

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Write down the question number (1.1–1.10) on the ANSWER SHEET attached to the question paper, choose the answer and make a cross (X) over the letter (A–D) of your choice.

EXAMPLE:

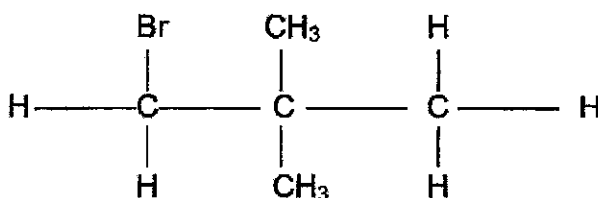
1.11	A	B	C	D
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1.1 To which homologous series does the molecule C_8H_{14} belong?

- A Alkanes
- B Alkenes
- C Alkynes
- D Alcohols

(2)

1.2 Consider the following compound:

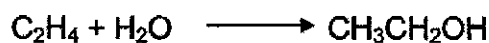


The IUPAC name for this compound is ...

- A 1-bromo-2,2-dimethylpropane
- B 3-bromo-2,2-dimethylpropane
- C 2,2-dimethyl-3-bromopropane
- D 2,2-dimethyl-1-bromopropane

(2)

1.3 Consider the following reaction:

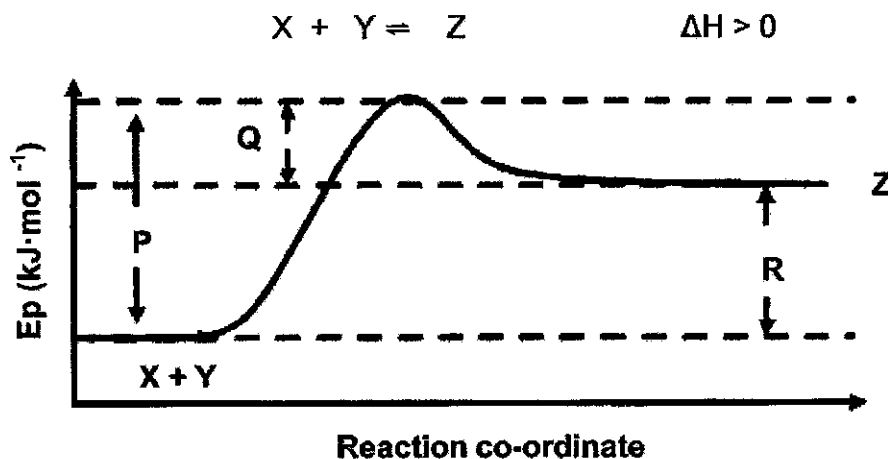


What type of reaction is illustrated in the above equation?

- A substitution
- B hydration
- C hydrolysis
- D dehydration

(2)

- 1.4 The graph represents the changes in potential energy occurring during the reaction:



The heat of reaction for the reverse reaction is represented by the interval:

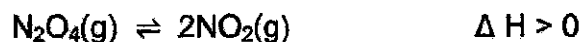
- A P
 B Q
 C R
 D Q + R (2)
- 1.5 The combustion of butane is represented by the following equation:



The number of moles of C_4H_{10} required to react with 18 moles of oxygen will be ...

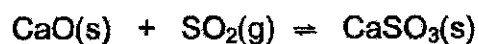
- A 2,8 mol
 B 1,4 mol
 C 2,9 mol
 D 2,6 mol (2)

- 1.6 An equilibrium reaction in a closed container is represented by the following equation:



Which ONE of the following changes will affect both the value of K_c and the concentration of $\text{NO}_2(\text{g})$?

- A Increasing the pressure at a constant temperature
 - B Adding a suitable catalyst
 - C Increasing the temperature
 - D Increasing the mass of $\text{N}_2\text{O}_4(\text{g})$ (2)
- 1.7 Consider the equation below:



If the equilibrium concentration of $\text{SO}_2(\text{g})$ at $25\text{ }^\circ\text{C}$ is equal to $0,2\text{ mol}\cdot\text{dm}^{-3}$, the value of the equilibrium constant at this temperature will be:

- A 5
 - B 0,2
 - C 0,4
 - D 2,5 (2)
- 1.8 Ethanoic acid is added to a sodium chloride solution. The pH of the resulting solution will ...
- A increase.
 - B decrease.
 - C stay the same.
 - D neutralise. (2)

- 1.9 A standard electrochemical cell is based on the following hypothetical half-reactions:



Which ONE of the following will be the strongest reducing agent?

