1. Which, if any, of the following reactions is an oxidation/reduction reaction?
   (1) $\text{FeCl}_3(aq) + \text{Na}_3\text{PO}_4(aq) \rightarrow \text{FePO}_4(s) + 3\text{NaCl}(aq)$
   (2) $\text{SO}_2(g) + \text{H}_2\text{O}(l) \rightarrow \text{HSO}_3(aq) + \text{H}^+(aq)$
   (3) $2\text{Na}(s) + 2\text{H}_2\text{O}(l) \rightarrow 2\text{NaOH}(aq) + \text{H}_2(g)$
   A. (1) only
   B. (3) only
   C. (1) and (2) only
   D. (2) and (3) only

2. Balance the following reaction by choosing the correct coefficients:
   $$\text{____ Fe + ____ H}_2\text{O} \rightarrow \text{____Fe}_2\text{O}_3 + \text{____ H}_2$$
   A. 4 6 2 6
   B. 2 3 1 3
   C. 1 1 1 1
   D. 2 3 2 3

3. The reducing agent (if any) in the following equation is:
   $$2\text{Mg}(s) + \text{TiCl}_4(l) \rightarrow \text{Ti}(s) + 2\text{MgCl}_2(s)$$
   A. Mg
   B. TiCl$_4$
   C. MgCl$_2$
   D. not a redox reaction

4. Which of the following chemicals is used as electrolyte in an alkaline manganese cell?
   A. Ammonium chloride
   B. Ammonium hydroxide
   C. Potassium hydroxide
   D. Sodium hydroxide

   A

   B

   C
Directions: Questions 5 to 7 refer to the following set-ups. A piece of filter paper moistened with sodium chloride solution is put between the two metals in each case.

5. Which of the following represents the order of tendency to form ions of the metals?
   A. W > Y > M > X > Z
   B. X > M > W > Z > Y
   C. X > Z > M > Y > W
   D. Y > X > Z > M > W

   **C**

6. In which of the following cases would you expect a reaction to occur?

   A. metal X solution of nitrate of metal Y
   B. metal M solution of nitrate of metal Z
   C. metal W solution of nitrate of metal M
   D. metal Z solution of nitrate of metal X

   **A**

7. Which of the two metals used as electrodes would give the highest cell voltage?
   A. M and W
   B. X and W
   C. X and Y
   D. M and Z

   **B**
8. The diagram below shows a dry cell. (8 marks)

(a) Name the metal used to make case Y.

Zinc

(b) Write a half ionic equation for the reaction at

I) the positive electrode;

\[
2\text{NH}_4^+ (\text{aq}) + 2e^- \rightarrow 2\text{NH}_3 (\text{aq}) + \text{H}_2 (\text{g})
\]

II) the negative electrode.

\[
\text{Zn}(s) \rightarrow \text{Zn}^{2+} (\text{aq}) + 2e^-
\]

(c) What is the function of manganese(IV) oxide in the cell?

Hydrogen is a poor conductor of electricity. It hinders further reactions and decreases the current of the cell. Magnesium(IV) oxide is an oxidizing agent and it can remove the hydrogen.

(d) A dry cell often leaks after prolonged usage. Explain.

The zinc case is consumed in the cell reaction.

(e) A dry cell is a primary cell. What is a primary cell?

Primary cells are cells that can be used once only and cannot be recharged.

(f) Explain why alkaline cells are always recommended to be used in motor-driven appliances.

An alkaline cell can produce a steady voltage/current.
9. The set-up below is a simple chemical cell.

(a) What is the function of the filter paper soaked with KNO₃ solution?

It acts as a salt bridge to complete the circuit and balance the charge between two half-cells.

(b) What is the direction of the electron flow in this cell?

The electron flow from electrode I to electrode II through the external circuit.

(c) What is observed in beaker A? Explain your answer.

The solution changes from pale green to yellow because Fe²⁺ is oxidized to Fe³⁺.

(d) What is observed in beaker B? Explain your answer.

The solution changes from purple to colourless because MnO₄⁻ is reduced to Mn²⁺.

(e) Write a half ionic equation for the reaction occurred at

(i) electrode I.

\[ \text{Fe}^{2+}(aq) \rightarrow \text{Fe}^{3+}(aq) + e^- \]

(ii) electrode II.

\[ \text{MnO}_4^-(aq) + 8H^+(aq) + 5\text{Fe}^{2+}(aq) \rightarrow \text{Mn}^{2+}(aq) + 4\text{H}_2\text{O}(l) + \text{Fe}^{3+}(aq) \]

(8 marks)
For question 10, you are required to give a paragraph-length answer. 3 of the marks for the question will be awarded for effective communication of knowledge in Chemistry.

10. Briefly describe an experiment of electroplating of chromium on a metal fork. Give the expected observations of the experiment.

The following apparatus and chemicals are provided:

A metal fork, a chromium plate, chromium(III) sulphate crystals, a beaker of distilled water, a beaker of sodium hydroxide solution, a d.c. power supply with connecting wires.

(9 marks)

Prepare a (saturated) chromium(III) sulphate solution. (1)
Clean the fork with sodium hydroxide solution. (1)
Correct connection of metal fork and chromium plate to d.c. power supply. (1)
Immerse fork and plate into (saturated) chromium(III) sulphate solution and turn on the power supply. (1)

Observation (Any TWO of the following) (2)

Silvery deposit on metal fork.
Chromium plate decrease in size.
Colour of chromium(III) sulphate solution remain unchange/conc. remain unchange.

Effective communication (3 marks)