

Candidate Name

Candidate Number

Centre Name

Centre Number

Paper 1: Chemistry

**Model Paper
(2 hours)**

It is necessary to respond on the answer sheets provided alongside this question paper. Additionally, you must have 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, centre name, and centre number 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 labelled 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 Section**Total Marks: 25**

1. What are the three states of matter? They include solid, liquid, and gas. What is the term used for the transition when a liquid transforms into a solid?

- A. Freezing
- B. Melting
- C. Evaporation
- D. Condensation

2. Why can this water be consumed safely even though it has impurities?

- A. The impurities have no smell.
- B. The impurities have no colour.
- C. The impurities are not dangerous.
- D. The impurities dissolve in water.

3. Various methods exist for separating mixtures of substances. Which of the following represents a mixture of substances?

- A. The air
- B. Carbon dioxide gas
- C. Precious metal gold
- D. Metal titanium

4. Which substance listed below will exist as a solid at 20 °C but melt when immersed in hot water at 80 °C?

Melting point in °C	Boiling point in °C
30	2402
-32	27
122	249
-7	59

- A.
- B.
- C.
- D.

5. Ink consists of coloured substances dissolved in water. What method is employed to separate these coloured substances in the ink?

- A. Filtration
- B. Chromatography
- C. Fractional distillation
- D. Crystallization

6. An aluminium atom has 27 nucleons and 13 protons. How many neutrons are present in this aluminium atom?

- A. 13
- B. 14
- C. 27
- D. 40

7. An element Q has an atom with 19 electrons, 19 protons, and 20 neutrons. What is the identity of element Q?

- A. potassium
- B. yttrium
- C. calcium
- D. strontium

8. The table displays the atomic structure of four atoms. Which of these atoms is not classified as a metal?

	Electrons	Neutrons	Protons
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A	20	20	20
B	19	20	19
C	18	22	18
D	19	21	19

9. Which of the following statements about atoms is accurate?

- A. Atoms comprise protons and electrons within the nucleus.
- B. Neutrons possess a negative charge.
- C. Protons carry a positive charge.
- D. The nucleon number represents the number of neutrons.

10. The relative atomic mass of chlorine is 35.5. In determining relative atomic mass, what is the reference particle used for comparing the mass of a chlorine atom?

- A. Neutron
- B. Proton
- C. Carbon-12 atom
- D. Hydrogen-1 atom

11. This question concerns electrolysis. When molten potassium bromide undergoes electrolysis, what are the two substances produced?

- A. hydrogen and bromine
- B. potassium and bromine
- C. hydrogen and oxygen
- D. potassium and oxygen

12. Electrolysis is performed on molten lead bromide. What are the products of this electrolysis?

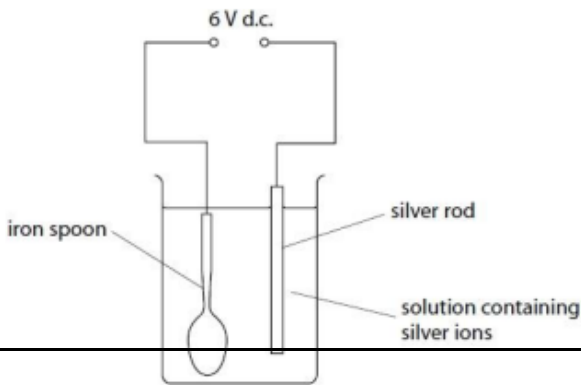
- A. Lead and oxygen
- B. Hydrogen and oxygen
- C. Hydrogen and bromine
- D. Lead and bromine

13. Why does molten zinc chloride serve as an electrolyte?

- A. It includes molecules capable of movement.
- B. It has a large-scale structure.
- C. It contains electrons that are not fixed to specific atoms.
- D. It includes ions that can move.

14. Objects crafted from transition metals are occasionally plated with a thin layer of another transition metal to enhance their appearance and guard against corrosion.

The figure shows equipment that can be used to electroplate an iron spoon with silver.



Which row of the table correctly shows the charge on the silver rod electrode and the type of reaction occurring at this electrode?