A Q

B R

C R^{2+}

D Q^{3-}

(2)

- 1.10 Which ONE of the following processes best describes the industrial preparation of sulphuric acid?

A Haber

B Fractional distillation

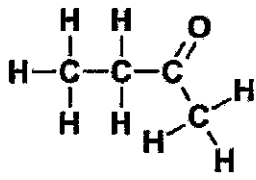
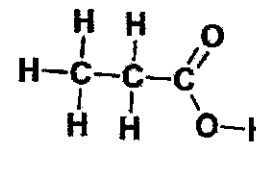
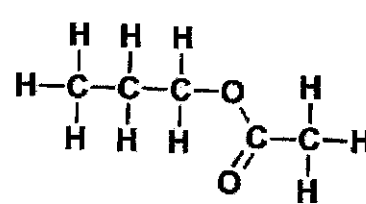
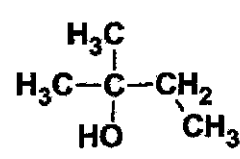
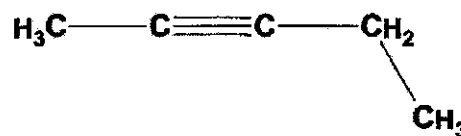
C Ostwald

D Contact

(2)
[20]

QUESTION 2 (Start on a new page.)

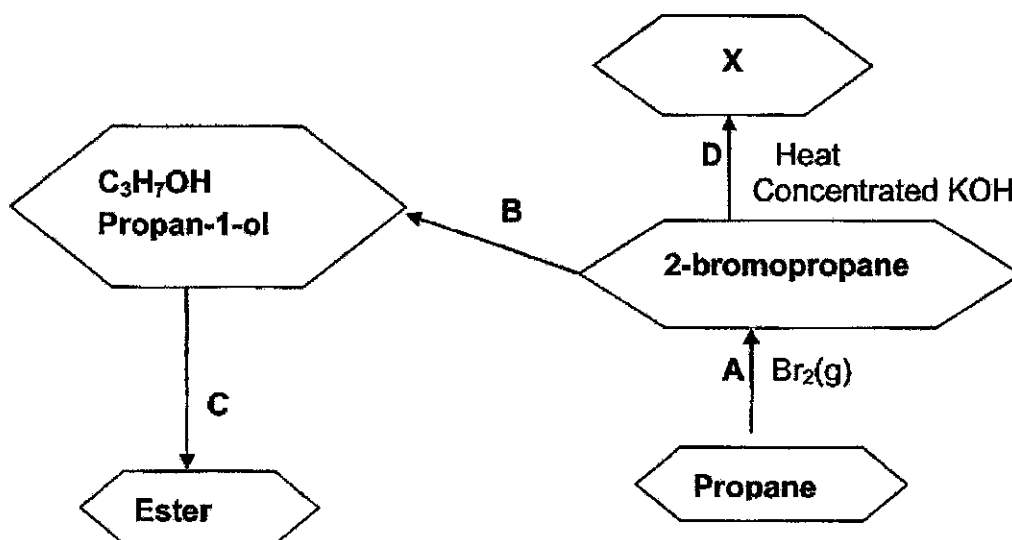
The letters A to F in the table below represents six organic compounds.

<p>A</p> 	<p>B</p> 
<p>C</p> 	<p>D</p> 
<p>E</p> 	<p>F Butane</p>

- 2.1 Write down the LETTER representing the compound which:
- 2.1.1 Has the general formula C_nH_{2n-2} (1)
 - 2.1.2 Is a gas used in cigarette lighters (1)
 - 2.1.3 Has a carboxyl group as a functional group (1)
 - 2.1.4 Is an alcohol (1)
- 2.2 Write down the IUPAC name of the positional isomer of compound A. (2)
- 2.3 Consider compound C:
- 2.3.1 Write down its IUPAC name. (2)
 - 2.3.2 Draw the STRUCTURAL FORMULA of the alcohol needed to prepare C. (2)
- [10]**

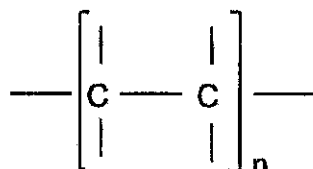
QUESTION 3 (Start on a new page.)

