NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2021

TECHNICAL SCIENCES: PAPER II

Time: 1,5 hours 75 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 6 pages and a Data Sheet of 4 pages (i–iv). Please check that your question paper is complete.
2. This paper consists of 7 questions. Answer ALL the questions in the Answer Book.
3. Start each question on a new page in your Answer Book.
4. Number your answers exactly as the questions are numbered.
5. Leave ONE line open between sub-questions, e.g. between QUESTION 2.2 and QUESTION 2.3.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEET.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a MINIMUM of TWO decimal places.
11. Give brief motivations, discussions, etc. where required.
12. Read the questions carefully.
13. Do not write in the margin.
14. It is in your own interest to write legibly and to present your work neatly.

QUESTION 1

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Choose the correct answer and only write A, B, C or D next to the question number (1.1–1.5) in your Answer Book.

1.1 4-Chlorobut-1-ene is the name of which one of the following alkenes?

A $CH_2Cl\text{-}CH_2\text{=}CH\text{-}CH_2$
B $CH_2Cl\text{-}CH_2\text{-}CH\text{-}CH_2$
C $CH_2Cl\text{=}CH_2\text{-}CH\text{=}CH_2$
D $CH_2Cl\text{-}CH_2\text{-}CH\text{=}CH_2$ (2)

1.2 Identify the one that is not an organic addition reaction.

A Hydration
B Dehydration
C Halogenation
D Hydrohalogenation (2)

1.3 Which one of the following is the product that forms when ethene reacts with bromide?

A $BrH_2C\text{-}CH_2Br$
B $BrH_2C\text{=}CH_2Br$
C $Br_2HC\text{=}CHBr_2$
D $Br_2HC\text{-}CHBr_2$ (2)

1.4 In these incomplete half reactions, which reactant is an oxidising agent?

$Ag(s) \rightarrow Ag^+(aq)$
$Cl^-(aq) \rightarrow Cl_2(g)$
$Sn^{2+}(aq) \rightarrow Sn^{4+}(aq)$
$Fe^{3+}(aq) \rightarrow Fe^{2+}(aq)$

A Ag(s)
B $Cl^-(aq)$
C $Sn^{2+}(aq)$
D $Fe^{3+}(aq)$ (2)

1.5 Three beakers contain copper chloride ($CuCl_2$) of an equal concentration. A piece of metal is placed in each of the beakers.

Beaker	Solution	Metal
1	$CuCl_2$	zinc
2	$CuCl_2$	silver
3	$CuCl_2$	nickel

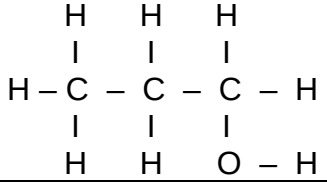
Reactions occur in:

A Beaker 2 only
B Beakers 1, 2 and 3
C Beakers 1 and 2 only
D Beakers 1 and 3 only (2)

[10]

QUESTION 2 (Start on a new page)

Use the table below to answer the following questions.

A	2-Methyl Propane	B	
C	$CH_3CH_2CH_2COOH$	D	But-2-ene
E	C_2H_2	F	Ethyl butanoate

2.1 Define an unsaturated compound. (2)

2.2 Give the letter(s) from the table that represent(s) unsaturated compounds. (2)

2.3 To which homologous series does C belong? (1)

2.4 Give the IUPAC name for:

2.4.1 B (2)

2.4.2 C (2)

2.5 Draw the structural formula of:

2.5.1 A (2)

2.5.2 F (2)

2.6 2.6.1 Name the reaction when compound A reacts with Br_2. (1)

2.6.2 Using STRUCTURAL FORMULAE, write down a balanced equation for this reaction. (3)

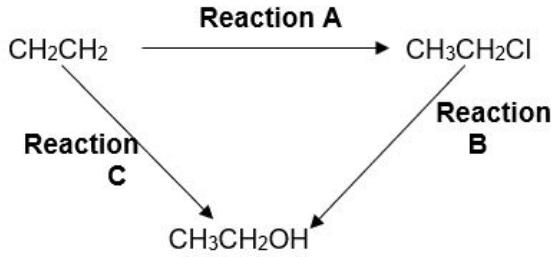
2.7 Define the term *positional isomer*. (2)

2.8 Draw a positional isomer of compound B. (2)

[21]

QUESTION 3 (Start on a new page)

The flow diagram below indicates processes preparing different alcohols. Use the given information to answer the questions.