	Charge	Type of reaction
A	Negative	Oxidation
B	Negative	Reduction
C	Positive	Oxidation
D	Positive	reduction

15. Ammonia solution exhibits alkalinity. Which of the following options could demonstrate the alkaline nature of ammonia solution?

- A. Conical flask
- B. pH meter
- C. Pipette
- D. Thermometer

16. The Periodic Table displays all known elements.

Elements are organized according to their1..... numbers.

The melting points of Group I elements decrease2..... the group.

The melting points of Group VII elements increase3..... the group.

Which words correctly fill in the blanks 1, 2, and 3?

	1	2	3
A	proton	decrease	Increase
B	nucleon	decrease	Increase
C	proton	increase	Decrease
D	nucleon	increase	Decrease

17. What characteristic of an element can be utilized to forecast its chemical properties?

- A. Melting point
- B. Position in the Periodic Table
- C. Boiling point
- D. Density

18. Which assertion regarding the Periodic Table is accurate?

- A. Elements in the same period possess an identical count of outer electrons.
- B. Typically, the elements on the left are gaseous.
- C. The left side of the Periodic Table predominantly contains the most metallic elements.
- D. The relative atomic mass of elements generally rises from left to right.

19. Which statement accurately describes the element with a proton number of 19?

- A. It is a gas that can dissolve in water.
- B. It is a solid metal with low reactivity to water.

- C. It is a non-metal that combusts rapidly in the air.
- D. It is a malleable metal highly reactive with water.

20. A steel bicycle left outdoors for several months was beginning to rust. Which action would not decrease the rate of corrosion?

- A. Eliminate the rust and apply paint to the bicycle.
- B. Remove the rust and store the bicycle in a dry shed.
- C. Eliminate the rust and wipe the bicycle with a clean damp cloth.
- D. Eliminate the rust and wipe the bicycle with an oily cloth.

21. Which method is not employed for preventing rust?

- A. Applying oil to the moving components of industrial machinery.
- B. Encasing gardening wire in plastic for outdoor use.
- C. Soaking gardening tools in water for storage.
- D. Applying paint to car bodies.

22. Which gas among these is considered an atmospheric pollutant?

1. Carbon monoxide

2. Nitrogen dioxide

3. Sulfur dioxide

- | | |
|-------------|-----------------|
| A. 1 Only B | C. 3 only |
| B. 2 Only C | D. D 1, 2 and 3 |

23. A town centre's air sample was analyzed, revealing mainly nitrogen and oxygen, with traces of the four listed gases below.

Which among these gases is considered a pollutant?

- | | |
|-------------------|-------------------|
| A. Argon | C. Sulfur dioxide |
| B. Carbon dioxide | D. Water vapour |

24. Which of these reactions entails oxidation?

- A. Heating hydrated copper (II) sulfate in the air
- B. Polymerization of ethene
- C. Rusting of iron
- D. Thermal decomposition of calcium carbonate

25. In which reaction does the colour transition occur from blue to white?

- A. Heating hydrated cobalt (II) chloride
- B. Heating hydrated copper (II) sulfate
- C. Adding water to anhydrous cobalt (II) chloride
- D. Adding water to anhydrous copper (II) sulfate

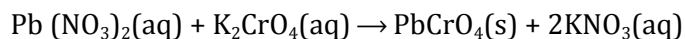
Theoretical Questions

Total Marks: 45

Q1: A student experimented to investigate the law of conservation of mass, which asserts that the mass of the products equals the mass of the reactants. The procedure involved is as follows:

1. Pour lead nitrate solution into a beaker labelled A.
2. Pour potassium chromate solution into a beaker labelled B.
3. Measure the mass of both beakers and their contents.
4. Transfer the solution from beaker B into beaker A.
5. Re-measure the mass of both beakers and their contents.

