

**Candidate Name**

**Candidate Number**

**Centre Name**

**Centre Number**


**Paper 2: Chemistry**

**Model Paper  
(2 hours)**

It is necessary to respond on the answer sheets provided alongside this question paper. Additionally, it would help if you had a soft pencil (preferably of type B or HB), a clean eraser, and a dark blue or black pen.

**INSTRUCTIONS:**

- You must write your name, candidate number, and center name on the answer sheets in the designated spaces.
- The objective section consists of 25 questions, and you must attempt all of them.
- Each question has four options labeled A, B, C, and D. Select the option that you think is correct. Mark it on the multiple-choice answer sheet using a soft pencil.
- Attempt all the questions from the subjective section using a dark blue or black pen.
- It is important to follow the instructions provided on the answer sheets.
- Do not use correction fluid.
- Avoid writing on any bar codes.
- You are allowed to use a calculator if needed.

**INFORMATION:**

- This paper has a total of 100 marks.

- In the objective section, there are 25 questions, each carrying one mark. There is no negative marking for incorrect responses.
- Subjective section comprises 75 marks
- The number of marks assigned for every question or its parts is indicated within brackets ( ).
- Rough work must be completed on this question paper.

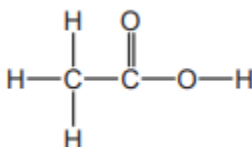
## Objective Questions

Total Marks: 25

1. Which of the following statements regarding carboxylic acids is inaccurate?

- When reacted with a metal carbonate, they generate carbon dioxide.
- Methyl orange shifts to a yellow hue in aqueous ethanoic acid.
- They comprise the functional group  $\text{-COOH}$ .
- Aqueous ethanoic acid exhibits a pH below 7.

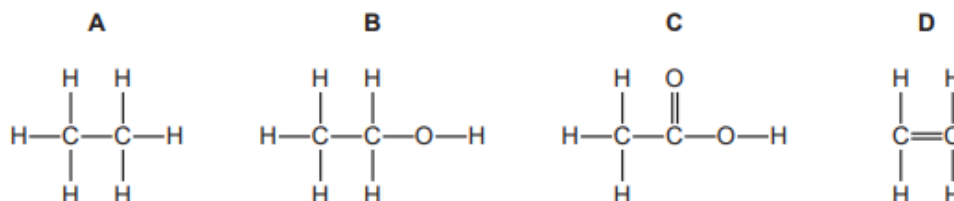
2. The diagram illustrates the structure of compound Y.



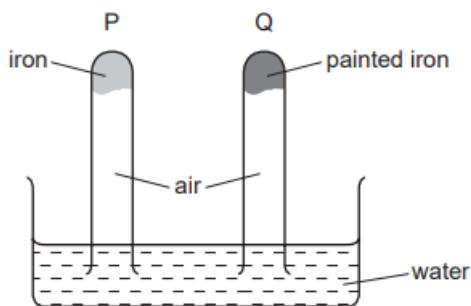
Which row provides details about the physical characteristics of Y?

	Colorless	Characteristics smell	Dissolves in water
<b>A</b>	Yes	Yes	No
<b>B</b>	no	no	No
<b>C</b>	Yes	yes	No
<b>D</b>	no	no	yes

3. Which diagram displays a carboxylic acid?



4. The diagram depicts an experiment aimed at examining the impact of paint on the rusting process of iron.



What occurs to the water level in tubes P and Q?

	Tube P	Tube Q
<b>A</b>	rises	Falls
<b>B</b>	No change	Rises
<b>C</b>	falls	Rises
<b>D</b>	rises	No change

5. Sulfur dioxide, carbon monoxide, and nitrogen oxides are prevalent gaseous contaminants present in the atmosphere. Which of these pollutants contribute to acid rain?

- a) Carbon monoxide and sulfur dioxide                      c) Nitrogen oxides only  
b) Nitrogen oxides and sulfur dioxide                      d) Sulfur dioxide only

6. An untreated iron piece and three iron pieces with various coatings were left exposed to the air.

Which iron piece would experience rusting?

- a) the painted piece    c) the untreated piece  
b) the tin-coated piece    d) the zinc-coated piece

7. Why is carbon monoxide categorized as an air pollutant?

- a) It contributes to changes in climate.                      c) It acts as a major greenhouse gas.  
b) It leads to the deterioration of buildings.                      d) It is toxic.

8. A steel bicycle that had been left outdoors for several months was beginning to rust. Which action would not decrease the corrosion rate?

- a) Remove the rust and paint the bicycle.  
b) Remove the rust and store the bicycle in a dry shed.  
c) Remove the rust and wipe the bicycle with a clean damp cloth.  
d) Remove the rust and wipe the bicycle with an oily cloth.

