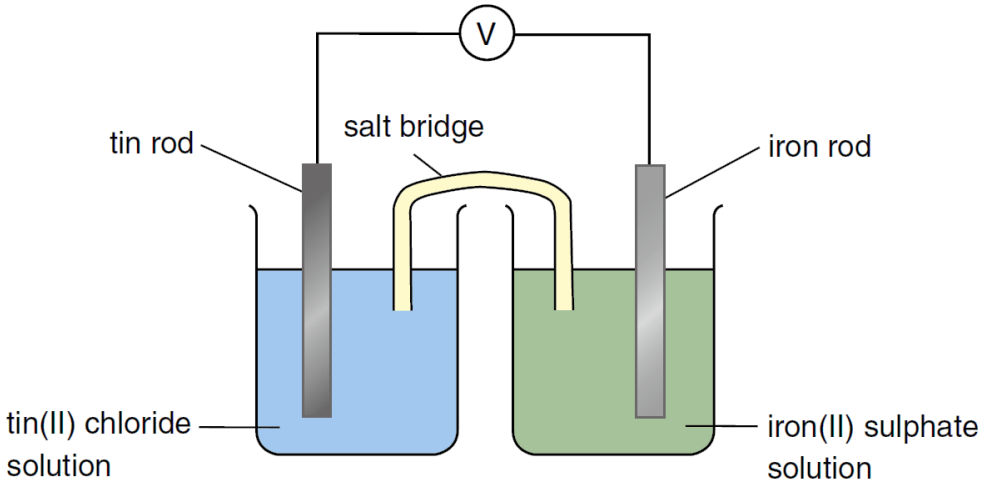
Quiz (Chemical Cell with Two Half Cells System)

1. Consider the chemical cell below:



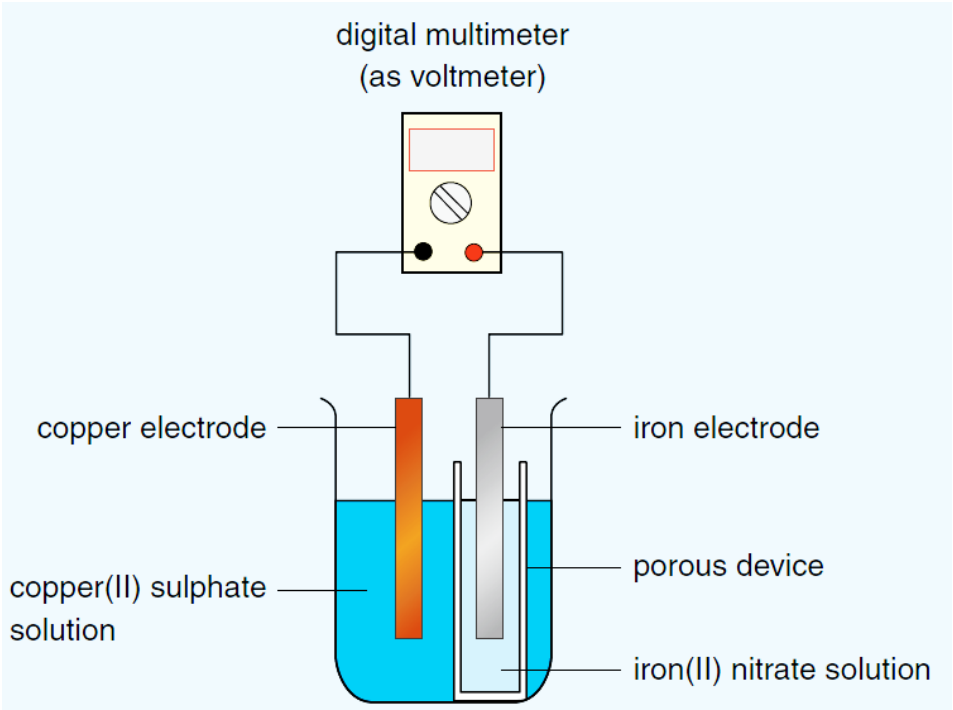
(a) State and explain the direction of electron flow in the external circuit when the cell operates.

(b) Write half equations for the reactions taking place at
(i) the iron rod; and
(ii) the tin rod.

(c) Write the overall equation for this chemical cell.

(d) What would happen if no salt bridge was used to connect the two half cells?

2. Consider the following chemical cell:



(a) State and explain the direction of electron flow in the external circuit when the cell operates.

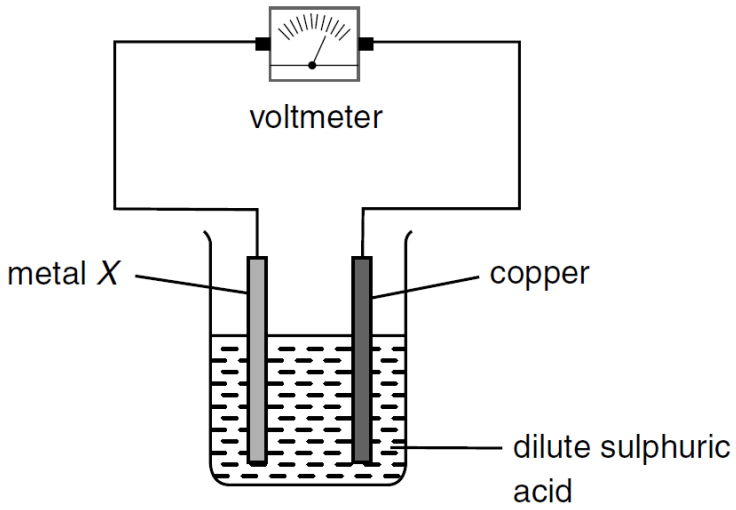
(b) Is the copper electrode the positive electrode or the negative electrode?