The flow diagram below shows four organic reactions. The letter X represents an organic compound.



- 3.1 Name the type of reactions illustrated by each of ...
- 3.1.1 **A**
- 3.1.2 **B**
- 3.1.3 **C** (3)
- 3.2 Use CONDENSED structural formulae to write down a balanced chemical equation for reaction D. (3)
- 3.3 A 5-carbon ester is formed in reaction C.
- 3.3.1 Write down the IUPAC name of the carboxylic acid needed. (2)
- 3.3.2 Use STRUCTURAL FORMULAE to write down a balanced chemical equation for the reaction in QUESTION 3.3. (5)
- 3.4 For reaction A write down the:
- 3.4.1 Reaction condition for the reaction (1)
- 3.4.2 NAME of the inorganic product that forms (1)

3.5 The structure of an addition polymer is given below:



3.5.1 Define the term *addition polymer*. (2)

3.5.2 Write down the STRUCTURAL FORMULA of the monomer of the given polymer. (2)

[19]

QUESTION 4 (Start on a new page.)

Factors that affect vapour pressure are investigated. The vapour pressure of compounds **A**, **B**, **C** and **D** from two different homologous series are determined and shown in the table below.

COMPOUND		VAPOUR PRESSURE (kPa)	MOLECULAR MASS (g·mol ⁻¹)
A	Propane	853,16	44
B	Butane	112	58
C	Propan-1-ol	2,4	60
D	Butan-1-ol	0,1	74

4.1 Define the term *homologous series*. (2)

4.2 Write down the homologous series to which compound **C** belongs. (1)

4.3 In one investigation the vapour pressures of compound **C** and **D** are compared. Write down the ...

4.3.1 independent variable. (1)

4.3.2 dependent variable. (1)

4.3.3 conclusion that can be drawn. (2)

4.4 Refer to the TYPE and the STRENGTH of intermolecular forces to explain the differences in vapour pressure of butane and butan-1-ol. (4)

4.5 Which ONE of the compounds **A**, **B**, **C** or **D** has the highest boiling point? Explain your answer. (3)

[14]

QUESTION 5 (Start on a new page.)

An excess diluted $\text{HCl}(\text{aq})$ is used to dissolve 5 g of $\text{CaCO}_3(\text{s})$ in a beaker during an experiment on reaction rate. The following reaction takes place:



The results obtained are summarised in the table below:

Mass of beaker, HCl and $\text{CaCO}_3(\text{s})$	62,0	61,2	60,6	60,2	60,0	60,0
Time (s)	0	10	20	30	40	50

- 5.1 Give a reason why the mass of the beaker with its contents decreased in the first 30 s. (1)
- 5.2 How long did it take to use up all the $\text{CaCO}_3(\text{s})$ in this experiment? Explain how you arrived at the answer. (2)
- 5.3 Calculate the volume of $\text{CO}_2(\text{g})$ produced at STP. (6)
- 5.4 When the diluted $\text{HCl}(\text{aq})$ is replaced by concentrated $\text{HCl}(\text{aq})$, the rate of the reaction increases. Use the collision theory to explain this observation. (3)
- [12]**

QUESTION 6 (Start on a new page.)

The Haber process is represented by the following equation:



In a small scale plant, x moles of $\text{N}_2(\text{g})$ and 8 moles of $\text{H}_2(\text{g})$ are added in a 5 dm^3 sealed container. When equilibrium is reached at temperature T_1 , it is found that 25,5 g of $\text{NH}_3(\text{g})$ is present.

- 6.1 Define the term *chemical equilibrium*. (2)
- 6.2 If the K_c value for this reaction is 0,13, calculate the initial number of moles of $\text{N}_2(\text{g})$. (9)
- 6.3 How will the equilibrium concentration of the product compare with that of the reactants? Choose from LARGER THAN, SMALLER THAN or EQUAL TO. Refer to the provided K_c value in QUESTION 6.2 to give a reason for the answer. (2)
- 6.4 A new equilibrium is now established at a higher temperature T_2 . Will the value of the equilibrium constant (K_c) INCREASE, DECREASE or STAY THE SAME? (4)
Use Le Chatelier's principle to explain the answer. (4)
- [17]**

QUESTION 7 (Start on a new page.)

