

IGCSE CHEMISTRY P1V1

Key

Objective Portion

Marks: 25

1. A
2. C
3. A
4. B
5. B
6. B
7. A
8. C
9. C
10. C
11. B
12. D
13. D
14. B
15. B
16. A
17. B
18. C
19. D
20. C
21. C
22. D
23. C
24. C
25. B

Subjective Portion

Marks: 45

1.

(a) Formation of a yellow precipitate of lead chromate (PbCrO_4).

(b)

Total mass before mixing = $(128.71 \text{ g} + 128.97 \text{ g}) = 257.68 \text{ g}$

Total mass after mixing = $(154.10 \text{ g} + 103.58 \text{ g}) = 257.68 \text{ g}$

Law of conservation of mass confirmed.

(c) 0.01 g

(d) Relative formula mass (M_r) of lead nitrate ($\text{Pb}(\text{NO}_3)_2$) = $(1 * 207) + (2 * 14) + (6 * 16) = 207 + 28 + 96 = 331$

(e) CrO_4^{2-} .

(f) The student's results would not support the law of conservation of mass due to the production of gas (CO_2) and water (H_2O), which can escape causing a decrease in measured mass not accounted in the final result.

2.

(a)

$$\begin{aligned} X &= (\Delta T_1 + \Delta T_2 + \Delta T_4) / 3 \\ &= (24.5^\circ\text{C} + 22.5^\circ\text{C} + 26.0^\circ\text{C}) / 3 \\ &= (73^\circ\text{C}) / 3 \\ &= 24.3^\circ\text{C} \end{aligned}$$

(b)

Most reactive: Magnesium

Intermediate: Zinc

Least reactive: Cobalt

(c) $18 \pm 2.0^\circ\text{C}$.

(d) The **volume of hydrochloric acid** is a **control variable**. This is because it is kept constant throughout the experiment, ensuring fair testing while investigating the reactivity of different metals.

(e) The student should ensure the spatula of metal powder added to the hydrochloric acid is of uniform size and mass for each trial.

(f)

A: Activation energy

B: Energy of the transition state

C: Overall energy change of the reaction

3.

(a) E. Butan-2-one.

(b) Compounds C and D with general formula C_nH_{2n+2} showing alkanes.

(c) Compounds A and F are structural isomers with same molecular formula (C_4H_{10}) but differ in the arrangement of atoms within the molecule. Also called chain isomerism.

(d) Because it contains a carbon-carbon double bond.

(e) Through hydrogenation in which hydrogen gas (H_2) is added across the double bond of B, forming D, as shown:



(f) **-CH₂-CH₂-**

These repeating units link through addition polymerization.

4.

(A)

(a) A compound composed of only hydrogen and carbon atoms.

(b) All carbon atoms are bonded to the maximum number of hydrogen atoms in the molecule.

(c) C_nH_{2n+2}

(d) To determine the mass of one mole of an alkane containing 14 carbon atoms, first calculate its molar mass:

Molar mass = $(14 \times \text{atomic mass of carbon}) + (2 \times 14 \times \text{atomic mass of hydrogen})$

= $(14 \times 12.01 \text{ g/mol}) + (2 \times 14 \times 1.008 \text{ g/mol})$

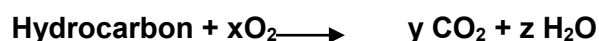
= $168.14 \text{ g/mol} + 28.224 \text{ g/mol}$

= 196.364 g/mol

(B)

(a) **$C_9H_{20} + 14.5O_2 \longrightarrow 9CO_2 + 10H_2O$**

(b) To determine the formula of the hydrocarbon and the equation for its combustion, first use the volume ratios of the reactants and products:



Given:

Initial volume of hydrocarbon = 20 cm^3

Initial volume of oxygen = 200 cm³

Final volume of oxygen = 40 cm³

The final volume of carbon dioxide = 100 cm³

From the volume ratios, we determine that 1 volume of hydrocarbon reacts with 10 volumes of oxygen. So, the formula of the hydrocarbon is C₂H₅. The equation for combustion:



(C)

(a)

(i)

- Short-chain alkanes: Used as fuels due to their volatility and ease of combustion.
- Alkenes: Used as starting materials in producing chemicals e.g. plastics and pharmaceuticals.
- Hydrogen: Used in industrial processes, including ammonia production and as a fuel.



(b)

(i) UV light or heat is present to initiate the reaction.

(ii) An alternative product could be 2-chloropropane:



Practical Portion

Marks: 30

1.

- (a) Stir the mixture using a glass rod to increase salt-water contact, aiding faster dissolution.
- (b) Filter the solution through filter paper to remove sand particles.
- (c) Wear safety goggles during heating in step 5 to protect against splashes.
- (d) Salty water is heated (point A), causing evaporation; steam rises and condenses in the condenser (point B) back into liquid water, leaving salts behind. The liquid is collected in the receiver flask.
- (e) 100°C under standard atmospheric pressure.

2.

(a)

(i) MgO formula mass:

$$M_r = \text{Mass of Mg} + \text{Mass of O} = (1 \times 24) + (1 \times 16) = 40 \text{ g/mol}$$

(ii) Mg percentage in MgO:

$$\text{Percentage} = \frac{\text{Mass of Mg}}{M_r \text{ of MgO}} \times 100 = \frac{24}{40} \times 100 = 60\%$$

(iii) Mg mass for 25g MgO:

$$\text{Mass of Mg} = \frac{25}{40} \times 24 = \frac{5}{8} \times 24 = 15 \text{ g}$$

(b)

(i)

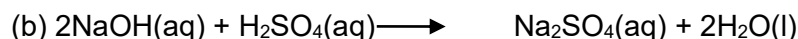
- Incomplete combustion
- MgO loss:

(ii)

- Multiple trials verify results and minimize systematic errors.
- It improves precision by estimating true value.

3.

(a) A strong acid completely dissociates into ions when dissolved in water, yielding a high concentration of hydrogen ions (H^+) in solution.



(c)

- Place the conical flask on a white tile. Fill the burette with 0.100 mol/dm³ sulfuric acid solution.
- Drop phenolphthalein on solution; pink indicates a basic solution.

- Slowly add sulfuric acid from the burette into the flask, neutralizing the sodium hydroxide.
- Stop when pink disappears and note the final sulfuric acid volume.
- Conduct multiple titrations for consistent results.

(d)

Given 0.100 mol/dm³ sulfuric acid, and 25.0 cm³ used:

$$\text{Moles of H}_2\text{SO}_4 = \frac{0.100 \text{ mol/dm}^3 \times 25.0 \text{ cm}^3}{1000 \text{ cm}^3/\text{dm}^3} = 0.00250 \text{ mol}$$

Using stoichiometry, 0.00250 mol H₂SO₄ reacts with NaOH.

$$\text{Moles of NaOH} = 0.00250 \times 2 = 0.00500 \text{ mol}$$

$$\text{Concentration of NaOH} = 0.00500 \text{ mol} / 25.0 \text{ cm}^3 \times 1000 \text{ cm}^3/\text{dm}^3 = 0.200 \text{ mol/dm}^3$$