CHEMISTRY GRADE 10

MARKING SCHEME

SECTION A (40 MARKS)

1. **Atomic Structure Diagram (5 marks)**

(a) Parts labeled in the diagram: (3 marks - 1 mark each)

- A = Nucleus (or protons/neutrons/positively charged nucleus)
- B = First electron shell (or K shell/innermost shell)
- C = Second/Third electron shell (or L/M shell)

(b) Relative mass of a proton: 1 (or 1 a.m.u) (1 mark)

(c) Isotopes: Atoms of the same element with the same atomic number but different mass numbers (different number of neutrons). (1 mark)

2. **Distillation Apparatus Diagram (6 marks)**

(a) Apparatus identified: (5 marks - 1 mark each)

- A = Round-bottomed flask (or distillation flask/flat-bottomed flask)
- B = Thermometer (or glass thermometer)
- C = Liebig condenser (or water condenser/Graham condenser/straight tube condenser)
- D = Delivery tube (or outlet tube/outlet)
- E = Conical flask (or flat-bottomed flask/collection flask/receiving flask)

(b) Purpose of apparatus C: To cool/condense the vapours into liquid (by circulating cold water). (1 mark)

3. **Paper Chromatography Diagram (7 marks)**

(a) Apparatus identified: (2 marks - 1 mark each)

- A = Beaker (or chromatography beaker/glass beaker)
- D = Filter paper (or chromatography paper/Whatman paper)

(b) What B and C represent: (2 marks - 1 mark each)

- B = Origin line (or baseline/starting line where the sample is placed)
- C = Solvent front (or furthest line reached by the solvent)

(c) Use of paper chromatography: (1 mark) - Any ONE of:

- To separate and identify components of a mixture
- To identify food dyes/additives in food samples
- To separate amino acids in proteins
- To separate pigments from plant leaves

(d) Calculate Rf value: (2 marks)

Rf = Distance of solute from origin / Distance of solvent front from origin

Rf = 3 cm / 5 cm = 0.6 (or 3/5 or 60%)

Award 1 mark for correct formula/method, 1 mark for correct answer

4. **Bunsen Burner Setup Diagram (8 marks)**

(a) Apparatus identified: (4 marks - 1 mark each)

- A = Bunsen burner base (or stand/foot/base)
- B = Bunsen burner head/flame (or burner/heating element)
- C = Pipe clay triangle (or clay triangle/triangle)
- D = Test tube (or glass tube/sample container)

(b) Function of apparatus C (pipe clay triangle): (2 marks)

To support/hold the test tube or crucible during heating. It distributes/spreads the heat evenly. It prevents the test tube from falling into the flame. (Award 1 mark for 'support' and 1 mark for explaining how)

(c) Safety precautions: (2 marks - any TWO of:)

- Use tongs/pipe clay triangle to hold the test tube (not hands)
- Do not point the test tube towards anyone (contents may splatter)
- Do not look directly into the test tube when heating
- Allow the apparatus to cool before touching it
- Use appropriate amounts of substance (not too much)
- Ensure the Bunsen burner is on a stable, heat-resistant surface

1. **Electrolysis Cell Diagram (8 marks)**

(a) Parts identified: (3 marks - 1 mark each)

- A = Solution/electrolyte (ionic compound in molten/aqueous state)
- B = Cathode (or negative electrode)
- C = Anode (or positive electrode)

(b) What happens at the cathode: (2 marks)

Reduction occurs. Cations (positive ions) are attracted to the cathode and gain electrons. Metal atoms are formed/deposited at the cathode. (Award 1 mark for naming cathode as negative electrode, 1 mark for describing the reduction process)

(c) Equation for electrolysis of molten sodium chloride: (3 marks)

At cathode: $2Na^+ + 2e^- \rightarrow 2Na$ (1 mark)

At anode: $2Cl^- - 2e^- \rightarrow Cl_2$ (or $2Cl^- \rightarrow Cl_2 + 2e^-$) (1 mark)

Overall: $2NaCl \rightarrow 2Na + Cl_2$ (1 mark

SECTION B (40 MARKS)

2. **Molar Mass Calculations (6 marks)**

(a) Calcium carbonate ($CaCO_3$): (2 marks)

Molar mass = $Ca + C + 3O = 40 + 12 + (3 \times 16) = 40 + 12 + 48 = 100$ g/mol (1 mark for working, 1 mark for answer)

Answer: 100 g/mol

(b) Sodium hydroxide (NaOH): (2 marks)

Molar mass = $Na + O + H = 23 + 16 + 1 = 40$ g/mol (1 mark for working, 1 mark for answer)

Answer: 40 g/mol

(c) Sulphuric acid (H_2SO_4): (2 marks)

Molar mass = $2H + S + 4O = (2 \times 1) + 32 + (4 \times 16) = 2 + 32 + 64 = 98$ g/mol (1 mark for working, 1 mark for answer)

