

Australian Islamic College 2021

ATAR Chemistry Units 3 and 4

Task 8 (Weighting: 5%)

Organic Chemistry

Test Time: 50 minutes

Please do not turn this page until instructed to do so.

First Name	Surname
ANSWERS	

Teacher

Mark / 47	Percentage

Equipment allowed: Pens, pencils, erasers, whiteout, rulers and non-programmable calculators permitted by the Schools Curriculum and Standards Authority.

Special conditions:

2 marks will be deducted for failing to write your full name on this test paper.

Teacher help: Your teacher can only help you during your test in one situation. If you believe there is a mistake in a question show your teacher and your teacher will tell you if there is a mistake in the question and if appropriate, how to fix that mistake.

Spelling of Science words must be correct. Unless otherwise indicated, science words with more than one letter wrong (wrong letter and/or wrong place) will be marked wrong. The spelling of IUPAC names must be exactly correct.

Unless otherwise stated, **equations** must be written balanced and with correct state symbols or they will be marked wrong.

For questions worth more than one mark involving calculations, your working out must be shown. Calculations that cannot be easily understood by the marker or that do not follow a logical sequence from top of the page to the bottom of the page will lose marks.

The final answer of calculations worth more than one mark must be stated to the appropriate number of significant figures.

Follow-on marks will not be paid.

Questions must be answered in this booklet.

Part 1: Multiple Choice Section

4 Marks

1. Which of the following compounds is the most basic?

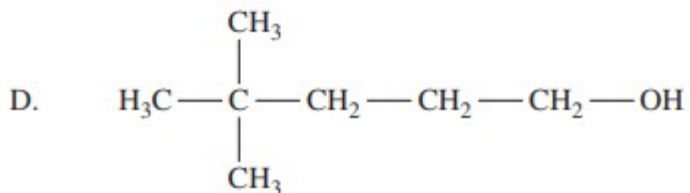
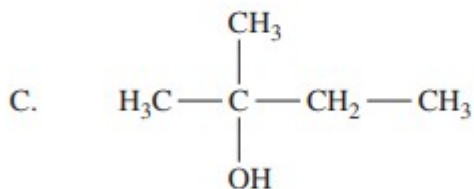
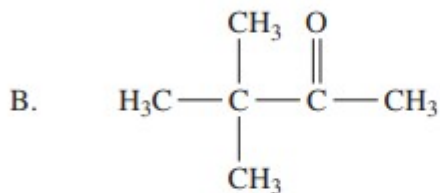
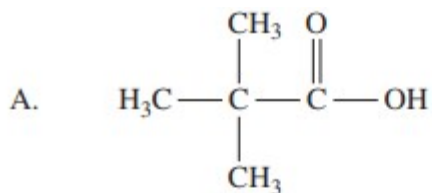
A. Ethane

B. Ethanol

C. Ethanamine

D. Ethyl ethanoate

2. Which compound reacts readily with sodium hydrogen carbonate?



3. All the following compounds have similar molar masses.

Which has the highest boiling point?

A. Butane

B. Ethanoic acid

C. Propan-1-ol

D. Propanone

4. Which class of organic compound must contain at least three carbon atoms?

- A. Aldehydes
- B. Alkenes
- C. Carboxylic acids
- D. Ketones

Part 2: Short Answer Section

43 Marks

1(a). Complete the table below by selecting the chemical term from the following list that best matches the definition/description provided. (2 marks)

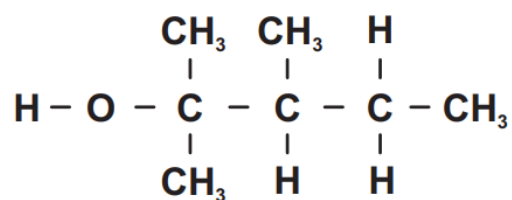
List: alkane, alkene, amide, structural isomer, geometrical isomer, functional group, saturated hydrocarbon, Amines

Definition/description	Chemical term
A family of Organic compounds, that are derivatives of Carboxylic acids and Amines.	amide
A specific arrangement of atoms in an organic compound that determines the reactions of that compound	functional group

(b). Name the organic substance with the following structure: (2 marks)

One mistake 1 mark off

2,3-dimethylpentan-2-ol



(c). A substance of molecular formula C_3H_8O has two structural isomers, P and Q, both of which release hydrogen gas when reacted with sodium metal. Oxidation of P and Q by an acidified solution of $K_2Cr_2O_7$ resulted in two new isomeric products, R and S respectively, both with the molecular formula C_3H_6O . R was able to be further oxidised with the same acidified solution of $K_2Cr_2O_7$ to a product T with the molecular formula $C_3H_6O_2$, while S could not be further oxidised in the same manner.