Upon mixing lead nitrate solution and potassium chromate solution, a chemical reaction occurs, represented by the equation:



(a) What visual changes would the student observe during the reaction? (1 Marks)

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(b) The table shows the student's results. (2 Marks)

	Mass in g
Beaker A and contents before mixing	128.71
Beaker B and contents before mixing	128.97
Beaker A and contents after mixing	154.10
Beaker B after mixing	103.58

Show that the law of conservation of mass is true.
Use the data from the table above.

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(c) What is the precision level of the balance utilized to acquire the data in the table? (1 Marks)

Tick (✓) any 1 box

0.01 g ☐

0.1 g ☐

1 g ☐

100 g ☐

(d) Determine the relative formula mass (M_r) of lead nitrate, $\text{Pb}(\text{NO}_3)_2$, using the following relative atomic masses (A_r): N = 14, O = 16, Pb = 207. (2 Marks)

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Relative formula mass = _____

(e) The formula for potassium chromate is K_2CrO_4 , with the potassium ion carrying a +1 charge. (1 Marks)

What is the formula of the chromate ion?

Tick (✓) any one of the above boxes:

CrO_4^+ ☐

CrO_4^{2+} ☐

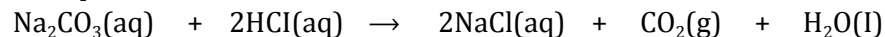
CrO_4^- ☐

CrO_4^{2-} ☐

(f) Another student also verifies the law of conservation of mass employing the identical procedure. (3 Marks)

The student employs a different reaction.

Here is the equation for the reaction.



Explain why this student's results would not appear to support the law of conservation of mass.

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..... (Total: 10)

Q2: A student examined the reactivity of metals with hydrochloric acid.

Here is the procedure followed:

1. Dispense 50 cm³ of hydrochloric acid into a polystyrene cup.
2. Record the initial temperature of the hydrochloric acid.
3. Add one spatula of metal powder to the hydrochloric acid and mix thoroughly.
4. Record the maximum temperature reached by the mixture.
5. Calculate the temperature change during the reaction.
6. Repeat steps 1 to 5 thrice more.
7. Perform steps 1 to 6 using different metals.

Metal	Temperature increase in °C				Mean temperature increase in °C
	Trial 1	Trial 2	Trial 3	Trial 4	
Cobalt	6	7	5	9	7
Magnesium	54	50	37	55	X
Zinc	18	16	18	20	18

(a) Determine the average temperature rise, X, for magnesium from the provided table.

Exclude the anomalous result from your computation. (1 Mark)

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$$X = \text{_____}^{\circ}\text{C}$$

(b) Determine the order of reactivity for the metals cobalt, magnesium, and zinc. (2 Marks)

Use the table above

Most Reactive

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Least Reactive

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(c) The range of measurements on either side of the mean represents the uncertainty in the average temperature increase. (2 Marks)

Complete the sentence. Refer to the table above.

The mean temperature increase for zinc is $18 \pm \text{_____}^\circ\text{C}$.

(d): Which type of variable represents the volume of hydrochloric acid in this investigation? (1 Mark)

Check (✓) one box.

Control ☐

Dependent ☐

Independent ☐

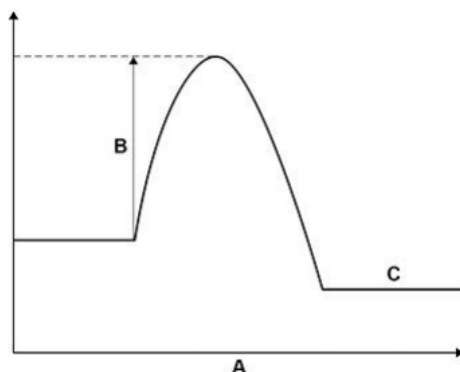
(e) Propose a method to enhance step 3 in the procedure for obtaining more consistent results. (1 Marks)

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(f) The figure below shows a reaction profile for the reaction of magnesium with hydrochloric acid. (3 Marks)



What do labels A, B, and C represent in the figure above?

