

TECHNICAL SCIENCES: PAPER II

Time: 1½ hours

75 marks

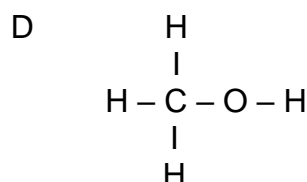
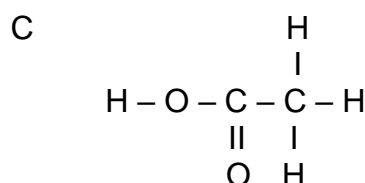
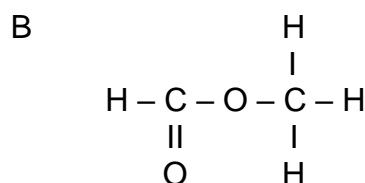
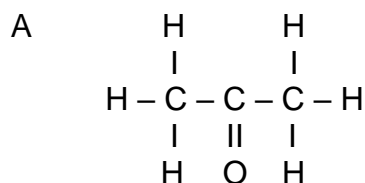
PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 7 pages and a Data Sheet of 4 pages (i–iv). Please check that your question paper is complete.
 2. This paper consists of 6 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.
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QUESTION 1

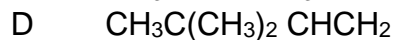
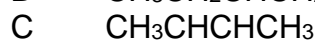
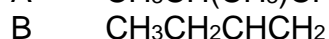
Four possible answers are given to the following questions. Each question has only ONE correct answer. Choose the correct answer and write only the letter A, B, C or D next to the question number (1.1–1.5) in your Answer Book.

1.1 Which ONE of the following compounds represents a ketone?



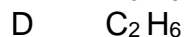
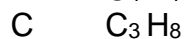
(2)

1.2 Which ONE of the following compounds is SATURATED?



(2)

1.3 Which ONE of the following compounds has the lowest boiling point?



(2)

1.4 In a redox reaction, a reducing agent always:

A undergoes reduction

B gains electrons

C loses electrons

D undergoes a decrease in oxidation number

(2)

1.5 Which ONE of the following statements regarding the anode of a standard galvanic cell in operation is correct?

- A The anode accepts electrons.
- B The mass of the anode decreases.
- C The concentration of the electrolyte in the half-cell containing the anode initially decreases.
- D The anode is the positive terminal of the cell.

(2)
[10]

QUESTION 2 (Start on a new page)

The letters **A** to **F** represent six organic compounds

A	$\text{H}_2\text{C} = \text{CH} - \text{CH}_2 - \text{CH}_3$	B	Buthyl ethanoate
C	2-chloro-2-methylpropane	D	$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$
E	$ \begin{array}{ccccc} & \text{H} & & \text{O} & & \text{H} \\ & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - \text{H} \\ & & & & & \\ & \text{H} & & & & \text{H} \end{array} $	F	$ \begin{array}{ccccccc} & & & \text{CH}_3 & & \text{O} - \text{H} \\ & & & & & \\ \text{CH}_3 & \text{CH} & \text{CH} & - & \text{CH} & - & \text{C} & - \text{H} \\ & & & & & \\ & \text{CH}_3 & & & & \text{H} \end{array} $

2.1 Write down the letter that represents the following:

2.1.1 An alcohol (1)

2.1.2 A carboxylic acid (1)

2.2 Give the IUPAC name for the following:

2.2.1 E (2)

2.2.2 F (3)

2.3 Write down the structural formula of compound C. (3)

2.4 Write down the homologous series to which compound B belongs. (1)

2.5 When compound A reacts with Cl_2 a new compound is formed.

2.5.1 What type of reaction takes place? (1)

2.5.2 Write the structural representation of the reaction. (3)
[15]

QUESTION 3 (Start on a new page)

Five alcohols represented by the letters A–E are listed in the table below:

A	Methanol
B	Ethanol
C	Propan-1-ol
D	Butan-2-ol
E	2-methylpropan-2-ol

3.1 The letter E represents 2-methylpropan-2-ol. For this alcohol, write down the following:

3.1.1 The structural formula. (2)

3.1.2 The LETTER in the table that represents one of its structural isomers. (1)

3.2 3.2.1 Name the substance that must be added to the alcohol represented by the letter D to form 2-bromo-butane. (1)

3.2.2 What type of reaction takes place in Question 3.2.1? (1)

3.3 Viscosity is a measure of a fluid's resistance to flow. Learners conduct an investigation to compare the viscosities of the first three alcohols (A–C) in the table above. They use a pipet to measure a fixed volume of each of the alcohols. The alcohol is then dripped into a glass beaker. The learners use a stopwatch to measure the time it takes a fixed volume of each of the alcohols (A–C) to drip into the beaker. They record this flow time, which is an indication of the viscosity of each alcohol, as given in the table below.

