FINAL
Alternative Assessment

(COVER PAGE)

Session	:	**August 2020**
Programme	:	Foundation in Science (CFSI)
Course	:	**CHM1204: Chemistry 2**
Date of Examination	:	15 December 2020 (Tuesday)
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. Gurdeep Kaur

*This paper consists of **10** printed pages, including the cover page.*

FOUNDATION IN SCIENCE (CFSI)
CHM1204: CHEMISTRY 2
FINAL ALTERNATIVE ASSESSMENT: AUGUST 2020 SESSION

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

Question 1

(a) This question is about the six alcohols below.

butan-2-ol **ethane-1,2-diol**
2-methylpentan-3-ol **2-methylpropan-2-ol**
propan-1-ol **propan-2-ol**

Which alcohol is an example of a tertiary alcohol?

(1 mark)

(b) Draw the line-angle structural formula for 2-methylpentan-3-ol.

(1 mark)

(c) Butan-2-ol and 2-methylpropan-2-ol are structural isomers

(i) What is meant by the term *structural isomer* ?

(1 mark)

(ii) Draw another structural isomer of these two alcohols.

(1 mark)

(d) Ethane-1,2-diol can be dissolved in water to act as an anti-freeze in car radiators. Explain why ethane-1,2-diol is very soluble in water.

(2 marks)

(e) Ethane-1,2-diol is heated under reflux with ethanoic acid and a small amount of H_2SO_4 catalyst. Compound **A** is formed with molecular formula $C_6H_{10}O_4$.
Draw the structure of compound **A**.

(2 marks)

(f) Butan-2-ol is heated with H_2SO_4 catalyst.
- A mixture of **three** alkenes forms, **B**, **C** and **D**.
- The alkenes **B** and **C** are stereoisomers.

(i) Draw the structures of the two stereoisomers **B** and **C**.

(2 marks)

(ii) What type of stereoisomerism is shown by **B** and **C**?

(1 mark)

(iii) Draw the structure of the other alkene, **D**, that is formed in this reaction

(1 mark)

(g) Draw all possible open-chain structural isomers of $C_6H_{13}Cl$ that are primary halogenolalkanes.

(7 marks)

(h) F is an organic molecule which has the molecular formula $C_3H_6O_2$.
When F is heated with NaOH (aq) followed by H_2SO_4 (aq) the products G and H are made.

Separate samples of G and H are added to

- Na_2CO_3 (aq)
- sodium metal
- alkane aqueous iodine

the observations are described in the table.

reagent(s)	G	H
Na_2CO_3 (aq)	colourless bubbles of gas produced	no visible reaction
sodium metal	colourless bubbles of gas produced	colourless bubbles of gas produced
alkane aqueous iodine	no visible reaction	yellow precipitate forms

(i) Complete the table to identify the functional groups present in F, G and H.

	functional group
F	
G	
H	

(3 marks)

(ii) Name the yellow precipitate formed when alkaline aqueous iodine reacts with H.

(1 mark)

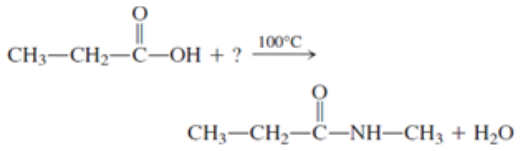
(iii) Draw the structures of G and H.

(2 marks)

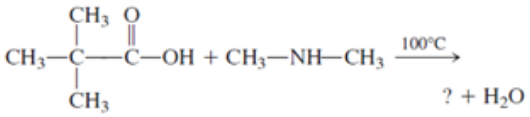
(TOTAL: 25 MARKS)

Question 2

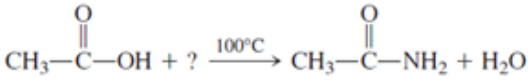
(a) Draw the structures of the missing substances in each of the following reactions involving amides.