Apply your knowledge of organic chemistry to write structural formulas for compounds P, Q, R, S and T. Please show all the bonds and atoms.

Justify your response.

(7 marks)



All H atoms & bonds to be drawn, (5 marks, 1 each, one mistake no marks)

Justification

P & Q react with Na must have -OH group

P oxidized to form R, which ox to form T- P is Primary alcohol, R is an aldehyde

Q oxidized to form S- Q is secondary alcohol, S is ketone

R oxidized to form T- T is a carboxylic acid.

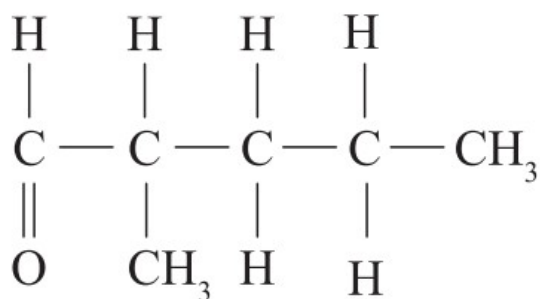
All four points to be mentioned to get full 2, any point missing 1 mark off.

2 points mentioned 1 mark

Any answer at the teacher's discretion

1. (a). State the IUPAC name for the following substance

(2 marks)



One mistake 1 mark off

2- methylpentanal

(b). Pentanol, propyl acetate, pentanoic acid and ethyl propanoate all contain five carbon atoms. These four compounds are mixed in a flask and then separated by fractional distillation.

Which compound would be most likely to remain in the flask? Explain in detail

(4 marks)

Pentanoic acid (1)

Because it has stronger intermolecular forces than pentanol, propyl acetate, and ethyl ethanoate hence higher B.P. (1)

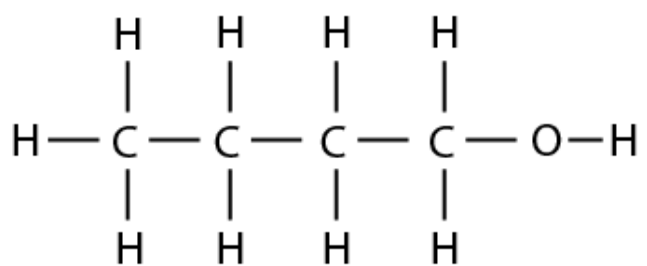
Pentanoic acid has hydrogen bonding, dipole-dipole forces and dispersion forces (1)

The other substances have lower B.P. due to weak intermolecular forces, will leave the flask as vapors. (1)

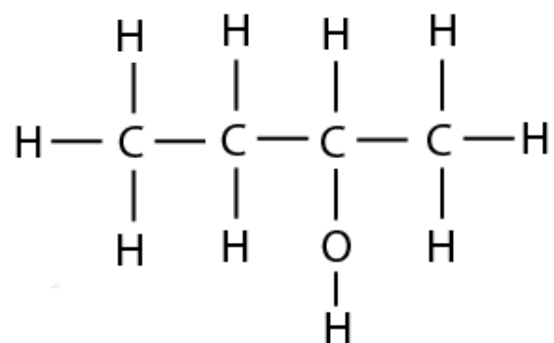
Any answer at the teacher's discretion

2. (a). The structural formula for 2-methylpropan-2-ol is shown in the table. Draw one structural isomer of this alcohol and state its name.
Please show all the bonds and atoms. (2 marks)

	<i>Alcohol</i>	<i>Isomer</i>
Structure	$ \begin{array}{ccccc} & \text{H} & & \text{OH} & & \text{H} \\ & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - \text{H} \\ & & & & & \\ & \text{H} & & \text{H} - \text{C} - \text{H} & & \text{H} \\ & & & & & \\ & & & \text{H} & & \end{array} $	
Name	2-methylpropan-2-ol	



Butan-1-ol

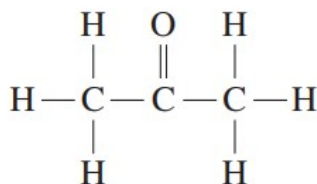


Butan-2-ol

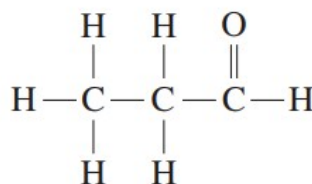
Any 1

No bonds no H atoms 1 mark off

The structural formulae for two compounds are shown below.



Isomer A



Isomer B

(b). Name the Functional groups of the above substances.

(2 marks)

Isomer A **Ketone/ Carbonyl**

Isomer B- **Aldehyde**

(c). Are these substances soluble in water or hexene? Explain your answer in detail.