	Alcohol	Flow time(s)
A	Methanol	4,0
B	Ethanol	7,9
C	Propan-1-ol	14,3

3.3.1 Formulate an investigative question for this investigation. (1)

3.3.2 Which ONE of the alcohols (A, B or C) has the highest viscosity? Use the data in the table to give a reason for your answer. (2)

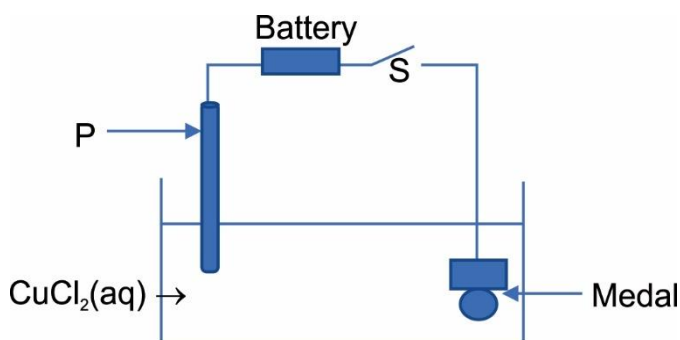
3.3.3 Refer to the intermolecular forces of the three alcohols (A, B and C) to explain the trend in viscosities as shown in the table. (2)

3.3.4 Lubricants reduce friction. Which one of alcohols A, B or C, will be the best lubricant? (1)

- 3.4 Which ONE of 2-methylpropan-2-ol and butan-2-ol has the highest viscosity? (1)
- 3.5 Refer to intermolecular forces to explain the answer to Question 3.4. (2)
- 3.6 Low-density polythene (LDPE) can be regarded as plastic.
- 3.6.1 Give the definition of a *plastic*. (1)
- 3.6.2 Give one use of LDPE. (1)
- [16]**

QUESTION 4 (Start on a new page)

The diagram below represents a cell that can be used to electroplate a tin medal with a thin layer of copper to improve its appearance.



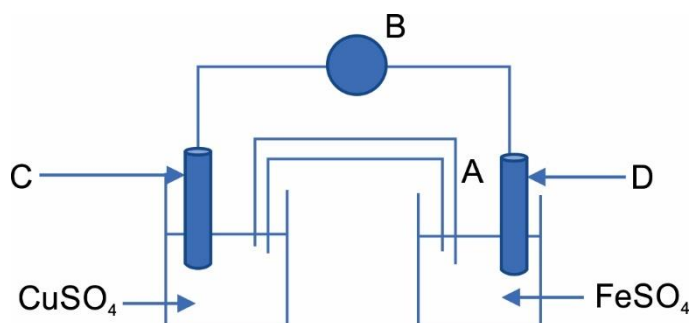
- 4.1 Name the type of electrochemical cell used in this procedure. (1)
- 4.2 Give the energy change that takes place in this cell. (1)
- 4.3 Which ONE of **P** or the **MEDAL** is the anode in this cell? (1)
- 4.4 Give the definition of *oxidation*. (2)
- 4.5 Switch S is now closed. Write down the visible changes that will occur at the medal. (1)
- 4.6 Write down the equation for the half-reaction to support the answer to Question 4.5. (2)
- 4.7 Is the reaction at Question 4.6 the oxidation or the reduction half-reaction? (1)
- 4.8 How will the concentration of the electrolyte change during the electroplating process? Write down only INCREASE, DECREASE or REMAINS THE SAME. (1)
- 4.9 Give a physical change in the electrolyte that will support your answer to Question 4.8. (1)
- 4.10 You want to coat the medal with silver instead of copper. State ONE change that you will make to the above cell to obtain a medal coated with silver. (1)

[12]

QUESTION 5 (Start on a new page)

Galvanic cells are used in everyday batteries. There are two types of batteries, primary or disposable batteries which cannot be recharged and secondary batteries which can be recharged.

The following diagram shows an Iron(Fe), Copper(Cu) galvanic cell. Use the diagram to answer the following questions.

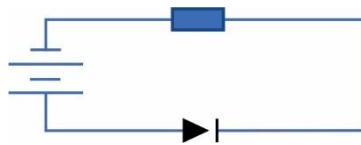


- 5.1 Name the apparatus used at A. (1)
- 5.2 Give the NAME or FORMULA of a compound that can be used in apparatus A. Give a reason why you would use that particular compound. (2)
- 5.3 Name the apparatus at B. (1)
- 5.4 What metal would be used as an electrode at electrode C? (1)
- 5.5 Name one standard condition for this cell. (1)
- 5.6 Write down the cell notation for this cell. (2)
- 5.7 Use the table of Standard Reduction Potentials to determine the EMF of the cell at standard conditions. (3)
- 5.8 Will this reaction take place spontaneously or not? Give a reason for your answer. (2)
- 5.9 Fuel cells can be used as a form of alternative energy. Give two other forms of alternative energy. (2)

[15]

QUESTION 6 (Start on a new page)

- 6.1 Define a *semi-conductor*. (2)
- 6.2 Name the process of adding impurities to intrinsic semiconductors. (1)
- 6.3 If an impurity such as Antimony, a pentavalent material, is added to Germanium, a tetravalent material, what kind of semiconductor will be formed? (1)
- 6.4 Explain what the depletion area is in a p–n junction diode. (1)
- 6.5 Explain what will happen to the depletion area if the positive terminal is connected to the n-type material and the negative terminal is connected to the p-type material in a p–n junction diode. (1)
- 6.6 Study the diagram below and determine whether the diode is forward-biased or reverse-biased.



(1)
[7]

Total: 75 marks