(i) 

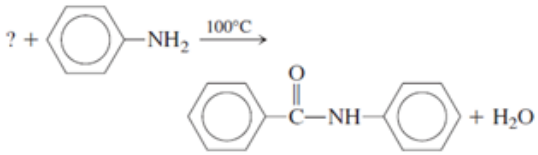
(1 mark)

(ii) 

(1 mark)

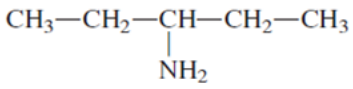
(iii) 

(1 mark)

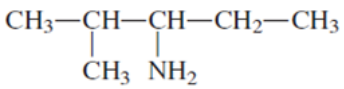
(iv) 

(1 mark)

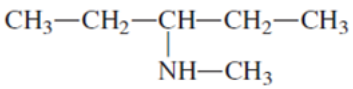
(b) Assign an IUPAC name to each of the following amines.

(i) 

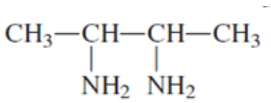
(1 mark)

(ii) 

(1 mark)

(iii) 

(1 mark)

(iv) 

(1 mark)

(c) Draw the structural formula of the hemiacetal formed from each of the following pairs of reactants.

(i) Acetaldehyde and ethyl alcohol

(2 marks)

(ii) 2-Pentanone and methanol

(2 marks)

(iii) Butanal and ethanol

(2 marks)

(iv) Acetone and isopropyl alcohol

(2 marks)

(d) Draw a condensed structural formula for each of the following unsaturated hydrocarbons.

(i) 3-Methylcyclopentene

(2 marks)

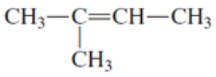
(ii) 1,3-Butadiene

(2 marks)

(iii) 3-Ethyl-1,4-pentadiene

(2 marks)

(e) For each molecule, tell whether *cis–trans* isomers exist. If they do, draw the two isomers and label them as *cis* and *trans*.

(i) 

(1 mark)

(ii) hex-3-ene

(1 mark)

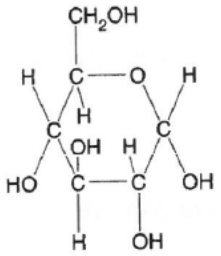
(iii) 4-methylpent-2-ene

(1 mark)

(TOTAL: 25 MARKS)

Question 3

(a) The structure of a monosaccharide is given below.



(i) What is the correct name for this molecule?

(2 marks)

(ii) Indicate on the diagram the carbon atoms 1,4.

(1 mark)

Glucose forms a number of polymers.

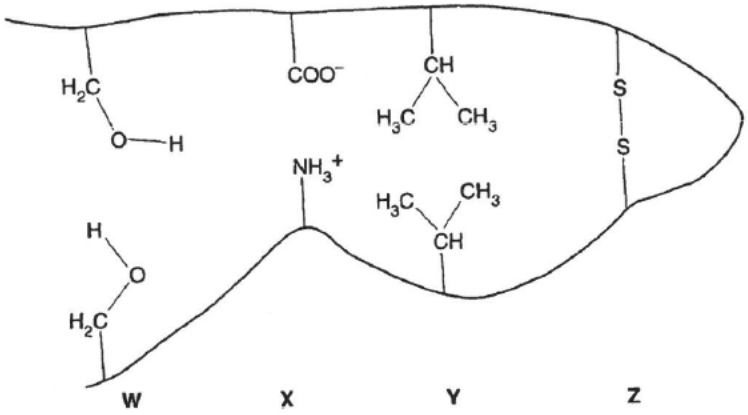
(iii) Name a polymer of glucose

(1 mark)

(iv) Draw a skeletal formula showing two glucose units linked in a length of the polymer you chose in (i). Your diagram should show clearly the link between the two glucose units.

(2 marks)

(b) The diagram shows a section of polypeptide chain with some sidechains of amino acids which can be involved in maintaining the tertiary protein structure.



(i) State the type of bonding or attraction involved at each of the sites W to Z shown.

(4 marks)

(ii) At which site in the diagram will the bonding be weakest?

