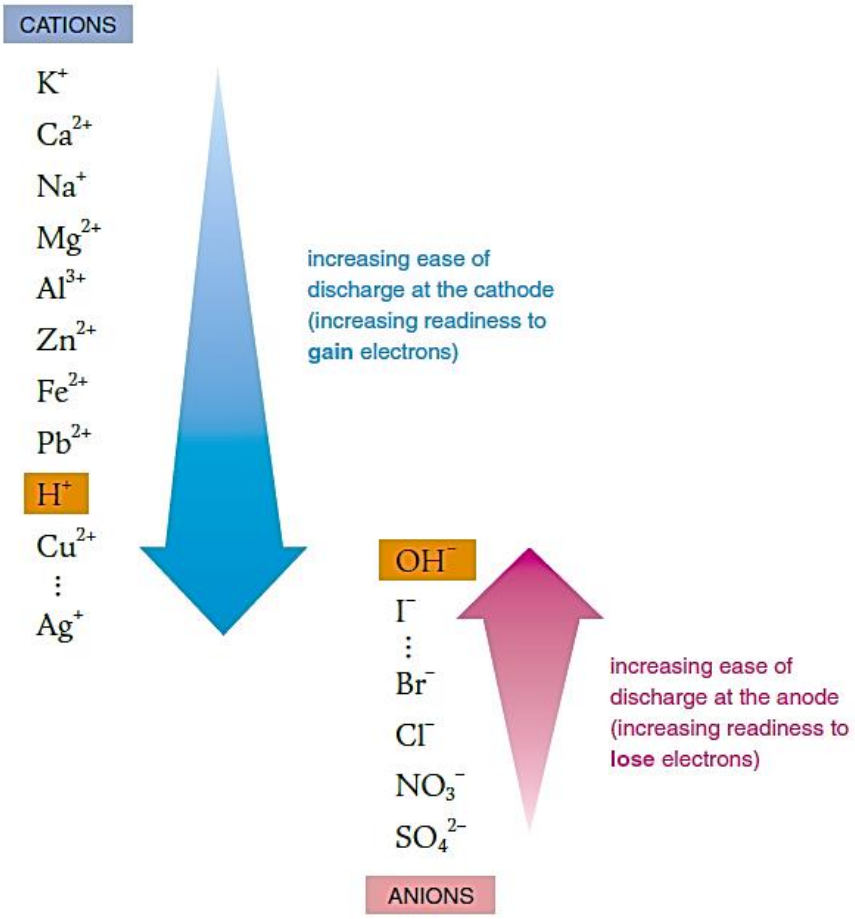
Quiz (Electrolysis of Aqueous Electrolytes)

1. The positions of $H^+(aq)$ and $OH^-(aq)$ in the E.C.S. are highlighted. In fact, their positions have special importance in the preferential discharge of ions in any aqueous solution.



Fill in the blanks:

In any aqueous solution, _____ ions and _____ ions are present.

Preferential discharge of cations at an inert cathode

- If a cation is below $H^+(aq)$ in the E.C.S., the _____ should be discharged, forming the _____.
- If a cation is above $H^+(aq)$, the _____ should be discharged, forming _____.

Preferential discharge of anions at an inert anode

- Basically, _____ ions should be discharged, forming _____.
- But in a concentrated halide solution (chloride, bromide or iodide), _____ may be discharged instead (due to _____ effect).