Answer: 98 g/mol

3. **Moles Calculation (3 marks)**

Number of moles = Mass / Molar mass
= 8 g / 40 g/mol = 0.2 mol
Award: 1 mark for formula, 1 mark for substitution, 1 mark for correct answer

4. **Gas Volume Calculation (5 marks)**

Equation: $Mg + 2HCl \rightarrow MgCl_2 + H_2$ (1 mark for correct equation)
Molar mass of Mg = 24 g/mol
Step 1: Calculate moles of Mg = 1.2 g / 24 g/mol = 0.05 mol (1 mark)
Step 2: From equation, 1 mol Mg produces 1 mol H_2
Therefore, 0.05 mol Mg produces 0.05 mol H_2 (1 mark for mole ratio)
Step 3: At RTP, 1 mol of gas occupies 22.4 dm3 (or 22,400 cm3)
Volume of H_2 = 0.05 mol × 22.4 dm3/mol = 1.12 dm3 (or 1120 cm3) (1 mark for calculation, 1 mark for answer with units)
Answer: 1.12 dm3 or 1120 cm3

5. **Percentage Composition Calculation (6 marks)**

Step 1: Calculate molar mass of $CaCO_3$ (1 mark)
Molar mass = 40 + 12 + (3 × 16) = 40 + 12 + 48 = 100 g/mol
Step 2: Identify mass of Ca in the compound (1 mark)
Mass of Ca = 40 g/mol
Step 3: Write percentage composition formula (1 mark)
Percentage composition = (Mass of element / Molar mass of compound) × 100%
Step 4: Substitute values (1 mark)
Percentage of Ca = (40 / 100) × 100% = 40% (1 mark for answer)
Answer: 40% (or 0.4 or 2/5)

6. **Evaporation vs Distillation (4 marks)**

EVAPORATION: (2 marks)

- Process in which a liquid changes to vapour/gas
- Occurs at any temperature (not just boiling point)
- Used to separate a solid from a solution leaving the solid behind
- Example: Obtaining salt from salt solution

DISTILLATION: (2 marks)

- Process involving evaporation followed by condensation
- Vapours are cooled and condensed back to liquid
- Used to separate a liquid from a solution/mixture
- Example: Obtaining pure water from salt solution

7. **Crystallization Method (6 marks)**

Procedure for preparing a pure solid by crystallization: (6 marks - award 1 mark per step)

8. Dissolve the impure solid in a small amount of hot solvent (e.g., hot water) to form a saturated solution
9. Filter the hot solution using filter paper to remove insoluble impurities

10. Pour the clear filtrate into an evaporating dish
11. Cool the filtrate slowly to allow crystals to form
12. Filter the crystals and wash them with small amounts of cold distilled water/cold solvent
13. Dry the crystals by placing them on filter paper at room temperature or in a warm oven

14. **Oxidation and Oxygen (6 marks total)**

(a) Definition of oxidation in terms of oxygen: (2 marks)

Oxidation is the chemical process in which a substance combines with oxygen or loses hydrogen. (1 mark for combining with oxygen, 1 mark for losing hydrogen)

(b) Sources of oxygen in the laboratory: (2 marks - any TWO of:)

- Decomposition of hydrogen peroxide using manganese dioxide as catalyst: $2H_2O_2 \rightarrow 2H_2O + O_2$
- Heating of potassium permanganate: $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$
- Heating of potassium chlorate with manganese dioxide catalyst: $2KClO_3 \rightarrow 2KCl + 3O_2$
- From compressed oxygen cylinders
- Electrolysis of water

(c) Test for oxygen gas: (2 marks)

A glowing splint is brought to the mouth of the test tube/jar containing oxygen. The splint reignites/lights up, indicating the presence of oxygen. (1 mark for procedure, 1 mark for observation/result)

15. **Chemical Reactions (8 marks total)**

(a) Definition of a chemical reaction: (2 marks)

A chemical reaction is a process in which one or more substances are converted into different substances with new properties. New bonds are formed and/or old bonds are broken. (1 mark for definition, 1 mark for mention of bond breaking/formation)

(b) Three types of chemical reactions with examples: (6 marks - 2 marks per type)

1. SYNTHESIS/COMBINATION REACTION: (2 marks)

Two or more substances combine to form a single compound. (1 mark)

Example: $H_2 + Cl_2 \rightarrow 2HCl$ or $C + O_2 \rightarrow CO_2$ (1 mark)

2. DECOMPOSITION REACTION: (2 marks)

A compound breaks down into two or more simpler substances. (1 mark)

Example: $2H_2O \rightarrow 2H_2 + O_2$ or $CaCO_3 \rightarrow CaO + CO_2$ (1 mark)

3. DISPLACEMENT/SUBSTITUTION REACTION: (2 marks)

An element displaces another element from a compound, forming a new compound. (1 mark)

Example: $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$ or $Mg + 2HCl \rightarrow MgCl_2 + H_2$ (1 mark)