(1 mark)

(iii) Which of W to Z is most likely to be affected by a change of pH from 7.0 to 10.0? Explain your answer.

(2 marks)

(iv) Use two molecules of glycine, $H_2NCH_2CO_2H$, to show how amino acids are linked in a dipeptide. Show every bond in a displayed structure.

(2 marks)

(c) A fragment of protein is coded for by the m-RNA sequence.

- CGGUUUAGGGUA-

(i) How do you know that this is an RNA sequence and not DNA?

(1 mark)

(ii) Deduce the amino acid sequence in the protein coded for by this stretch of m-RNA. Use the genetic code provided in Table 3.1.

Table 3.1

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

(1 mark)

(iii) Write the sequence of the part of the DNA strand from which this stretch of m-RNA is obtained by transcription.

(2 marks)

(iv) Write the sequence of the DNA strand complementary to the one you wrote in part c (iv).

(1 mark)

(v) Complete figure below to show how these two complementary bases are linked in double helical DNA.

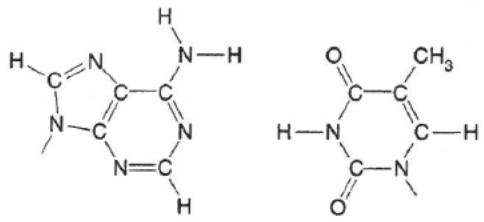


Fig. 3.1

(1 mark)

(d) Samples of the following compounds were labelled A to E as shown.

A $CH_3CH_2CH_2OH$
B $CH_3CH_2CH(OH)CH_3$
C CH_3CHO
D CH_3COCH_3
E $CH_3CH{=}CHCH_3$

Complete the table below by inserting the letter (or letters) of the compounds that correspond for each test.

reagent	observation	letter(s)
acidified potassium dichromate (VI)	green colour obtained on boiling	
hydrogen in the presence of a platinum catalyst	hydrogen absorbed	
Benedict's solution	brown-red precipitate obtained on boiling	
bromine in an inert solvent	solution decolourised	

(4 marks)
(TOTAL: 25 MARKS)

Question 4

(a) This question is concerned with factors affecting the rates of enzyme catalyzed reactions.

(i) What do you understand by the term active site of an enzyme?

(1 mark)

(ii) Fig 4.1 shows how the rate of an enzyme catalyzed reaction changes with substrate concentration.

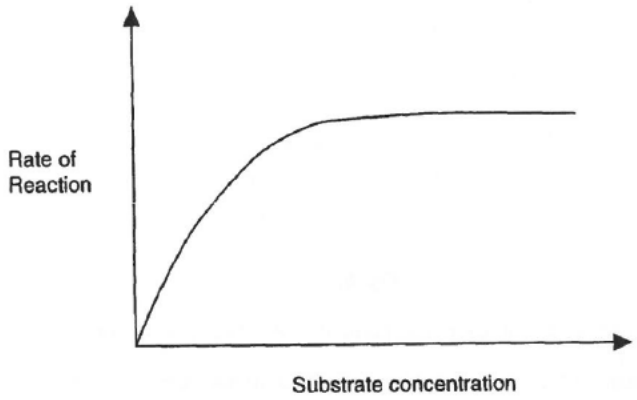


Fig. 4.1

Explain why the rate of reaction changes in the way shown on the graph.

(3 marks)

(iii) State the difference between competitive and non-competitive inhibition.

(2 marks)

(iv) Draw a curve on Fig 4.1 to show how you would expect the rate to change with substrate concentration in the presence of a competitive inhibitor.

(2 marks)

(b) This question is about triglycerides.

(i) Draw the structure of the triglyceride made from stearic acid, $CH_3(CH_2)_{16}CO_2H$, and propane-1,2,3-triol.

(2 marks)

(ii) Explain why triglycerides are soluble in non-polar solvents, and suggest why they do not dissolve in water.

(2 marks)

(iii) State two uses for triglycerides in plants and animals.

(2 marks)

(c) Glucose, $C_6H_{12}O_6$, can be completely combusted to give carbo dioxide and water.

