FINAL
Alternative Assessment

(COVER PAGE)

Session	:	**April 2022**
Programme	:	Foundation in Science (CFSI)
Course	:	**CHM1204: Chemistry 2**
Date of Examination	:	3 August 2022 (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. Abhilashini Achuthan

*This paper consists of **15** printed pages, including the cover page.*

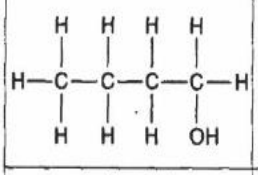
FOUNDATION IN SCIENCE (CFSI)
CHM1204: CHEMISTRY 1
FINAL ALTERNATIVE ASSESSMENT: APRIL 2022 SESSION

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

Question 1

(a) There are four structural isomers of $C_4H_{10}O$ that are alcohols. One of the isomers has been drawn for you.

Complete the table below to show the other structural isomers.

			
butan-1-ol	isomer 1	isomer 2	isomer 3

(3 marks)

(b) Butan-1-ol is oxidised by an acidified solution of potassium dichromate (VI) to form a carboxylic acid.

(i) State the colour change that you would see.

Colour changes from _____ to _____.

(1 mark)

(ii) Write a balanced equation for this oxidation of butan-1-ol to form a carboxylic acid. Use [O] to represent the oxidising agent.

(2 marks)

(iii) Identify which of the isomers 1, 2 or 3 part (a) could also be oxidised to form a carboxylic acid.

(1 mark)

(c) Butan-1-ol reacts with hot concentrated sulphuric acid to form compound B.

(i) Compound B has an empirical formula of CH_2 and a relative molecular mass of 56.12
Use this information to deduce the molecular formula of compound B. Show your working.

(2 marks)

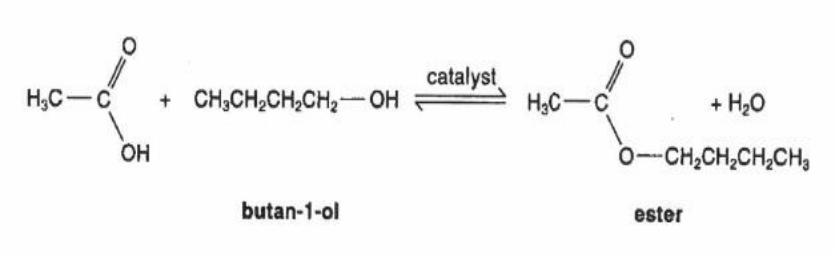
(ii) Write a balanced equation to show the conversion of butan-1-ol into compound B.

(1 mark)

(iii) One of isomers, 1, 2 or 3, in part (a) also reacts with hot concentrated sulphuric acid to form compound B. Identify which isomer.

(1 mark)

(d) The ester, $CH_3COOCH_2CH_2CH_2CH_3$, was formed by reacting ethanoic acid with butan-1-ol.



Mr of ester = 116.18

(i) State a catalyst for this reaction.

(1 mark)

(ii) In an experiment, 6.97 g of the ester was produced from 0.100 mol of butan-1-ol. Calculate the number of moles of ester produced.

(1 mark)

(iii) Calculate the percentage yield

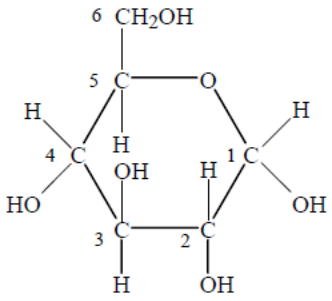
(1 mark)

(e) Glucose is the most abundant monosaccharide.

(i) Draw the straight chain structure of glucose.

(1 mark)

(ii) The structure of α-glucose is shown below:



Outline the structural difference between α-glucose and β-glucose.

(1 mark)

(iii) Glucose molecules can condense to form starch which can exist in two forms, amylose and amylopectin. Describe the structural differences between the two forms.

(2 marks)

(f) 1.00g of sucrose, $C_{12}H_{22}O_{11}$, was completely combusted in a food calorimeter. The heat evolved was equivalent to increasing the temperature of 631 g of water from 18.4 C to 24.6 C. Calculate the calorific value of sucrose (in $kJmol^{-1}$)given the specific heat capacity of water is 4.18 kJ K^{-1} kg^{-1} or 4.18 J K^{-1} g^{-1}.

(3 marks)

(g) Genetic information is stored in chromosomes which contain a very long DNA sequence.

(i) A nucleotide of DNA contains deoxyribose, a phosphate group and an organic base. Outline how nucleotides are linked together to form polynucleotides.

