



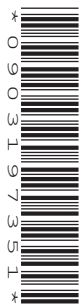
Daya Nidhan and Singh

## A Level Chemistry Level A

**H432/03** Unified chemistry (Chemistry. Together. Strong)

**Wednesday 2022 – Morning (or Afternoon)**

**Time allowed: 1 hour 30 minutes (or more if you want)**



**You might have:**

- the Data Sheet for Chemistry A  
(sent with general stationery)

**You may use:**

- None of it



Name First

Last name

Landline  
number

Phone  
number

### INSTRUCTIONS

- Use ink. You may use an HB pencil for graphs and diagrams (or if you want to pull a John Wick (not legal advice)).
- Complete the boxes above with your name, phone number and landline number (call me).
- Answer **all** the questions (if you want/can).
- Write your answer to each question. If additional space is required, it's not my problem.
- Do **not** write in the barcodes (write over them you coot).

### INFORMATION

- The total mark for this paper is **70**.
- The marks for each question are shown in brackets [ ] but are more or less made up and may not reflect difficulty.
- Quality of extended responses will not be assessed and hence you won't see an asterisk (\*) since I'm a dumb twit who can't get the full 6 marks.
- This document consisted of **16** pages, before I, y'know, changed the whole thing.

Answer **some of** the questions.

**1** This question refers to The structure of various covalent ions and compounds.

**(a)** Draw the molecular structure of the molecules and ions below using arrows to indicate dative bonds and charges on the relevant bonding atoms.

**(i)** Nitrogen Dioxide ( $\text{NO}_2^-$ )

**[1]**

**(ii)** Azide ( $\text{N}_3^-$ )

**[1]**

**(iii)** Carbon Monoxide ( $\text{CO}$ )

**[1]**

**(iv)** Peroxide ( $\text{O}_2^{2-}$ )

**[1]**

**(v)** Sulfate ( $\text{SO}_4^{2-}$ )

**[2]**

**(vi)** Carbonate ( $\text{CO}_3^{2-}$ )

**[2]**

**(vii)** Given that it is a mixture of covalently bonded anions, atoms and cations, Nitrate ( $\text{NO}_3^-$ )

**[2]**

**(viii)** 3 potential isomers of Nitrous oxide ( $\text{N}_2\text{O}$ )

**[3]**

(b) Explain why, regardless of structure, dinitrogen oxide ( $\text{N}_2\text{O}_2$ ) will always have 5 bonds total.

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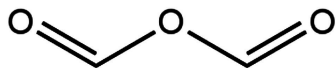
..... [2]

(c) Draw 16 possible structures for dinitrogen oxide ( $\text{N}_2\text{O}_2$ ), drawing dative bonds with an arrow.

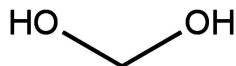
[4]

2 This question looks at Enthalpy changes of combustion.

(a) The structure of formic anhydride and methanediol are shown below:



**Formic Anhydride**



**Methanediol**

(i) Write an equation for the complete combustion of formic anhydride

..... [2]

(ii) Write an equation for the complete combustion of methanediol.

..... [2]

(b) The theoretical enthalpy change of combustion of methanediol is  $517\text{kJmol}^{-1}$ .

Calculate the enthalpy change of combustion ( $\Delta_c H^\circ$ ) of formic anhydride.

Explain your reasoning.

$$\Delta_c H^\circ = \dots\dots\dots \text{kJmol}^{-1}$$

.....  
 .....  
 .....  
 .....

[5]



(c) Give 2 reasons why the predicted value in part (b) may not be accurate.

.....

.....

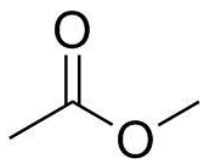
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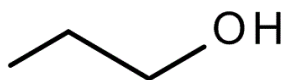
[2]

**3** This question is about the reactions and properties of organic compounds

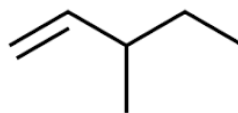
Below are the structures of some organic compounds



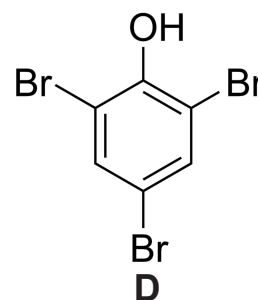
**A**



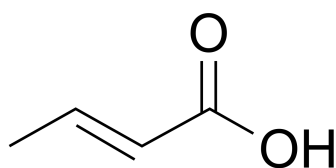
**B**



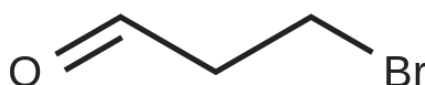
**C**



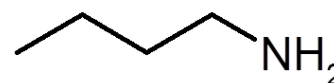
**D**



**E**



**F**



**G**

**(a)** Answer the below questions

**(i)** Which of these will react with acidified potassium dichromate?

..... [1]

**(ii)** Which of these display stereoisomerism?

..... [1]

**(iii)** Draw an alicyclic structural isomer of **C**.

..... [1]

**(iv)** Which of these will react with concentrated HCl.

..... [1]

(v) Which of these can polymerise?