(c) Write the half equation for the reaction taking place at each of the following electrodes when the cell operates:
(i) iron electrode
(ii) copper electrode

(d) Write the overall equation for this chemical cell.

(e) What would happen if the porous device with iron(II) nitrate solution was not used in the cell?

3. A simple chemical cell is set up as shown below.



The solution in the beaker turns pale green after some time.

(a) Suggest what metal *X* may be.

(b) What is the function of dilute sulphuric acid?

(c) Briefly describe any observable changes at the copper electrode and write a half equation for the reaction involved.

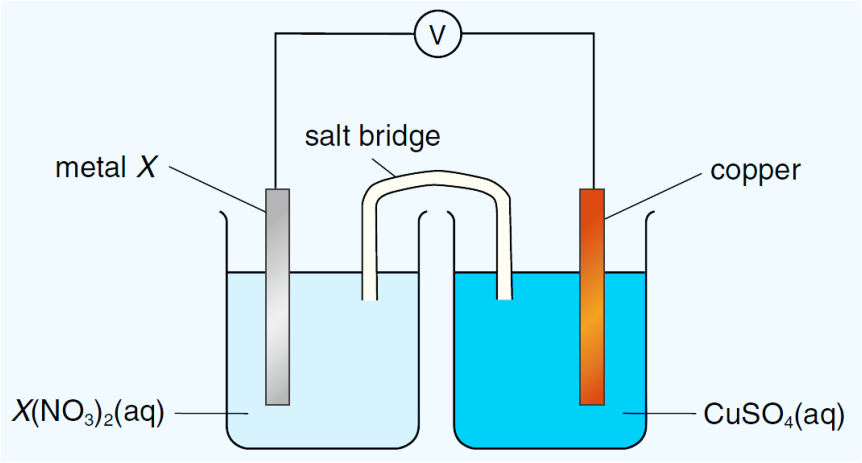
(d) (i) Write a half equation for the reaction occurring at metal *X*.
(ii) Explain why bubbles appear at metal *X*.

(e) Explain why the voltmeter reading becomes zero when dilute sulphuric acid is replaced by pure sulphuric acid.

4. A portion of the Electrochemical Series is shown below:

$Zn^{2+}(aq) + 2e^- \leftrightarrows Zn(s)$
$X^{2+}(aq) + 2e^- \leftrightarrows X(s)$
$Cu^{2+}(aq) + 2e^- \leftrightarrows Cu(s)$
$Ag^{+}(aq) + e^- \leftrightarrows Ag(s)$

The following diagram shows a chemical cell set up by using a copper electrode and a metal *X* electrode.



(a) State and explain the direction of electron flow in the external circuit.

(b) Write a half equation for the reaction taking place at
(i) the copper electrode, and
(ii) the metal *X* electrode.

(c) Write an equation to show the overall reaction in the above chemical cell.

Suggested Answer

1. (a) Electrons flow from the iron rod to the tin rod in the external circuit.
This is because iron loses electrons more readily than tin.

(b) (i) $Fe(s) \longrightarrow Fe^{2+}(aq) + 2e^-$
(ii) $Sn^{2+}(aq) + 2e^- \longrightarrow Sn(s)$

(c) $Fe(s) + Sn^{2+}(aq) \longrightarrow Fe^{2+}(aq) + Sn(s)$

(d) There would be excess positive charges and excess negative charges in the right and left half cells respectively. As a result, the reaction would stop.

2. (a) From iron electrode to copper electrode.
This is because iron loses electrons more readily than copper.

(b) Positive electrode

(c) (i) $Fe(s) \longrightarrow Fe^{2+}(aq) + 2e^-$
(ii) $Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)$

(d) $Fe(s) + Cu^{2+}(aq) \longrightarrow Fe^{2+}(aq) + Cu(s)$

(e) If the porous device is not used, the copper(II) ions will come into contact with the iron electrode. A displacement reaction will occur on the iron deposits (copper) form on the iron electrode.

3. (a) Iron

(b) It acts as an electrolyte.

(c) Gas bubbles appear at the copper electrode.
$2H^+(aq) + 2e^- \longrightarrow H_2(g)$

(d) (i) $Fe(s) \longrightarrow Fe^{2+}(aq) + 2e^-$
(ii) Metal X (iron) reacts with dilute sulphuric acid and forms hydrogen gas.

(e) Pure sulphuric acid does not contain any ions to conduct electricity.

4. (a) Electrons flow from metal X to copper in the external circuit.
This is because metal X loses electrons more readily than copper / X is higher than copper in the Electrochemical series.

(b) (i) $Cu^{2+} + 2e^- \longrightarrow Cu(s)$
(ii) $X(s) \longrightarrow X^{2+}(aq) + 2e^-$

(c) $X(s) + Cu^{2+}(aq) \longrightarrow X^{2+}(aq) + Cu(s)$