7.1 The hydrogen phosphate ion (HPO_4^{2-}) can act as an ampholyte.

7.1.1 Define the term *ampholyte*. (2)

7.1.2 Consider the following reaction:



Is the HPO_4^{2-} ion in this reaction acting as a Brønsted-Lowry acid or a base? Give a reason for the answer. (2)

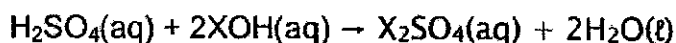
7.1.3 Write down the FORMULA of the substance which forms a conjugate acid-base pair with the HPO_4^{2-} ion. (1)

7.2 A container holds an unknown solution. On the label is written: pH = 13,3.

7.2.1 Is the solution acidic, basic or neutral? (1)

7.2.2 Determine the concentration of the hydroxide ions (OH^-) in the solution. (5)

7.2.3 Exactly 25 cm^3 of the solution in QUESTION 7.2.2 is titrated with a sulphuric acid solution of unknown concentration. At the end point it is found that $17,85 \text{ cm}^3$ of the sulphuric acid was used. The balanced equation for the reaction is:



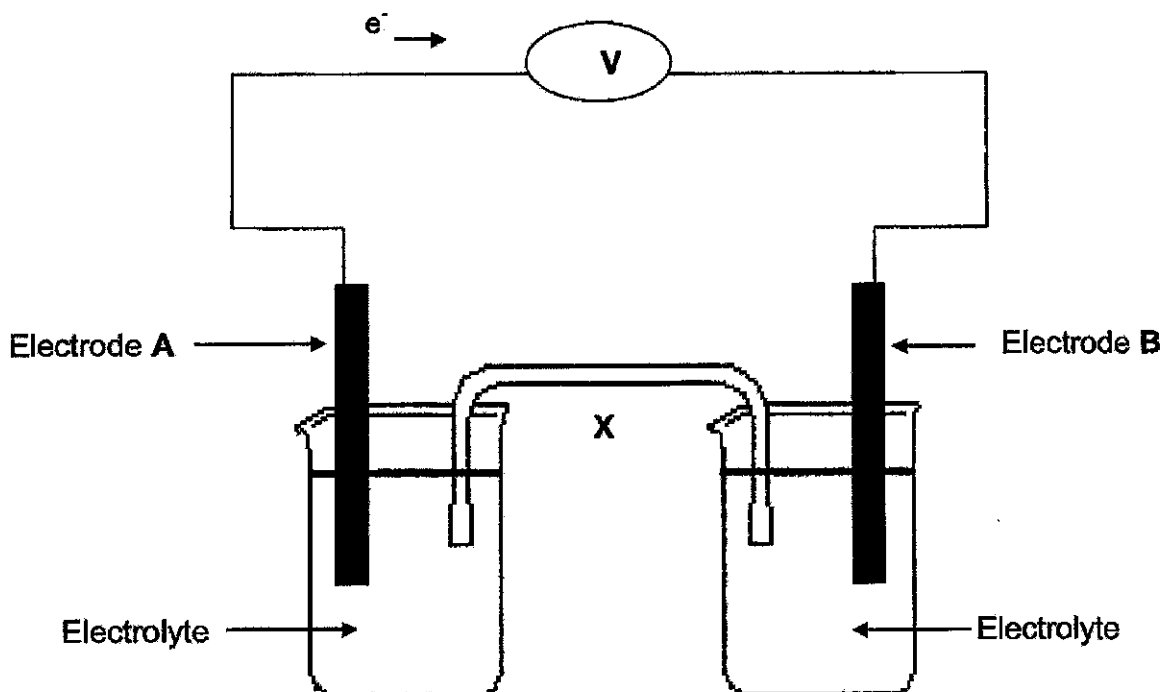
Calculate the concentration of the sulphuric acid solution. (5)

7.2.4 Use a calculation to identify element X if the molar mass of compound XOH is $56 \text{ g}\cdot\text{mol}^{-1}$. (2)

[18]

QUESTION 8 (Start on a new page.)