(2 marks)

(ii) Describe the bonding between the two strands in the double helical structure of DNA.

(2 marks)

(TOTAL: 25 MARKS)

Question 2

(a) The ethanol present in an alcoholic drink passes into the bloodstream and the liver is involved in breaking down the ethanol. The first stage of this breakdown involves the following reaction.

$$CH_3CH_2OH + [O] \dashrightarrow CH_3CHO + H_2O \quad \textbf{reaction 2(a)}$$

CH_3CHO is then oxidised to other products.

(i) Name the functional group present in CH_3CHO.

(1 mark)

(ii) Suggest **one** possible oxidation product that can be formed from CH_3CHO.

(1 mark)

(b) Methylated spirit contains ethanol and methanol, CH_3OH. Methylated spirit is unfit for drinking because an oxidation product of methanol causes liver damage and blindness. The methanol is oxidised in the body in a similar oxidation to that of ethanol shown in **reaction 2(a)**.

Write an equation for the oxidation of methanol.

(2 marks)

(c) Methanol can be added to petrol.

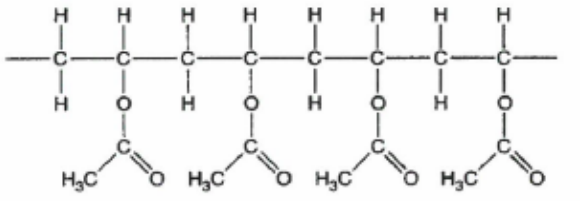
(i) Write a balanced equation for complete combustion of methanol.

(1 mark)

(ii) Suggest why methanol is added to petrol.

(1 mark)

(d) Much of ethanoic acid produced is used in the manufacture of the monomer ethenyl ethanoate (vinyl acetate). The monomer is then used to produce the polymer, polyvinyl acetate (PVA), part of which is shown below.



(i) Draw a circle around the repeat unit in PVA.

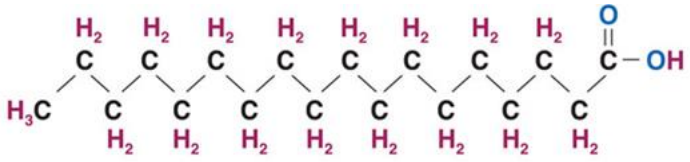
(1 mark)

(ii) Draw the structure of the monomer ethenyl ethanoate (vinyl acetate).

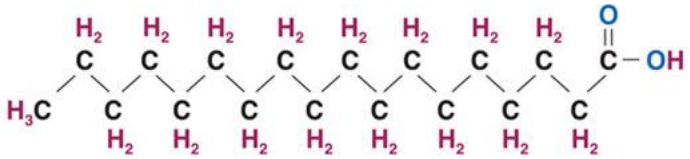
(1 mark)

(e) Linoleic acid, $C_{17}H_{31}COOH$, (M_r = 279.49)and stearic acid, $C_{17}H_{35}COOH$, (M_r = 284.54), both contain eighteen carbon atoms and have similar molar masses.

Stearic acid
$C_{18}H_{36}O_2$



Stearic acid
$C_{18}H_{36}O_2$



(i) Explain why the melting point of linoleic acid is considerably lower than the melting point of stearic acid.

(3 marks)

(ii) Determine the maximum mass of bromine,Br_2 ,(M_r = 159.8) that can add to **100 g of stearic acid**:
and **100 g of linoleic acid**:

(3 marks)

(iii) Draw the simplified structural formula of a fat containing one stearic acid and two linoleic acid residues.

(1 mark)

(iv) Give the formulas of the products formed when this fat is hydrolysed by sodium hydroxide.

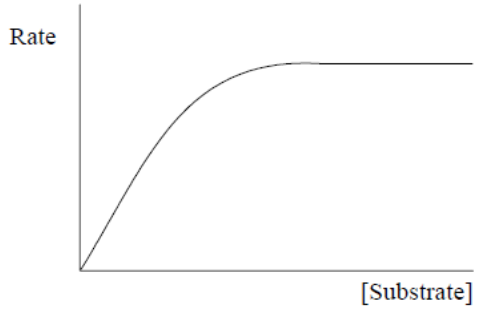
(1 mark)

(f) An experiment was carried out using a calorimeter to determine the calorific value of a 'low fat' chocolate bar with a mass of 50.0 g. The complete oxidation (combustion) of a 10 g sample of the chocolate bar raised the temperature of 500 g of water to 86.5°C. The initial temperature of the water was 19.0 °C. Calculate the calorific value (in kJ) of the chocolate bar.