Choose answers from the box.

activation energy	energy	overall energy change
products	progress of reaction	reactants

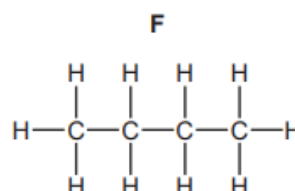
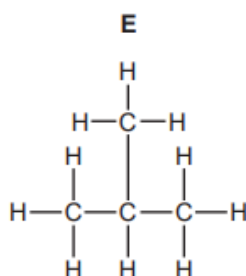
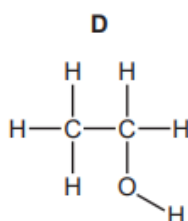
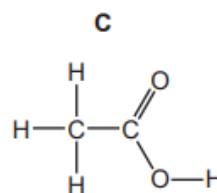
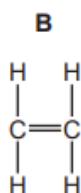
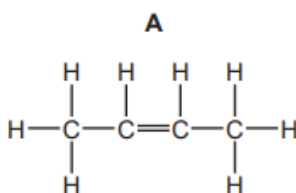
A _____

B _____

C _____

(Total Marks 10)

Q3. The structures of six organic compounds are shown.



(a) Give the name of E. (1 Marks)

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(b) Recognize two compounds belonging to the identical homologous series. (2 Marks)

Provide the general formula for this homologous series.

Compounds _____

General formula _____

(c) Which two compounds are structural isomers of one another? (2 Marks)

Explain the reason behind their isomerism.

Compounds _____

Explanation _____

(d) Explain why B is classified as an unsaturated hydrocarbon. (1 Marks)

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(e) Explain the process by which D is produced from B. Provide a chemical equation depicting the reaction. (1 Marks)

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(f) Compound A undergoes addition polymerization. (3 Marks)

Illustrate two repeating units of the addition polymer derived from A.

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(Total Marks 10)

Q4: The alkanes are a group of saturated hydrocarbons. Their reactions involve combustion, cracking, and substitution.

(A) (Marks 5)

(a) What does the term hydrocarbon refer to?

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(b) What does the term "saturated" signify?

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(c) What is the general formula for the family of alkanes?

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(d) Determine the mass of one mole of an alkane containing 14 carbon atoms.

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(B) (Marks 5)

(a) The complete combustion of hydrocarbons results in the formation of only carbon dioxide and water. Provide the equation for the full combustion of nonane, C_9H_{20} .

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(b) 20 cm³ of a gaseous hydrocarbon was combined with an excess of oxygen, 200 cm³. The mixture was ignited. Upon cooling, 40 cm³ of oxygen and 100 cm³ of carbon dioxide were left. Determine the formula of the hydrocarbon and the equation for its combustion. All volumes were measured at standard temperature and pressure (STP).

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(C) (Marks 5)

(a) Cracking is employed to extract short-chain alkanes, alkenes, and hydrogen from long-chain alkanes.

(i) Assign a purpose for each of the three mentioned products:

Short-chain alkanes _____

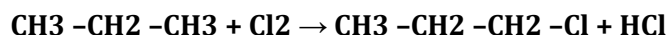
Alkenes _____

Hydrogen _____

(ii) Formulate an equation illustrating the cracking of decane, $C_{10}H_{22}$, yielding two distinct alkenes and hydrogen as the exclusive products.

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(b) Chlorine undergoes a substitution reaction with propane to produce 1-chloropropane.



(i) What is the key requirement for the described reaction?

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(ii) There are multiple potential substitution reactions between chlorine and propane. Propose the structural formula of an alternative product.

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(Total Marks 15)

Practical Portion

Q1: Rock salt comprises a mixture of sand and salt. While salt readily dissolves in water, sand remains insoluble. Several students successfully separated rock salt using the following method:

1. Place the rock salt in a beaker.
2. Introduce 100 cm³ of cold water into the beaker.
3. Allow the sand to settle at the bottom of the beaker.
4. Gently transfer the saline solution into an evaporating dish.
5. Apply heat to the contents of the evaporating dish using a Bunsen burner until salt crystals begin to precipitate.