3.1 Name the substance added to the CH_2CH_2 in reaction A to form CH_3CH_2Cl. (1)

3.2 Name one condition for this reaction to take place. (1)

3.3 Which substance must be in excess in reaction C so that CH_3CH_2OH can be formed and what do we call the process taking place? (2)

3.4 Use structural formulae to write a balanced equation for the reaction taking place in reaction C. (3)

3.5 Which base can we add to the haloalkane to form ethanol as in the diagram above? (1)

3.6 Would the reaction in Question 3.5 be an addition or a substitution reaction? (1)

[9]

QUESTION 4 (Start on a new page)

Ethanol fuel is Ethyl alcohol and the same type of alcohol found in alcoholic beverages. It is mostly used as motor fuel and is also used in rocket fuel in bipropellant rockets.

Different alcohols have different boiling points. Study the boiling points given in the following table and answer the questions that follow.

Organic Compound	**Boiling Point**
Ethanol	78,37 °C
Methanol	66 °C
Butan-1-ol	117,4 °C

4.1 Explain the term *boiling point.* (2)

4.2 Explain why the boiling point of butan-1-ol is so much higher than the boiling point of methanol. (2)

4.3 The boiling point of butane is –1 °C. Explain why the boiling point of butane is so much lower than that of butan-1-ol. (2)

4.4 Which of the compounds, butanal or butan-1-ol, will have the highest viscosity. Give a reason for your answer. (2)

[8]

QUESTION 5 (Start on a new page)

5.1 Define the term *monomer*. (2)

5.2 Give two uses of low-density polythene. (2)
[4]

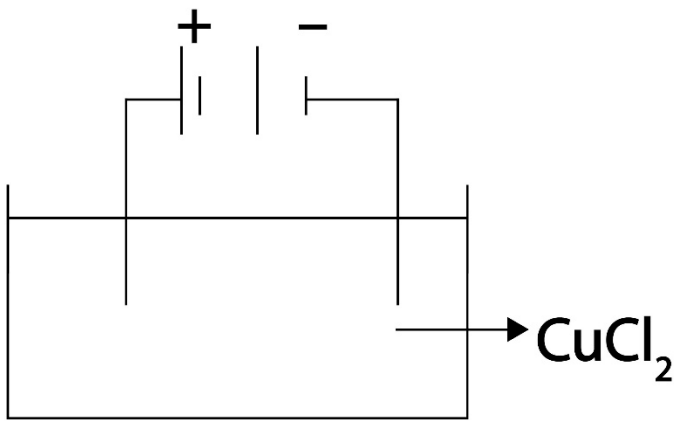
QUESTION 6 (Start on a new page)

Electrolysis is widely used in the manufacturing business. Electrolysis can even be used to clean rusty objects.

A similar experiment was done in class.

Two electrodes were placed into a solution of copper(II)chloride and were then connected to a cell.

The sketch below illustrates this experiment.



6.1 What energy transfer takes place in this electrolytic cell? (1)

6.2 What are the electrodes made of? Give a reason why this substance can be used as electrodes. (2)

6.3 Define the term *oxidation.* (2)

6.4 6.4.1 At which electrode in this electrolytic cell does oxidation take place, at the positive or the negative electrode? (1)

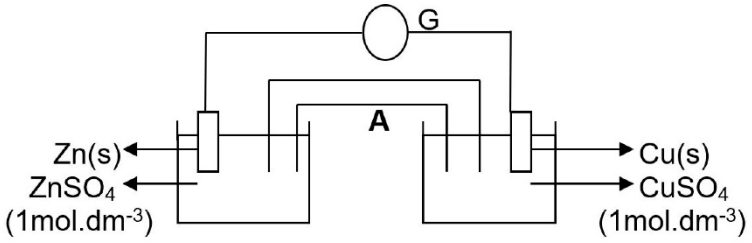
6.4.2 What will you see at this electrode, identified in Question 6.4.1, to physically prove this? (1)

6.4.3 Give a balanced half reaction to support your answer. (1)

6.5 If you allow this experiment to continue for a long time, describe what colour change will take place in the solution. Explain why this happens. (2)
[10]

QUESTION 7 (Start on a new page)

Consider the sketch below.



7.1 Name this type of cell. (1)

7.2 What do we call the object at A in the sketch? Name one function of this object. (2)

7.3 Is Zn or Cu the anode of this cell? Does oxidation or reduction take place there? (2)

7.4 Use the Table of Standard Electrode Potentials to determine the E^{θ} of this cell. (3)

7.5 Use your answer to Question 7.4 to predict whether this reaction will take place spontaneously or not. (1)

7.6 Write the standard cell notation for this cell. (2)

7.7 Name one characteristic of alternative energy. (1)

7.8 Give one example of alternative energy. (1)

[13]

Total: 75 marks