9. The emissions from car exhausts and certain power stations contain oxides of the form XO and YO<sub>2</sub>.

What are the identities of X and Y?

	X	Y
A	Carbon and Nitrogen	Carbon and nitrogen only
B	Carbon only	Nitrogen only
C	Carbon and nitrogen	Carbon, nitrogen, and sulfur
D	Carbon only	Nitrogen only

10. An air sample from a town center was examined and discovered to primarily consist of nitrogen and oxygen, alongside traces of the four gases listed below.

**Which of these gases is considered a pollutant?**

- a) Argon
- b) Carbon dioxide
- c) Sulfur dioxide
- d) Water vapour

**11. Which process involves oxidation?**

- a) Heating hydrated copper (II) sulfate in the air
- b) Polymerization of ethene
- c) Rusting of iron
- d) Thermal decomposition of calcium carbonate

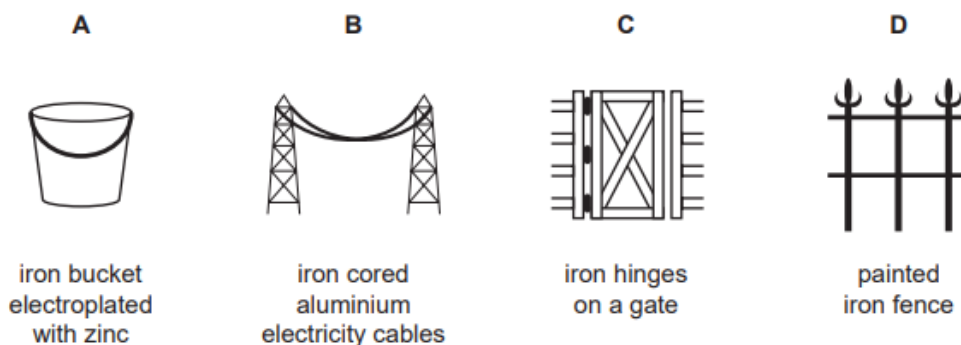
**12. An uncoated iron piece and three iron pieces with different coatings were left exposed to the air.**

**Which iron piece would undergo rusting?**

- a) the painted piece
- b) the tin-coated piece
- c) the uncoated piece
- d) the zinc-coated piece

**13. The diagrams illustrate four applications of iron.**

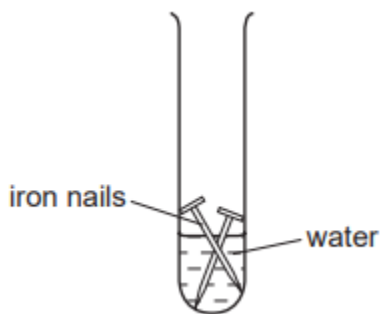
**Which of these applications is most prone to rusting?**



**14. What is the accurate sequence of the gases' abundance in the air?**

- a) nitrogen → oxygen → argon → carbon dioxide
- b) nitrogen → oxygen → carbon dioxide → argon
- c) oxygen → nitrogen → argon → carbon dioxide
- d) oxygen → nitrogen → carbon dioxide → argon

**15. The displayed experiment was arranged to explore the corrosion of iron.**



**Rusting takes place in this experiment due to the presence of**

- a) Hydrogen and oxygen.
- b) Nitrogen and oxygen.
- c) Nitrogen and water.
- d) Oxygen and water.

**16. Statement 1: Mixing iron with other substances to create stainless steel stops iron from rusting by blocking out oxygen.**

**Statement 2: Painting, oiling, and electroplating are all techniques for preventing iron from rusting.**

**Which option is accurate?**

- a) Both statements are accurate, and statement 2 elucidates statement 1.
- b) Both statements are accurate, but statement 2 does not clarify statement 1.
- c) Statement 1 is accurate, but statement 2 is inaccurate.
- d) Statement 2 is accurate, but Statement 1 is inaccurate.

**17. Which row contains an air pollutant that is inaccurately matched with its source?**

	Air Pollutant	Source
A	Nitrogen oxides	Decomposing vegetation
B	Carbon monoxide	Incomplete combustion of fuels
C	Sulfur oxides	Burning coal and other fossil fuels
D	Lead compounds	Burning petrol in cars

**18. The diagram illustrates three categories of items.**



cutlery



cooking pan



instruments used  
in hospitals

**Which rust prevention method applies to all three types of items?**

- a) plastic coating
- b) grease covering
- c) galvanizing
- d) utilizing stainless steel

**19. Fertilizers are blends of various compounds utilized to enhance crop growth.**

**Which combination of substances contains the three vital elements for plant growth?**

- a) ammonium nitrate and calcium phosphate
- b) ammonium nitrate and potassium chloride
- c) ammonium phosphate and potassium chloride
- d) potassium nitrate and calcium carbonate

**20. Which compound is not classified as a fertilizer?**

- a) ammonium sulfate,  $(\text{NH}_4)_2\text{SO}_4$
- b) calcium hydroxide,  $\text{Ca}(\text{OH})_2$
- c) potassium chloride,  $\text{KCl}$
- d) urea,  $\text{CO}(\text{NH}_2)_2$

**21. Which approach can be employed to extract ammonia from ammonium sulfate?**

- a) Heat it with an acid.
- b) Heat it with an alkali.
- c) Heat it with an oxidizing agent.
- d) Heat it with a reducing agent.