(The specific heat capacity of water= 4.18 J g^{-1} K^{-1}.)

(4 marks)

g) A typical graph for the relationship between the rate of an enzyme-catalysed reaction and substrate concentration is shown below.



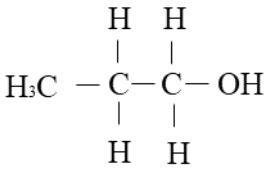
Draw on the graph above the curves that would be obtained in the presence of a competitive inhibitor (labelled C) and a non-competitive inhibitor (labelled N). Explain the shapes of the curves.

(5 marks)

(TOTAL: 25 MARKS)

Question 3

(a) The following compounds were all found to be components of a sample of petrol.

$CH_3(CH_2)_2CH_3$	$(CH_3)_3CCH_2CH(CH_3)_2$	
G	H	J

(i) Give the molecular formula of compound G.

(1 mark)

(ii) Give the empirical formula of compound H.

(1 mark)

(b) Draw a condensed formula for each of the following compounds:

(i) 5-Methyl-2-hexyne.

(2 marks)

(ii) 1,6-Heptadiene.

(2 marks)

(c) Although butylamine and pentane have similar molecular masses (73 and 72 amu, respectively), the boiling point of butylamine is much higher (78°C) than that of pentane (36°C). Explain why.

(2 marks)

(d) Draw condensed formulas for the following compounds

(i) 2-Methylpentanamide

(2 marks)

(ii) Diethylammonium chloride

(2 marks)

(iii) Trimethylanilinium chloride

(2 marks)

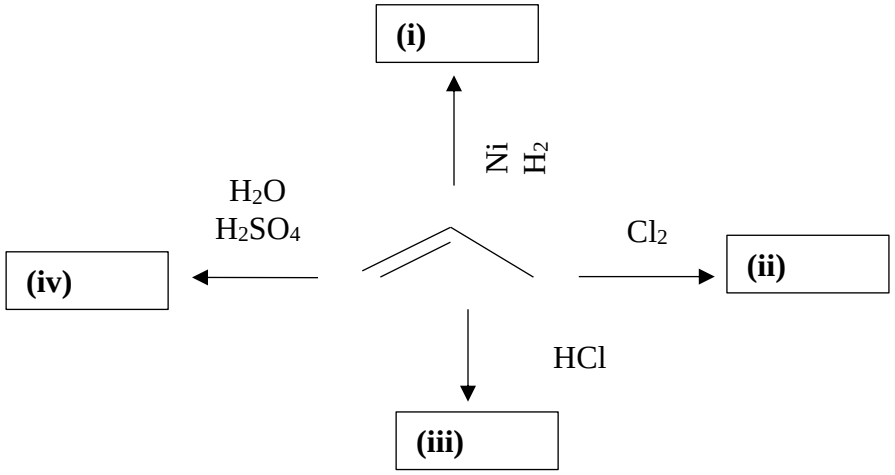
(e) Give the IUPAC name for the ester $CH_3(CH_2)_2COO(CH_2)_3CH_3$

(2 marks)

(f) The unsaturated ester, ethyl deca-2,4-dienoate contributes to the flavor of pears. Draw the structure of this ester.

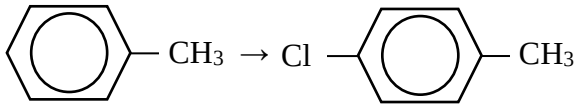
(2 marks)

g) The following conversion scheme centered on propene. Draw the line-angle structures of the products (i) to (iv).



(4 marks)

(h) There are several ways of introducing chlorine atoms into organic molecules. State the reagents and conditions necessary to carry out the following transformations.

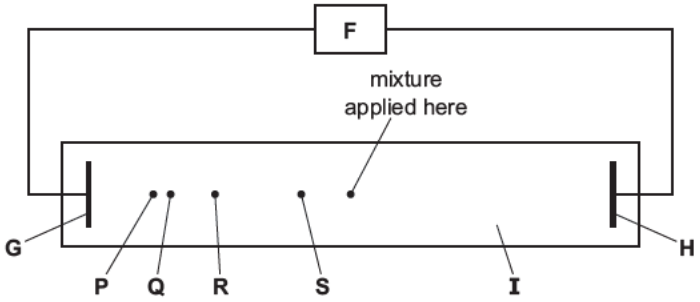
Transformation	Reagents + conditions
$C_2H_4 \rightarrow C_2H_5Cl$	
$C_2H_4 \rightarrow C_2H_4Cl_2$	
	

(3 marks)

(TOTAL: 25 MARKS)

Question 4

(a) Electrophoresis can be used to separate mixtures of amino acids and peptides.
A mixture of the tripeptide Ala-Ser-Gly and its three constituent amino acids was subjected to electrophoresis in a buffer at pH 11.
At the end of the experiment the following results were seen.