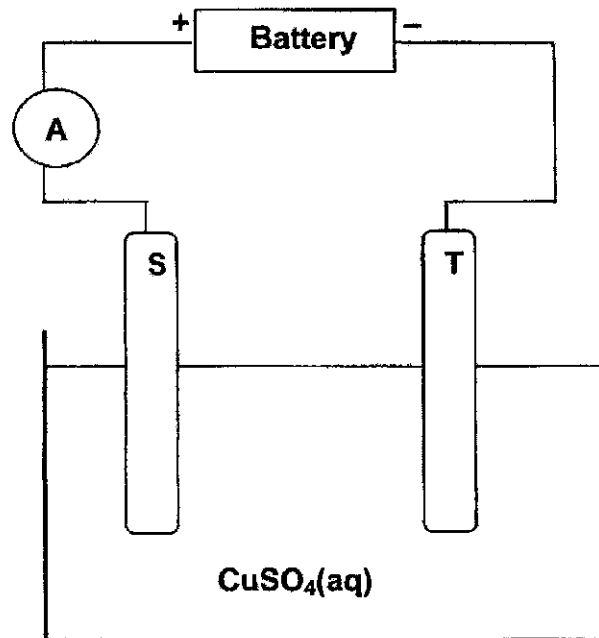
The diagram below represents a galvanic (voltaic) cell functioning under standard conditions using magnesium (Mg) and Lead (Pb) electrodes.



- 8.1 Define the term *electrolyte*. (2)
- 8.2 Write down the NAME of apparatus X and give its function. (2)
- 8.3 Which electrode, A or B, is lead? Refer to the relative strengths of reducing agents to explain your answer. (3)
- 8.4 Write down the NAME or FORMULA of a suitable electrolyte that can be used in the lead half-cell (2)
- 8.5 Electrode B is now replaced by a hydrogen half-cell.
- Write down the:
- 8.5.1 Half-reaction that takes place at the ANODE (2)
- 8.5.2 Cell notation for this cell (3)
- 8.5.3 Give a reason why the hydrogen half-cell is suitable to be used as electrode (1)
- [15]**

QUESTION 9 (Start on a new page.)

The simplified diagram below represents the electrolytic cell used to purify copper.

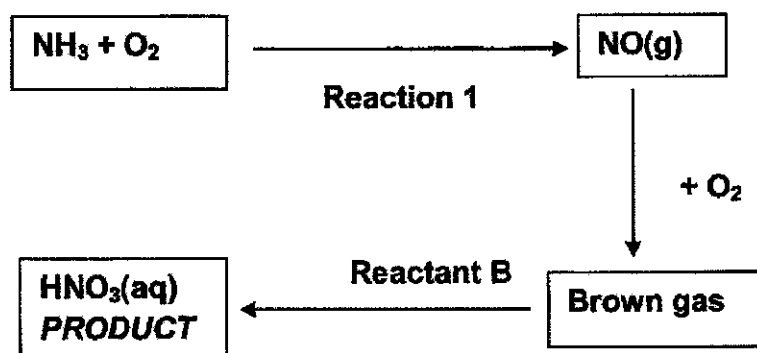


- 9.1 Define *cathode*. (2)
- 9.2 Which electrode, **S** or **T**, consists of pure copper? Give a reason for the answer. (2)
- 9.3 Write down the half-reaction that takes place at electrode **S**. (2)
- 9.4 During purification, metals such as silver and platinum form sludge at the bottom of the container. Refer to relative strength of reducing agents to explain why these two metals do not form ions during the purification process. (2)
- 9.5 Explain why the concentration of the copper (II) sulphate solution remains constant. Assume that the only impurities in the copper are silver and platinum. (2)

[10]

QUESTION 10 (Start on a new page.)

The flow diagram below shows the steps in the industrial preparation of nitric acid.



10.1 Write down the name of the industrial preparation of nitric acid. (1)

10.2 Write down:

10.2.1 ANY TWO reaction conditions needed in the process in QUESTION 10.1 (2)

10.2.2 A balanced chemical equation for the reaction 1 (3)

10.2.3 The NAME used for reaction 1 (1)

10.2.4 The NAME of the brown gas (1)

10.2.5 The NAME or FORMULA of reactant B (1)

10.3 Potassium nitrate is an example of a fertiliser that has a high percentage of nitrogen.

10.3.1 Write down the chemical formula of potassium nitrate. (1)

The composition of a 10 kg bag of a certain fertiliser is given below. Only 6,35 kg of the bag contains the fertilisers.



10.3.2 Calculate the mass of nitrogen in this bag of fertiliser. (5)

[15]

TOTAL: 150

Please turn over