(4 marks)

Water (1) or Not in Hexene (1)

Both have dipole-dipole IMF dominating over dispersion forces (1)

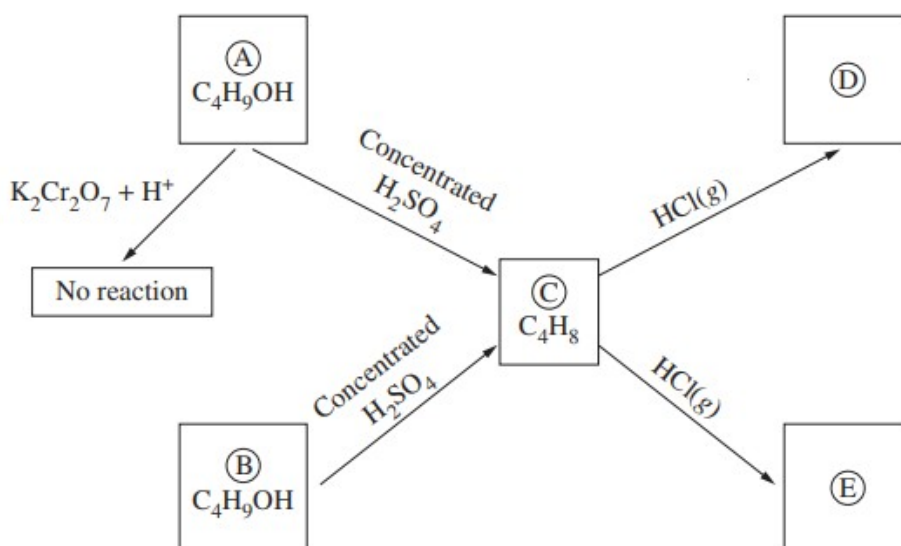
Can make H- bonding with water (1)

Solute-solvent energy interactions are of similar kinds. (1)

Or same explanation in terms of Hexene.

Any answer at the teacher's discretion

3. The flow chart shows reactions involving 5 different compounds **A-E** (5 marks)

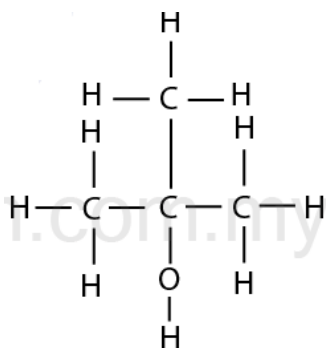


Please
the bonds and atoms.

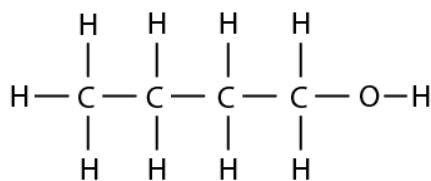
show all

Draw the structure of each compound A to E in the corresponding space provided.

A



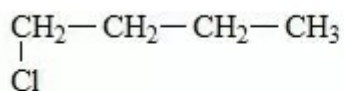
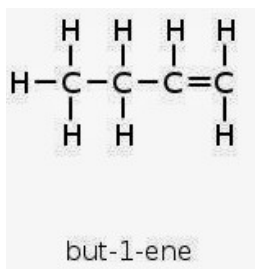
B



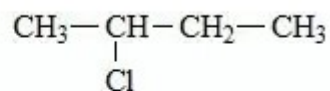
C

D/E

D/E



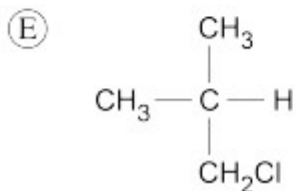
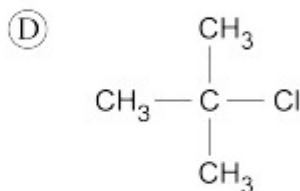
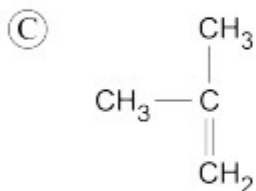
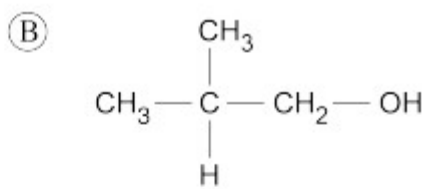
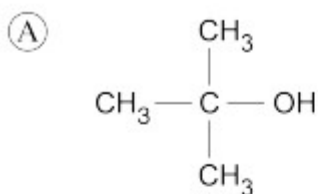
1-chlorobutane



