CHEMISTRY SAMPLE TEST: REDOX YEAR 12

ELECTROCHEMISTRY AND METAL EXTRACTION

PART A: MULTIPLE CHOICE (15 marks)

1. Which of the following correctly shows the substances listed in order of ***increasing*** strength as reducing agents ?

   (a) F, Al, Zn, Cu, I^-
   (b) I^-, F^-, Zn, Al, Cu
   (c) F^-, I^-, Cu, Al, Zn
   (d) F^-, I^-, Cu, Zn, Al

2. Which one of the following statements is ***FALSE*** ?

   (a) In an electrochemical cell, chemical energy is converted to electrical energy.
   (b) Oxidation occurs at the anode and reduction occurs at the cathode in both an electrochemical cell and an electrolytic cell.
   (c) In an electrolytic cell, an external source of electricity is used to drive the reaction.
   (d) In an electrochemical cell, the anode is positively charged.

3. What is the function of the salt bridge in an electrochemical cell ?
   (a) To allow movement of ions between the two half-cells to maintain electrical neutrality.
   (b) To supply the ions necessary for oxidation and reduction.
   (c) To allow the electrons to move from the anode to the cathode.
   (d) To keep the level of the solutions equal in both half-cells.

4. When comparing electrochemical cells and electrolytic cells, it is true to say that:

   (a) the anode is positive, and the cathode is negative.
   (b) reduction occurs at the negative electrode in an electrochemical cell.
   (c) reduction occurs at the cathode
   (d) oxidation occurs at the cathode in an electrolytic cell

5. Which of the following combinations of half cells would generate the greatest EMF ?

   (a) Mg / Mg^{2+} with Fe^{2+} / Fe
   (b) Mg / Mg^{2+} with Ni^{2+} / Ni
   (c) Mg / Mg^{2+} with Cu^{2+} / Cu
   (d) Mg / Mg^{2+} with Ag^{+} / Ag

6. A student was investigating metal displacement reactions. She had a lead (II) nitrate solution in a beaker, and a zinc screw, copper nail and silver spoon. She tried each item in the solution, one at a time. What would have happened ?

(a) all three items would become coated in lead
(b) only the nail and the spoon would be coated in lead
(c) there will be no reaction with any of the items
(d) only the zinc screw will be coated in lead

7. Which of the following statements about the lead - acid accumulator (car battery) is ***FALSE*** ?

(a) The major advantage of the lead - acid accumulator over the dry cell is that it can be recharged.
(b) During recharging the concentration of sulfuric acid decreases.
(c) When the lead - acid accumulator is discharging, the following reaction occurs:

$$Pb\,(s) + PbO_2\,(s) + 4\,H^+\,(aq) + 2\,SO_4^{-2}\,(aq) \rightarrow 2\,PbSO_4\,(s) + 2\,H_2O\,(l)$$

(d) The lead - acid accumulator converts electrical energy into chemical energy during the recharging process.

8. What is the primary role of manganese dioxide in the dry cell (ie: torch battery, Leclanché cell) ?

(a) To react and provide hydrogen ions for the redox reaction.
(b) To act as the electrolyte.
(c) To be reduced to Mn_2O_3 at the cathode.
(d) To act as a reducing aqent at the cathode.

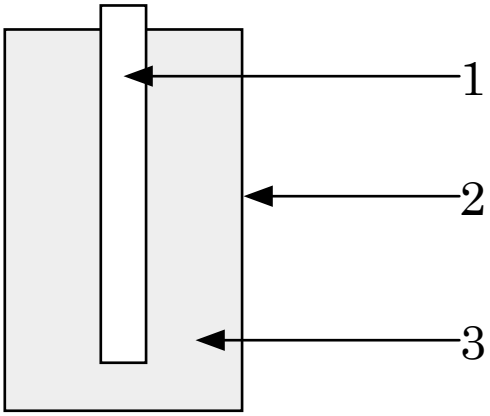
9. Rust is thought to be

(a) Hydrated iron oxide, $Fe_2O_3.xH_2O$
(b) Iron (III) oxide, Fe_2O_3
(c) Iron (II) oxide, FeO
(d) Iron (II/III) oxide, Fe_3O_4

10. In the extraction of iron by smelting iron ore (Fe_2O_3) in the blast furnace, which one of the following reduces the iron oxide to iron ?

(a) Hydrogen.
(b) Calcium carbonate.
(c) Oxygen from the air
(d) Carbon monoxide.

11. Below is a cross - sectional diagram of a dry cell (Leclanché cell).



Which one of the following correctly identifies the components of the cell labelled **1, 2** and **3** above ?

	1	**2**	**3**
(a)	Graphite	Aluminium	a paste of manganese dioxide and zinc sulfate
(b)	Graphite	Zinc	a paste of manganese dioxide and ammonium chloride
(c)	Zinc	Aluminium	a paste of manganese dioxide and zinc sulfate
(d)	Aluminium	Zinc	a paste of manganese dioxide and zinc sulfate