**22. Which compound would not serve as an efficient fertilizer?**

- a) ammonium nitrate,  $\text{NH}_4\text{NO}_3$
- b) calcium oxide,  $\text{CaO}$

- c) calcium phosphate,  $\text{Ca}_3(\text{PO}_4)_2$  d) potassium nitrate,  $\text{KNO}_3$

**23. Fertilizers must provide crops with three primary elements.**

**Which compound includes all three of these elements?**

- a)  $\text{H}_3\text{PO}_4$  c)  $\text{NH}_4\text{K}_2\text{PO}_4$   
b)  $\text{KNO}_3$  d)  $\text{NH}_4\text{NO}_3$

**24. Nitrogen, phosphorus, and potassium are vital elements for plant growth.**

**Which combination supplies all three essential elements?**

	mixture	formula
<b>A</b>	ammonium phosphate + potassium chloride	$(\text{NH}_4)_3\text{PO}_4$ + $\text{KCl}$
<b>B</b>	ammonium phosphate + ammonium nitrate	$(\text{NH}_4)_3\text{PO}_4$ + $\text{NH}_4\text{NO}_3$
<b>C</b>	ammonium phosphate + ammonium chloride	$(\text{NH}_4)_3\text{PO}_4$ + $\text{NH}_4\text{Cl}$
<b>D</b>	ammonium nitrate + potassium chloride	$\text{NH}_4\text{NO}_3$ + $\text{KCl}$

**25. Which compound includes two out of the three essential elements required for a comprehensive fertilizer?**

- a) ammonium chloride c) ammonium phosphate  
b) ammonium nitrate d) ammonium sulfate

## Theoretical Questions

Total Marks: 45

Q1: Electrolysis happens when solutions of certain compounds are broken down by passing direct electric current through them.

(a) Electrolysis was performed on a sodium chloride solution. [8]

The reaction yielded chlorine and hydrogen gases. The residual solution contained sodium hydroxide and NaOH.

(i) Identify a hazard related to chlorine gas. [3]

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(ii) Explain methods that can be utilized to recognize a gas sample as chlorine.[3]

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(iii) Mention applications of chlorine. [3]

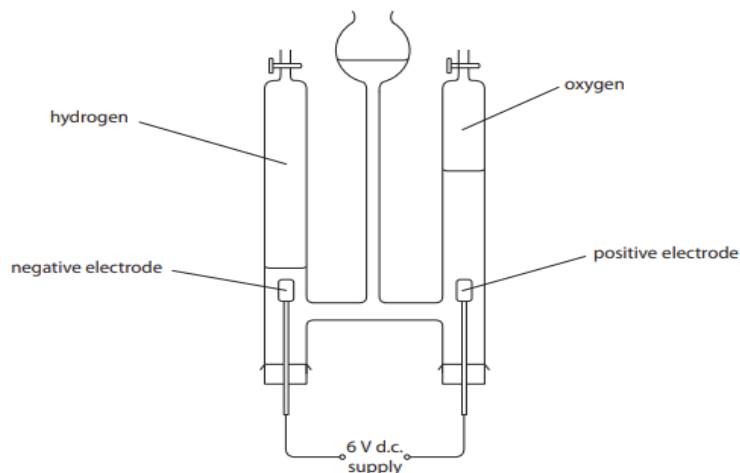
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(b) Electrolysis was used to decompose water in the depicted apparatus. [6]





The water separated into hydrogen and oxygen. After five minutes, the quantities of hydrogen and oxygen in the tubes were gauged. Two additional experiments were conducted, with only one variable altered in each experiment. All other variables remained constant.

The table illustrates the conditions and outcomes of all three experiments.

experiment	time / minutes	current / amps	volume of hydrogen / cm <sup>3</sup>	volume of oxygen / cm <sup>3</sup>
1	5	0.50	20.0	10.0
2	10	0.50	40.0	20.0
3	5	0.75	30.0	15.0

Utilize the electrolysis outcomes to contrast the volumes of hydrogen and oxygen generated and to demonstrate the impact of altering the time and current on the volumes of these gases.

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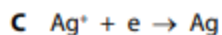
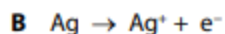
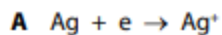
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{Total Marks 15}

Q2: Objects crafted from transition metals are occasionally plated with a thin layer of another transition metal to enhance their aesthetics and provide protection against corrosion.