(a) Propose one enhancement to step 2 to ensure complete dissolution of all salt in the water.[2]

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(b) The saline solution in step 4 still retained minute grains of sand. Recommend one modification to step 4 to eliminate all traces of sand.[2]

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(c) Recommend one safety measure the students should observe during step 5.[2]

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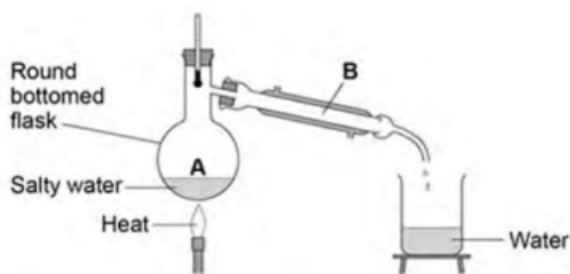
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(d) Another student removed water from salty water using the apparatus in the figure below.



Explain how this method operates by referencing the processes at points A and B. [3]

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(e) What does the thermometer indicate the temperature during this procedure? [1]

..... °C.

{Total Marks 10}

Q2: Several students investigated magnesium oxide.

(a) Magnesium oxide is represented by the formula MgO . {6 Marks}

(i) Determine magnesium oxide's relative formula mass (M_r).

Relative atomic masses: $\text{O} = 16$; $\text{Mg} = 24$.

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Relative formula mass =

(ii) Determine the mass percentage of magnesium in magnesium oxide.

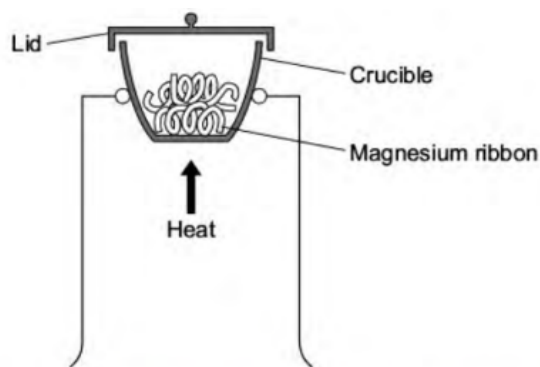
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Percentage by mass of magnesium in magnesium oxide =%

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(iii) Compute the mass of magnesium required to produce 25 grams of magnesium oxide.
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Mass of magnesium = g.

(b) The students determined that by utilizing 0.12 grams of magnesium, they anticipated producing 0.20 grams of magnesium oxide. They conducted this experiment to verify the accuracy of their calculation.

{6 Marks}.



The students measured out 0.12 grams of magnesium ribbon into a crucible.

- They proceeded to heat the magnesium ribbon.
- Occasionally, they slightly lifted the lid of the crucible to permit air to enter.
- They aimed to minimize lifting the lid excessively to prevent the potential escape of magnesium oxide.

- Once all the seemed to the students resulting magnesium oxide.

Mass of magnesium used in grams	0.12
Mass of magnesium oxide produced in grams	0.18

magnesium have reacted, weighed the

The results of the experiment are shown below.

- (i) The quantity of magnesium oxide generated was less than what the students had predicted. They attributed this discrepancy to experimental errors. Suggest two potential experimental errors made by the students.

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- (ii) The students experimented only once. Provide two reasons why they should have replicated the experiment.

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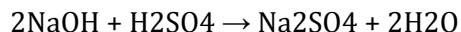
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{Total Marks 12}

Q3: Sodium hydroxide reacts with sulfuric acid to neutralize it. The reaction equation is:



(a) Sulfuric acid is classified as a strong acid.[2]

What is the definition of a strong acid?

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(b) Compose the ionic equation representing the neutralization reaction, ensuring to include state symbols.[2]

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(c) A student utilized a pipette to deliver 25.0 cm^3 of sodium hydroxide with an unknown concentration into a conical flask. The student proceeded with a titration to determine the volume of 0.100 mol/dm^3 sulfuric acid required to neutralize the sodium hydroxide. Detail the steps the student would take to carry out the titration, including selecting an appropriate indicator and specifying the observed colour change. [2]

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(d) The equation for the reaction is: $2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ Calculate the concentration of the sodium hydroxide. Give your answer to three significant figures. [2]

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{Total Marks 8}