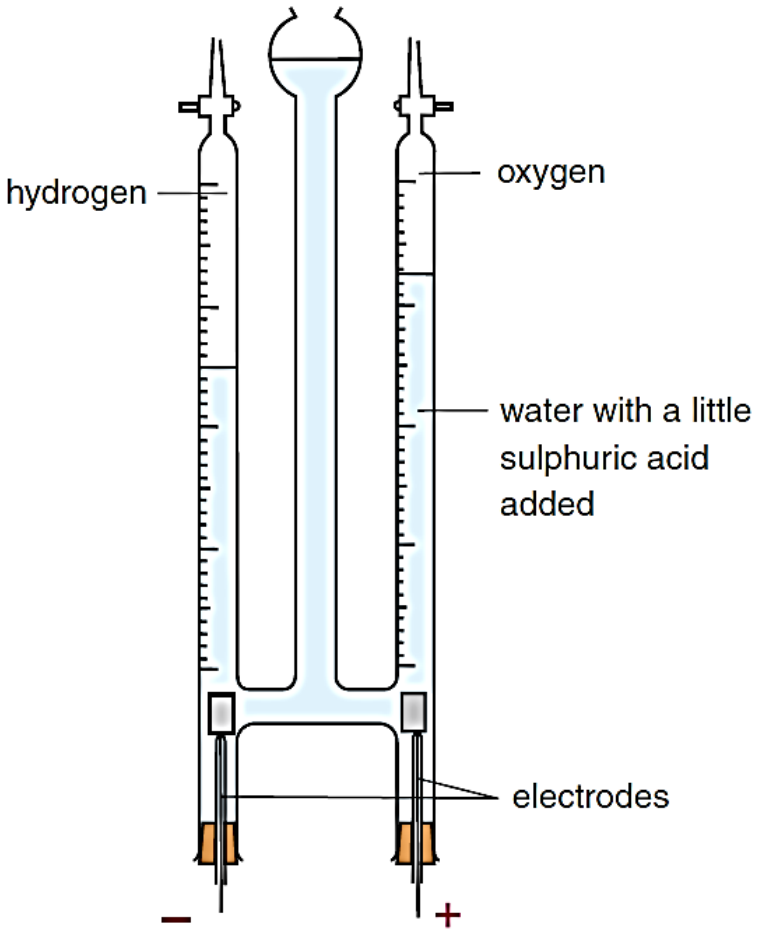
2. The diagram shows the electrolysis of water with a little sulphuric acid added.
   (a) Explain why a little sulphuric acid is added to the water.

   (b) Graphite is commonly used as electrodes in electrolysis, but not in this set-up. State TWO disadvantages if graphite electrodes are used instead.

   (c) Suggest a suitable material for the electrodes.

   (d) Write the half equations for the reaction at the cathode and that at the anode during the electrolysis.

   (e) Suggest a chemical test for each product obtained in the electrolysis.



3. A student carried out the electrolysis of water with a little dilute sodium hydroxide solution added using a Hofmann voltameter.
   (a) Write the formulae of the cations and anions present in the solution.

   (b) Name the product liberated and write down the half equation involved at the
      (i) anode and
      (ii) cathode.

   (c) What is the volume ratio of the products in (b)?

Suggested Answer

1. In any aqueous solution, **H^+(aq)** ions and **OH^-(aq)** ions are present.

   Preferential discharge of cations at an inert cathode

   - If a cation is below H^+(aq) in the E.C.S., the **cation** should be discharged, forming the **metal**.
   - If a cation is above H^+(aq), the **H^+(aq)** should be discharged, forming **hydrogen**.

   Preferential discharge of anions at an inert anode

   - Basically, **OH^-(aq)** ions should be discharged, forming **oxygen**.
   - But in a concentrated halide solution (chloride, bromide or iodide), **halide ion** may be discharged instead (due to **concentration** effect).

2. (a) To increase the electrical conductivity of water.

   (b) 1. Since the oxygen liberated would react with the graphite (carbon) electrode to form carbon dioxide, the volume of oxygen collected would be smaller than expected.

   2. The graphite electrodes would break up into small pieces as electrolysis continues.

   (c) Platinum

   (d) At the cathode: $2H^+(aq) + 2e^- \longrightarrow H_2(g)$
   At the anode: $4OH^-(aq) \longrightarrow O_2(g) + 2H_2O(l) + 4e^-$

   (e) Hydrogen burns with a 'pop' sound. Oxygen relights a glowing splint.

3. (a) Cations present in the solution: $Na^+(aq)$, $H^+(aq)$
   Anions present in the solution: $OH^-(aq)$

   (b) (i) At the anode: oxygen
   $4OH^-(aq) \longrightarrow O_2(g) + 2H_2O(l) + 4e^-$

   (ii) At the cathode: hydrogen
   $2H^+(aq) + 2e^- \longrightarrow H_2(g)$

   (c) Volume ratio of the O_2 to H_2 formed is 1 : 2.