- (i) Which half-equation describes the deposition of silver metal on the spoon? [3]



(ii) Why does the voltage of the cell decrease when it is left connected to a circuit? [4]

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(iii) Duralumin is an alloy composed of aluminium and copper. The radii of the aluminium and copper atoms are illustrated in the figure. [6]

	radius of atom / m
aluminium	$1.43 \times 10^{-12}$
copper	$1.27 \times 10^{-12}$

Explain why copper added to aluminium to form the alloy makes the alloy stronger than pure aluminium.

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{Total Marks 13}

Q3: This query pertains to alkenes and alcohols. Ethene, an alkene, is derived from large hydrocarbon molecules. Large hydrocarbon molecules are extracted from crude oil via fractional distillation.

(a) Identify the method employed to generate ethene from large hydrocarbon molecules. [3]

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(b) Explain the parameters required for ethene production from large hydrocarbon molecules. [4]

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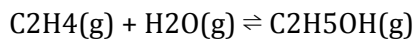
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(c) Ethanol can be synthesized from ethene and steam, as shown in the equation:



The forward reaction is exothermic. Describe the optimal conditions for this reaction to ensure economical ethanol production. [6]

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(d) Butanol can be derived from sugar solution through bacterial fermentation. Bacteria and yeast both decompose sugar solutions in comparable manners. Propose the necessary reaction conditions for producing butanol from sugar solution using bacteria. [4]

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## Practical Questions

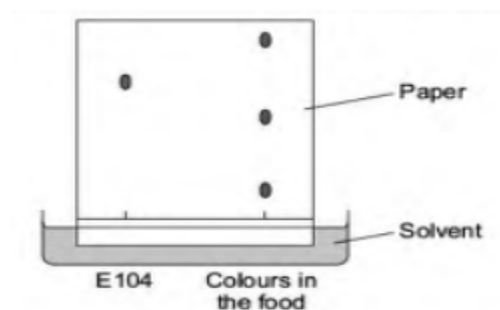
Total Marks 30

Q1: An article began:

**Ban Yellow Additives**

Quinoline yellow (E104) is suspected of causing hyperactivity, asthma, and rashes in children.

A student examined a food item to determine the presence of quinoline yellow (E104). The findings obtained by the student are presented below.



- (i) Draw a ring around the correct answer to complete the sentence. This method of detecting and identifying colors is called: [2]

Chromatography

Distillation

Electrolysis

- (ii) Based on the student's findings, how many distinct colors are present in the food? [3]

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- (iii) Based on the student's findings, how can you determine that the food does not contain quinoline yellow (E104)? [3]

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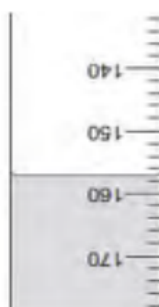
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The student recorded the volume of gas collected every 30 seconds. The table displays the student's findings.

Time in seconds	The volume of carbon dioxide collected in cm <sup>3</sup>
30	104
60	
90	198
120	221
150	232
180	238
210	240
240	240

Diagram 2



What caused the volume of gas to cease changing after 210 seconds?

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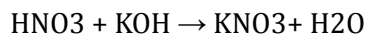
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{Total Marks 8}

Q4: Dilute nitric acid undergoes a reaction with potassium hydroxide solution. The equation for this reaction is:



A student investigated the temperature variation in this reaction. Here is the procedure the student followed:

Step 1 - Place 25 cm<sup>3</sup> of dilute nitric acid in a polystyrene cup.

Step 2 - Utilize a thermometer to measure the temperature of the dilute nitric acid.

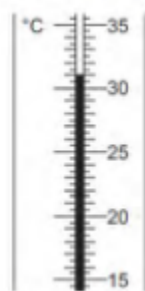
Step 3 - Employ a burette to dispense 4 cm<sup>3</sup> of potassium hydroxide solution into the dilute nitric acid and agitate the mixture.

Step 4 - Use a thermometer to determine the maximum temperature of the mixture.

Step 5 - Repeat steps 3 and 4 until 40 cm<sup>3</sup> of potassium hydroxide solution has been added.

Both the dilute nitric acid and the potassium hydroxide solution were initially at room temperature.

- (a) Figure 1 portrays a portion of the thermometer following the addition of some potassium hydroxide solution to the dilute nitric acid.



What temperature is indicated on the thermometer? The temperature displayed is ..... °C. [2]

(b) Errors could occur during this experiment.[6]

(i) Propose two potential sources of random error in the experiment.

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(ii) Another student opted for a glass beaker instead of a polystyrene cup. This led to a systematic error. Why does substituting a glass beaker for a polystyrene cup result in a systematic error?



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{Total Marks 8}