(i) Identify the components labelled **F-I** in the above diagram.

(4 marks)

(ii) Suggest the identities of the species responsible for spot **P** and spot **S**. Explain your answers.

(3 marks)

(b) Lavandulol, $C_{10}H_{18}O$, is a fragrant oil which is found in lavender. The structural and the line-angle structural formulae of lavandulol are shown below.

(i) Identify **two** different functional groups in lavandulol.

(2 marks)

(ii) Why does lavandulol not have cis-trans isomerism?

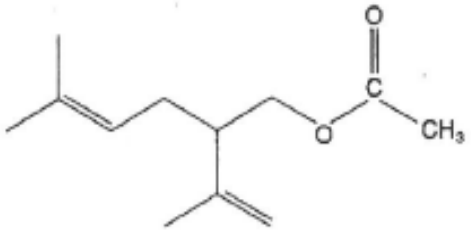
(1 mark)

(iii) Lavandulol, $C_{10}H_{18}O$, also reacts with bromine to form a saturated organic product.

State what you would see in this reaction and deduce the molecular formula of the organic product.

(3 marks)

(iv) Lavandulol could be converted into an ester X, which is also found in lavender oil.

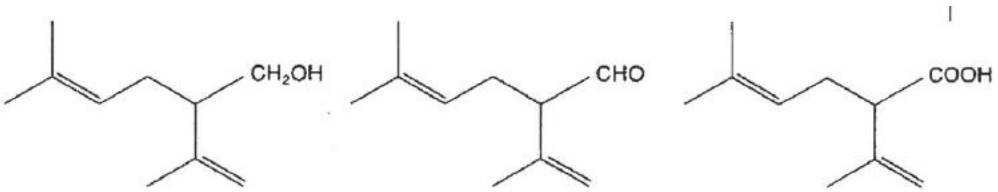


ester **X**

State a reagent and a catalyst that could be used to form ester X from lavandulol.

(2 marks)

(v) Lavandulol can be oxidised to produce either compound Y or compound Z.

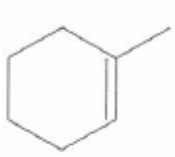


lavandulol $C_{10}H_{18}O$ | compound **Y** $C_{10}H_{16}O$ | compound **Z** $C_{10}H_{16}O_2$

Write a balanced equation for the oxidation of lavandulol to produce compound Z. Use the molecular formulae given above and use [O] to represent the oxidising agent.

(2 marks)

(c)



A

Compound A reacts with H_2 to give one product and with HBr to give two products.

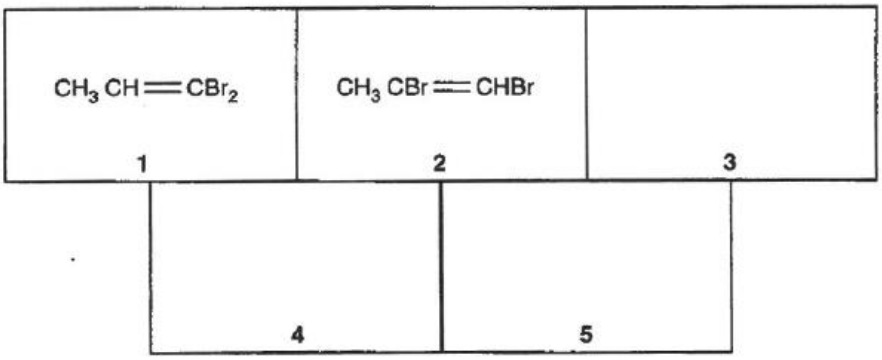
(i) Give the IUPAC name of compound A.

(1 mark)

(ii) Draw the structures of the products of these reactions.

(3 marks)

(d) Two of the structural isomers of C_3H_4Br are drawn below.



(i) Draw the other three structural isomers.

