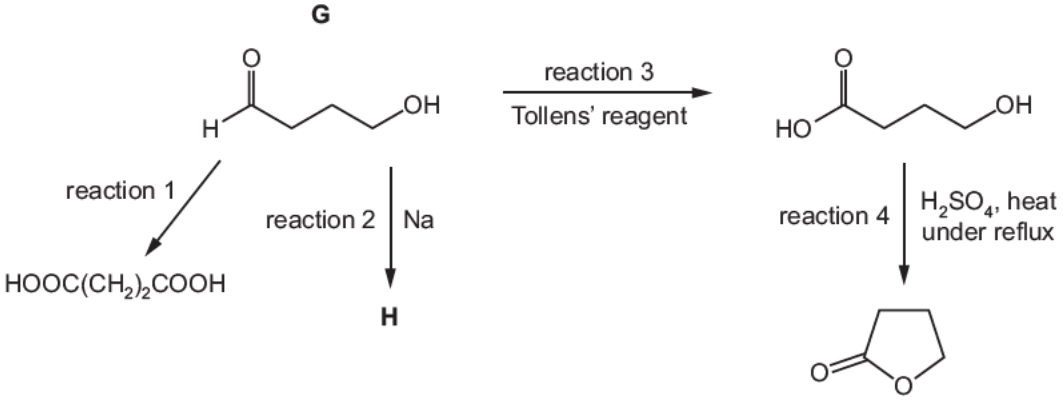
A mixture of the dipeptide , val-lys and its two constituent amino acids, valine and lysine, was analysed by electrophoresis using a buffer at pH 6.0.

Draw and label three spots on the diagram of the electrophoresis paper to indicate the likely position of each of these three species after electrophoresis. Explain your answer.



(5 marks)

(c) Some reactions of compound G are shown.



(i) State the type of reaction that occurs in reaction 1.

(1 mark)

(ii) Suggest the reagent (s) and conditions required for reaction 1.

(2 marks)

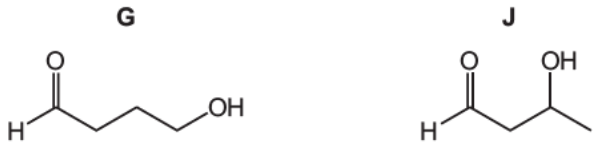
(iii) State what you would observe in reaction 3.

(1 mark)

(iv) Give the type of reaction shown by reaction 4.

(1 mark)

(d) G and J are structural isomers of each other.



(i) Name the type of structural isomerism shown by G and J.

(1 mark)

(ii) Suggest one chemical test that can distinguish G from J. Give the result of the test with each compound.

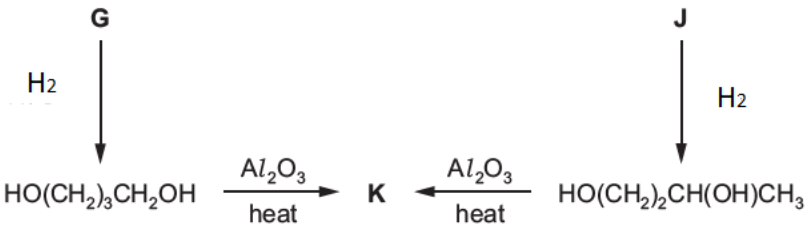
test _____

result with G_____

result with J _____

(2 marks)

In the reaction schemes below, G and J are converted into organic compound K.



(iii) State the role of H_2 in the reactions with G and J.

(1 mark)

(iv) Identify the organic product K.

(1 mark)

(e) Give IUPAC names for the four isomeric methyl esters that contain six carbon atoms and saturated carbon chains.

(4 marks)

(f) Draw the structure of the ester produced when the following pairs of carboxylic acid and alcohol react.

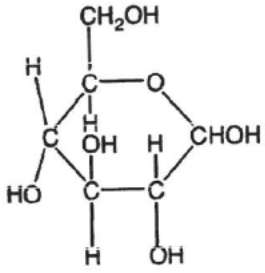
(i) 2-methylbutanoic acid and 2-propanol

(1 mark)

(TOTAL: 25 MARKS)

Question 4

(a) This question is about the carbohydrates D-glucose and maltose.



D-glucose

(i) Draw an open chain structure for D-glucose.

(1 mark)

(ii) Maltose is a disaccharide derived from D-glucose, $C_6H_{12}O_6$.

Draw the structure of maltose.

(2 marks)

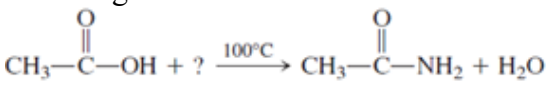
(iii) Describe one way in which maltose can be hydrolysed.

(1 mark)

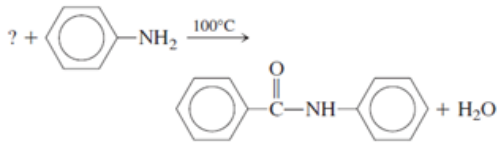
(iv) Suggest why maltose is much more soluble in water than starch.

(3 marks)

(b) Draw the structures of the missing substances in each of the following reactions involving amides.

(i) 

(2 marks)

(ii) 

(2 marks)

(c) Assign an IUPAC name to each of the four isomeric amines that have the molecular formula C_3H_9N.

(4 marks)

(d) This question is about molecules with molecular formula C_4H_8.

(i) Give the structures of a pair of positional isomers with the formula C_4H_8.

(1 mark)

(ii) Give the structures of a pair of skeletal isomers with formula C_4H_8 that do not exhibit stereoisomerism.

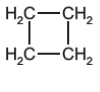
(1 mark)

(iii) Give the structures and full names of a pair of stereoisomers with the formula C_4H_8.

(2 marks)

(iv) The structure of a molecule A of formula C_4H_8 is shown.

Draw a functional group isomer of a molecule A in box B. Explain how molecules A and B could be distinguished by a chemical test.

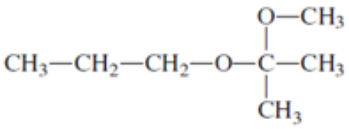


A

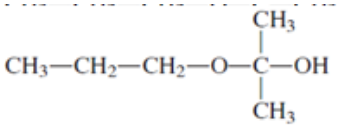
B

(3 marks)

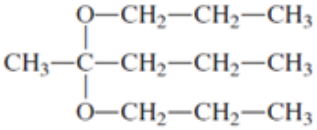
(e) Indicate whether each of the following compounds is an acetal.

(i) 

(1 mark)

(ii) 

(1 mark)

(iii) 

(1 mark)

(TOTAL: 25 MARKS)

--THE END--

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