$C_6H_{12}O_6$ (s) + 6 O_2 (g) → 6 CO_2 (g) + 6 H_2O (l)

A student carries out an experiment to determine the enthalpy change of combustion of glucose.

In the experiment, 0.831 g of glucose is burned. The energy released is used to heat 100 cm^3 of water from 23.7°C to 41.0 °C.

(i) Calculate the energy released, in kJ, during combustion of 0.831 g of glucose.
The specific heat capacity of water = 4.18 J g^{-1} K^{-1}
Density of water = 1.00 g cm^{-3}

(2 marks)

(ii) Calculate the amount, in moles, of glucose that is burned.

(2 marks)

(iii) Calculate the enthalpy change of combustion of glucose.
Give your answer to three significant figures.

(2 marks)

(iv) The standard enthalpy change of combustion of glucose can also be determine indirectly.

Calculate the standard enthalpy change of combustion of glucose using the standard enthalpy changes of formation below.

substance	ΔH_f^{θ}/ kJ mol^{-1}
$C_6H_{12}O_6$ (s)	-1250
CO_2 (g)	-394
H_2O (l)	-286

$C_6H_{12}O_6$ (s) + 6 O_2 (g) → 6 CO_2 (g) + 6 H_2O (l)

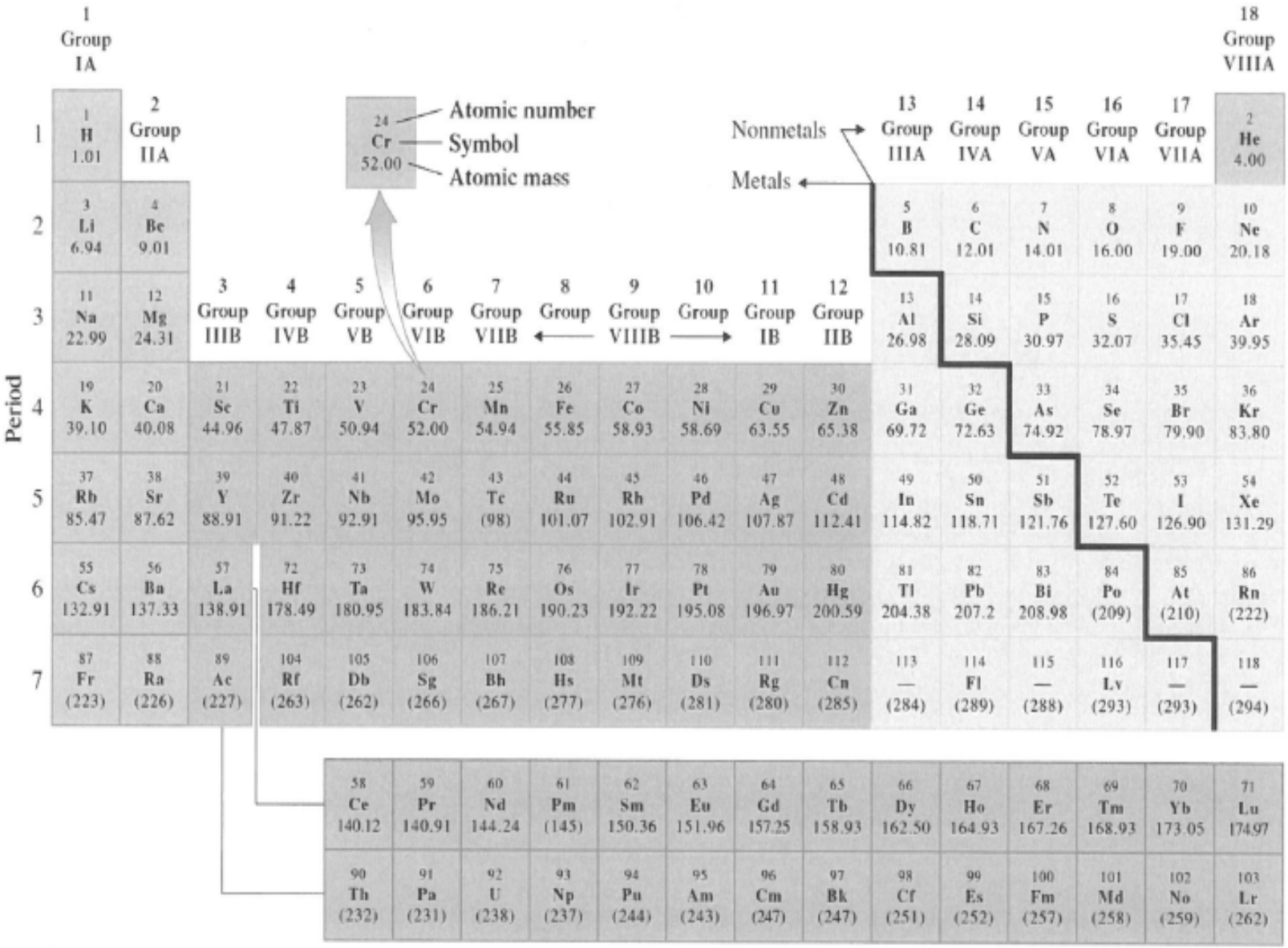
(3 marks)