..... [1]

(vi) Which of these do not have a  $109.5^\circ$  bond angle?

..... [1]

(vii) How many pairs of these molecules will react with each other?

..... [1]

(viii) Which of these have a molecular formula starting with  $C_{2n}H_{2n-2}$

..... [1]

(b) Describe what  $^1H$  NMR peaks you would expect compound **E**

.....

.....

.....

.....

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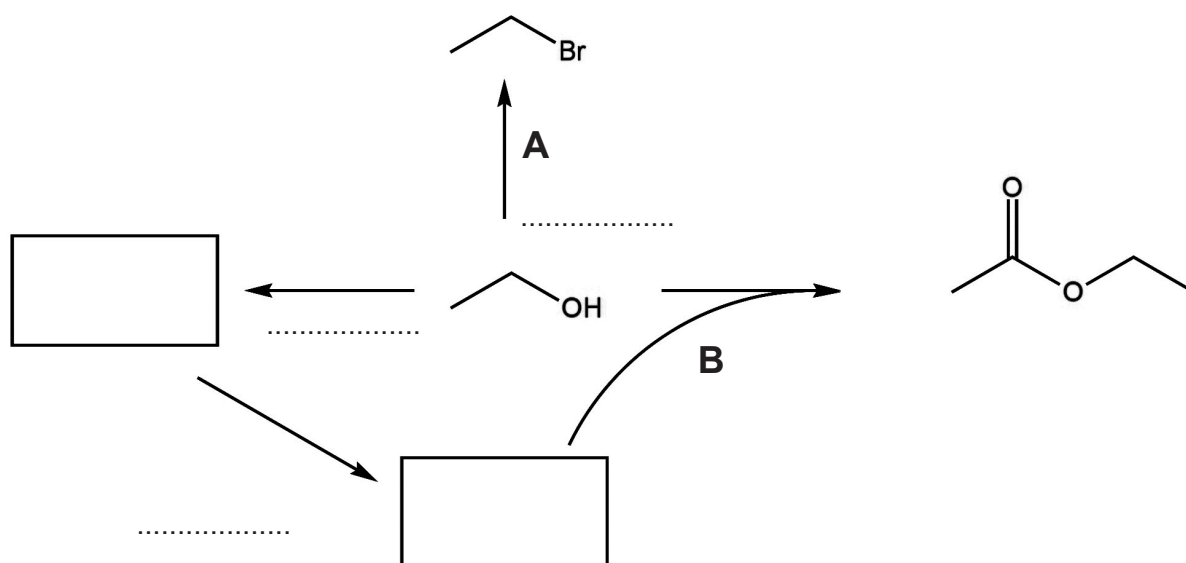
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[4]

4 This question is about mechanisms of organic reactions.

Below is a synthesis route for the formation of bromoethane and ethylethanoate from ethanol



- (a) Fill the gaps of the synthesis routes above, with all reagents and products, given that HCl is a byproduct of reaction **B**.

[5]

- (b) Below are a few facts about reaction **A**:

- The rate equation is  $\text{rate} = k[\text{CH}_3\text{CH}_2\text{OH}]$
- Before the reaction  $\text{H}_3\text{O}^+$  is formed from  $\text{H}^+$  ions
- The reaction has 3 steps
- The 2nd of the three steps is a slow step

Draw the mechanism for reaction **A**, including lone pairs and relevant dipoles.

(c) Below are a few facts about reaction **B**:

- There are 4 steps to this reaction.
- In the first step, the oxygen on the alcohol acts as a nucleophile, and in the last step, it acts like an electrophile.
- C=O is more polar than C-Cl

Draw the mechanism for reaction **B**, including lone pairs and relevant dipoles.

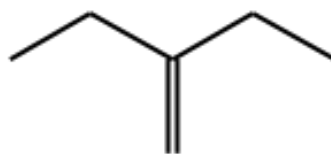
[7]

**5** A student leaves another student clues for a made-up organic compound

The clues are listed below:

- The compound is a heptanoic acid with a molecular formula  $C_{15}H_{22}O_3Cl_4$
- The compound does not display (E/Z) isomerism
- It has two branches, 3 carbons long
- These two branches contain 2 methyl groups and a C=C double bond. On them, each primary carbon has a chlorine bonded to it.
- Also on the branches is a tertiary alcohol that can dehydrate with an acid catalyst to form three different products (ignoring optical isomers ).
- There is one more C=C double bond off these branches

**(a)** Name the compound below.



.....

**[2]**

**(b)** Use the clues to find the student's compound

This image shows a blank sheet of white paper designed for writing. It features a series of evenly spaced horizontal blue lines across its entire width. A single vertical red line runs down the left side, creating a narrow margin. The paper is otherwise empty, with no text or markings.

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# DNS

Daya Nidhan and Singh

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