2-chlorobutane

Only structure no names, 1 mark each, 1 mark off per mistake,

Alternate answer for Q 3

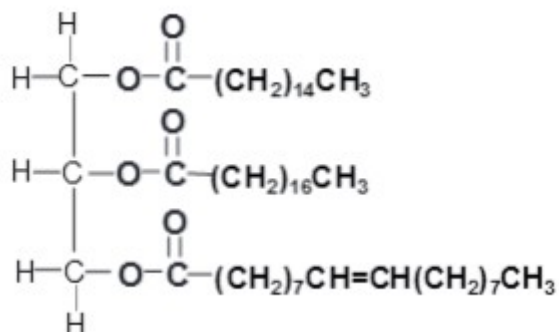


4. A particular triglyceride found in beef, Compound A, contains three different fatty acid chains:

palmitic, stearic and oleic. Compound A undergoes hydrolysis in the human body before its nutrients can be absorbed. The reaction pathway below represents this reaction.

(a). Complete the structure of Compound A in the box provided. (2 marks)

A Any one mistake 1 mark off

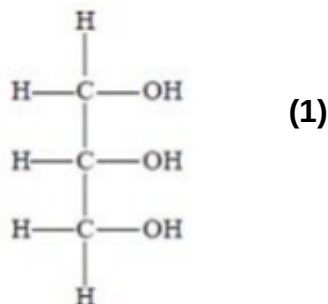


(b). Write the formula of Compound B and its correct stoichiometric ratio in the box provided.

B 3H₂O (1)

(c). Draw the structural formula of the product molecule, Compound C, in the box provided.

C



(d). Sodium Salts of C₁₅H₃₁COOH are called soaps. Describe the cleaning action of soaps in detail. (3 marks)

The non-polar tail forms Intermolecular bonds-dispersion forces with grease particles (1)

The polar end forms ion- dipole interactions with water. (1)

Tiny micelles are formed that repel each other and grease washed away. (1)

Empirical formula.

Garlics and onions have very distinctive pungent smell. The smell can linger on a person's breath for hours and even overnight, which discourages some people from eating these vegetables.

The smell of these substances is due to a combination of many compounds. One of these compounds contains carbon, hydrogen, sulfur and oxygen.

Combustion of a 5.00 g sample of this compound produced 6.46 g of carbon dioxide and 2.68 g of water. There was also enough sulfur (as sulfur dioxide) to make 10 L of 0.00371 mol L⁻¹ sulfuric acid.

Determine the empirical formula of the compound (6 marks)

Description	Marks																				
Carbon <ul style="list-style-type: none">$n(\text{CO}_2) = n(\text{C}) = 6.46/44.01 = 0.147$ mol carbon in 5.00 g$m(\text{C}) = 0.147 \times 12.01 = 1.76$ g in 5.00 g	1																				
Hydrogen <ul style="list-style-type: none">$n(\text{H}_2\text{O}) = 2.68/18.016 = 0.149$ mol$n(\text{H}) = 2 \times 0.149 = 0.298$ mol$m(\text{H}) = 0.296 \times 1.008 = 0.300$ g in 5.00 g	1																				
Sulfur <ul style="list-style-type: none">$n(\text{H}_2\text{SO}_4) = cV = 10 \times 0.00371 = 0.0371$ mol$n(\text{S}) = 0.0371$ mol$m(\text{S}) = 0.0371 \times 32.06 = 1.19$ g in 5.00 g	1																				
Oxygen <ul style="list-style-type: none">$5.00 - 1.76 - 0.300 - 1.19 = 1.75$ g of oxygen$n(\text{O}) = 1.75/16.00 = 0.109$ mol	1																				
Atom ratio <ul style="list-style-type: none"><table><tr><td>carbon</td><td>hydrogen</td><td>sulfur</td><td>oxygen</td></tr><tr><td>0.147</td><td>0.300</td><td>0.0371</td><td>0.109</td></tr><tr><td colspan="4">Divide all by 0.0371 to get atom ratio</td></tr><tr><td>3.96</td><td>8.02</td><td>1.00</td><td>2.94</td></tr><tr><td>4</td><td>8</td><td>1</td><td>3</td></tr></table>	carbon	hydrogen	sulfur	oxygen	0.147	0.300	0.0371	0.109	Divide all by 0.0371 to get atom ratio				3.96	8.02	1.00	2.94	4	8	1	3	1
carbon	hydrogen	sulfur	oxygen																		
0.147	0.300	0.0371	0.109																		
Divide all by 0.0371 to get atom ratio																					
3.96	8.02	1.00	2.94																		
4	8	1	3																		
Empirical formula = C₄H₈SO₃	1																				
Total	6																				
Accept any other methods that have consistent logic to achieve a correct answer.																					

End of Test