(v) Suggest two reasons why standard enthalpy changes of combustion determined experimentally are less exothermic than calculated theoretical values.

(2 marks)

(TOTAL: 25 MARKS)

--THE END--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1 Group IA
2 Group IIA
3 Group IIIB
4 Group IVB
5 Group VB
6 Group VIB
7 Group VIIB
8 Group
9 Group VIIIB
10 Group
11 Group IB
12 Group IIB
13 Group IIIA
14 Group IVA
15 Group VA
16 Group VIA
17 Group VIIA
18 Group VIIIA
24 Cr 52.00
Atomic number
Symbol
Atomic mass
Nonmetals
Metals
1 H 1.01
2 He 4.00
3 Li 6.94
4 Be 9.01
5 B 10.81
6 C 12.01
7 N 14.01
8 O 16.00
9 F 19.00
10 Ne 20.18
11 Na 22.99
12 Mg 24.31
13 Al 26.98
14 Si 28.09
15 P 30.97
16 S 32.07
17 Cl 35.45
18 Ar 39.95
19 K 39.10
20 Ca 40.08
21 Sc 44.96
22 Ti 47.87
23 V 50.94
24 Cr 52.00
25 Mn 54.94
26 Fe 55.85
27 Co 58.93
28 Ni 58.69
29 Cu 63.55
30 Zn 65.38
31 Ga 69.72
32 Ge 72.63
33 As 74.92
34 Se 78.97
35 Br 79.90
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37 Rb 85.47
38 Sr 87.62
39 Y 88.91
40 Zr 91.22
41 Nb 92.91
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45 Rh 102.91
46 Pd 106.42
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49 In 114.82
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53 I 126.90
54 Xe 131.29
55 Cs 132.91
56 Ba 137.33
57 La 138.91
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73 Ta 180.95
74 W 183.84
75 Re 186.21
76 Os 190.23
77 Ir 192.22
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80 Hg 200.59
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105 Db (262)
106 Sg (266)
107 Bh (267)
108 Hs (277)
109 Mt (276)
110 Ds (281)
111 Rg (280)
112 Cn (285)
113 — (284)
114 Fl (289)
115 — (288)
116 Lv (293)
117 — (293)
118 — (294)
58 Ce 140.12
59 Pr 140.91
60 Nd 144.24
61 Pm (145)
62 Sm 150.36
63 Eu 151.96
64 Gd 157.25
65 Tb 158.93
66 Dy 162.50
67 Ho 164.93
68 Er 167.26
69 Tm 168.93
70 Yb 173.05
71 Lu 174.97
90 Th (232)
91 Pa (231)
92 U (238)
93 Np (237)
94 Pu (244)
95 Am (243)
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98 Cf (251)
99 Es (252)
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101 Md (258)
102 No (259)
103 Lr (262)