(3 marks)

(ii) Name isomer 1

(1 mark)

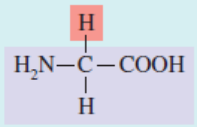
(TOTAL: 25 MARKS)

--THE END--

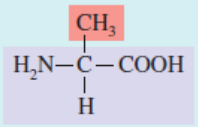
CHM1204(F)/APR2022/S.T.LIM

Table 1: The 20 Standard Amino Acids, Grouped According to Side-Chain Polarity

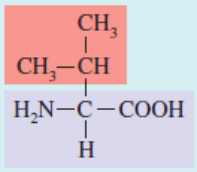
Nonpolar amino acids



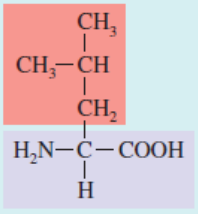
Glycine (Gly, G)
GLY-seen



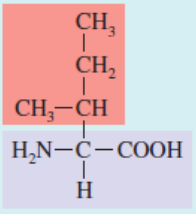
Alanine (Ala, A)
AL-ah-neen



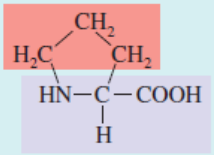
Valine (Val, V)
VAY-leen



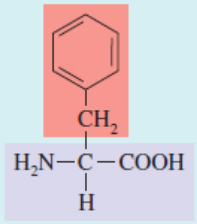
Leucine (Leu, L)
LOO-seen



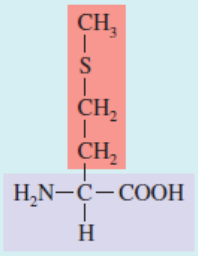
Isoleucine (Ile, I)
eye-so-LOO-seen



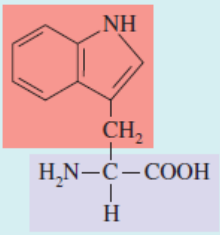
Proline (Pro, P)
PRO-leen



Phenylalanine (Phe, F)
fen-il-AL-ah-neen

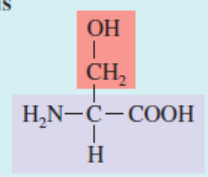


Methionine (Met, M)
me-THIGH-oh-neen

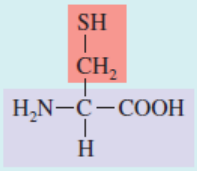


Tryptophan (Trp, W)
TRIP-toe-fane

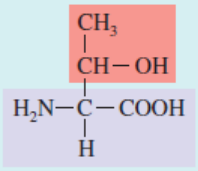
Polar neutral amino acids



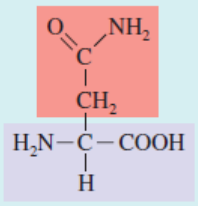
Serine (Ser, S)
SEER-een



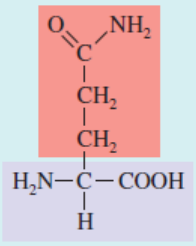
Cysteine (Cys, C)
SIS-teh-een



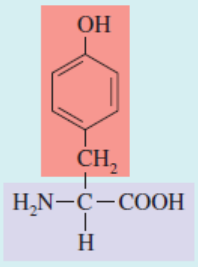
Threonine (Thr, T)
THREE-oh-neen



Asparagine (Asn, N)
ah-SPAR-ah geen

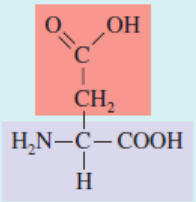


Glutamine (Gln, Q)
GLU-tah-meen

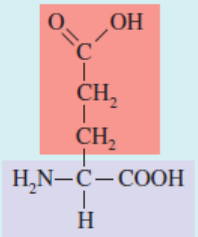


Tyrosine (Tyr, Y)
(TIE-roe-seen)

Polar acidic amino acids

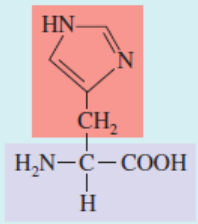


Aspartic acid (Asp, D)
ah-SPAR-tic acid

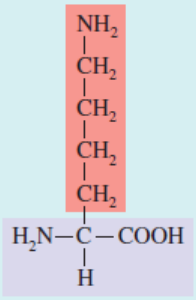


Glutamic acid (Glu, E)
GLU-tamic acid

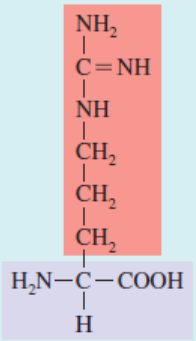
Polar basic amino acids



Histidine (His, H)
HISS-tuh-deen



Lysine (Lys, K)
LYE-seen



Arginine (Arg, R)
ARG-ih-neen

Table 2: The Universal Genetic Code

First Position (5′ end)	Second Position				Third Position (3′ end)
	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