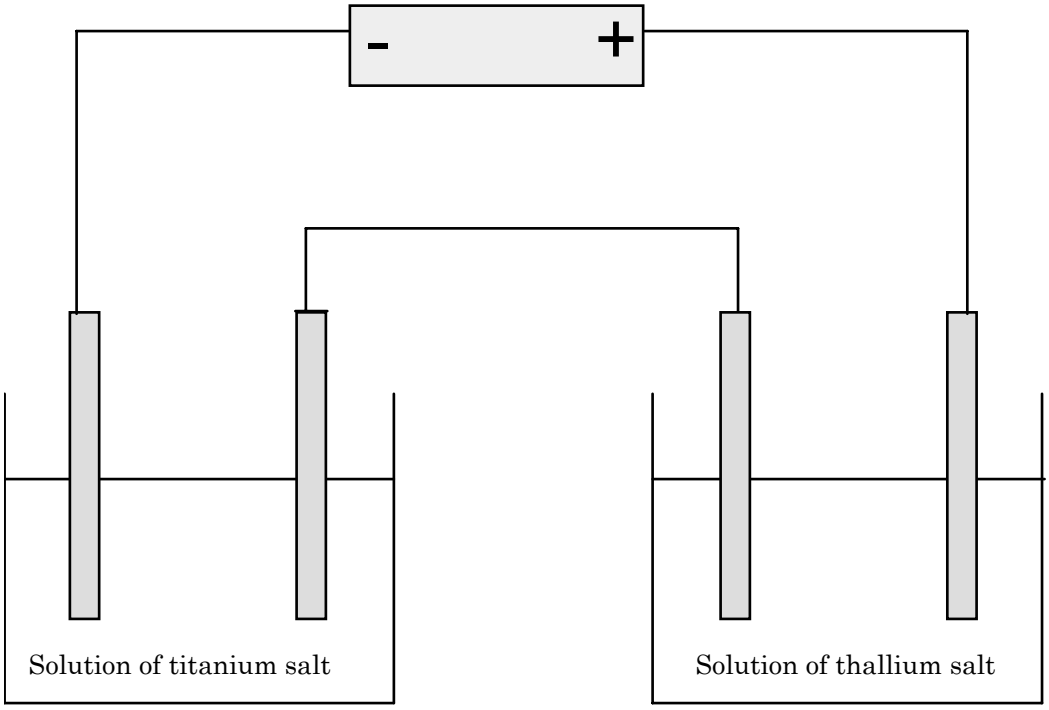
12. Which of the following **BEST** describes the function of cyanide in the production of gold ?

(a) To facilitate the reduction of gold by zinc
(b) To ensure that the reduced gold is easy to filter
(c) To oxidise natural gold sulfide to gold metal
(d) To promote the oxidation of gold by oxygen from the air

13. In the electroplating of cutlery, one electrode is made from the metal with which we want to coat the cutlery. For this to work,which of the following would have to be ***true*** ?

(a) the cutlery should be made the anode
(b) the electrolyte should be a solution of the metal from which the cutlery is made
(c) the cutlery should be made to be the negative electrode
(d) the cathode should be made from the metal which we want to electroplate on to the cutlery

14. In the diagram below, one solution contains a titanium (Ti) salt and the other contains a thallium (Tl) salt. When a quantity of electricity is passed through the two solutions as shown in the diagram below, 0.200 mole of Ti is deposited on one cathode and 0.400 mole of Tl is deposited on the other cathode.



Which of the following conclusions can be drawn from these observations **alone** ?

I Both the Ti and the Tl ions are positively charged.
II The charge on the Ti ion is double that on the Tl ion.
III The Ti ion has a charge of +2
IV The Tl ion has a charge of +1

(a) I and II only
(b) I only
(c) II only
(d) III and IV only

15. When an electric current is passed through 1.0 mol L^{-1} sodium chloride between graphite electrodes, which of the following half reactions occurs at the cathode ?

(a) $Na^+ (aq) + e^- \rightarrow Na (l)$
(b) $2 H_2O (l) + 2 e^- \rightarrow H_2 (g) + 2 OH^- (aq)$
(c) $2 Cl^- (aq) \rightarrow Cl_2 (g) + 2 e^-$
(d) $2 H_2O (l) \rightarrow O_2 (g) + 4 H^+ (aq) + 4 e^-$

END OF PART A: MULTIPLE CHOICE

PART B: WRITTEN SECTION (37 marks)

1. For an electrochemical cell consisting of Cu^{2+} / Cu and Zn^{2+} / Zn half cells:
   (a) **Draw** a labelled diagram showing all apparatus and reagents used. **(3 marks)**

   (b) **LABEL** the anode, the cathode, the positive and negative electrodes, the direction of electron flow, and the direction of movement of both positive and negative ions in both solutions. **(7 marks)**

   (c) Use half equations to calculate cell voltage under standard conditions. **(2 marks)**

2. For the electrolysis of a 1.00 M aqueous solution of $AgNO_3$ with inert electrodes and under standard conditions predict:
   (a) the overall reaction (Write half equations and a complete balanced equation)
   (b) the minimum voltage which must be applied to produce the overall reaction.
   (c) The observations you would make at each electrode. **(6 marks)**

3. Sodium metal may be produced by the electrolysis of molten sodium chloride
   (a) Write anode and cathode reactions for this process.
   (b) If a current of 2.05 Amps flows for 5.00 hours, what mass of liquid sodium metal will be produced (assume 100% current efficiency) ? **(6 marks)**

4. Briefly explain two methods used to prevent corrosion of iron. Make sure you also describe each method. **(4 marks)**

5. A "biobattery" has been suggested as an energy source for implanted pacemakers and bionic ears. It would consist of a platinum electrode and a zinc electrode inserted into the body, with blood acting as the electrolyte and supplying water and hydrogen ions necessary for the reactions.

   (a) Write a balanced equation for the reaction which would occur at each electrode. (Note: Platinum is inert. The reaction at the platinum electrode is mainly water in the near neutral blood being reduced, while the zinc is oxidized) **(2 marks)**

   (b) Write the overall biobattery equation. **(2 marks)**

   (c) Calculate how many days such a biobattery would last if the zinc electrode had a mass of 1.00g and the continuous current produced was 5.00×10^{-5} ampere. **(5 marks)**

END OF TEST - TOTAL = 52 marks