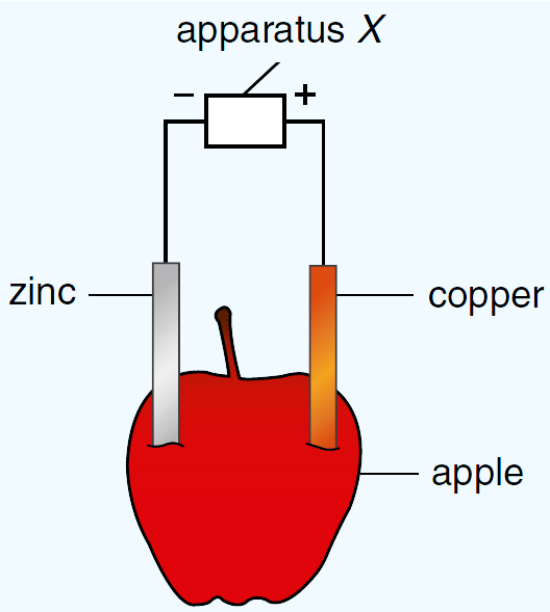
Quiz (Simple Chemical Cells)

1. The diagram below shows a simple chemical cell made from an apple.



(a) What is *X*? State a function of *X*.

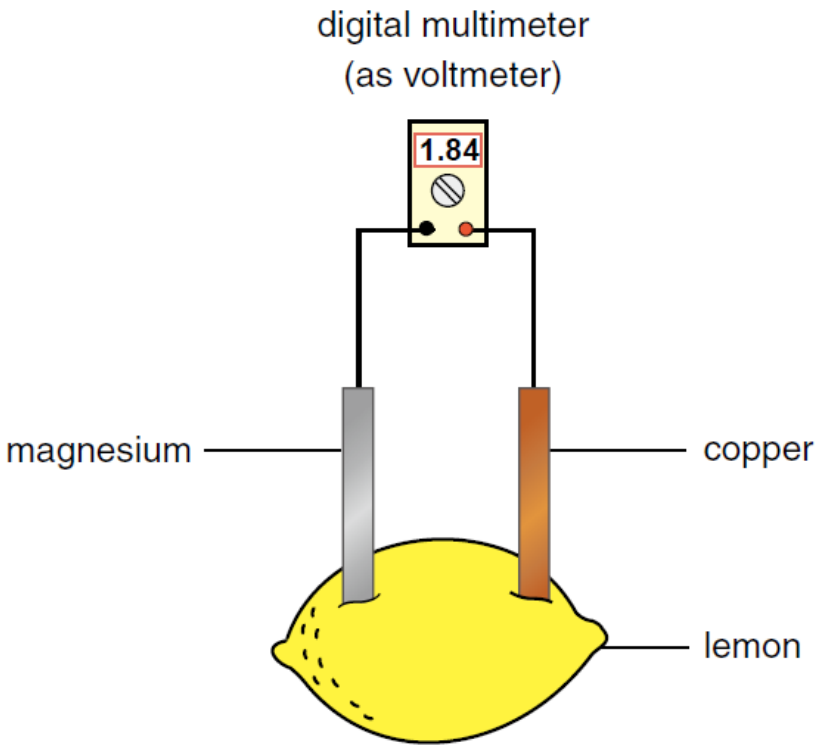
(b) State the direction of electron flow in the external circuit of this chemical cell.

(c) Write a half equation for the reaction that occurs at the zinc electrode.

(d) Apple juice containing malic acid acts as the electrolyte of the cell.
(i) Explain why malic acid can act as an electrolyte of this cell.
(ii) Suggest another fruit that can be used to make a chemical cell.

2. State one difference in the order of metals between the Electrochemical Series and the metal reactivity series. Explain briefly.

3. Consider the lemon cell below and answer the questions.



(a) Explain briefly why a lemon can be used to make a chemical cell.

(b) Write the half equation for the reaction that occurs
(i) at the magnesium strip.
(ii) at the copper strip.

(c) Write the overall equation for the reaction in the above lemon cell.

(d) State the direction of electron flow in the external circuit.

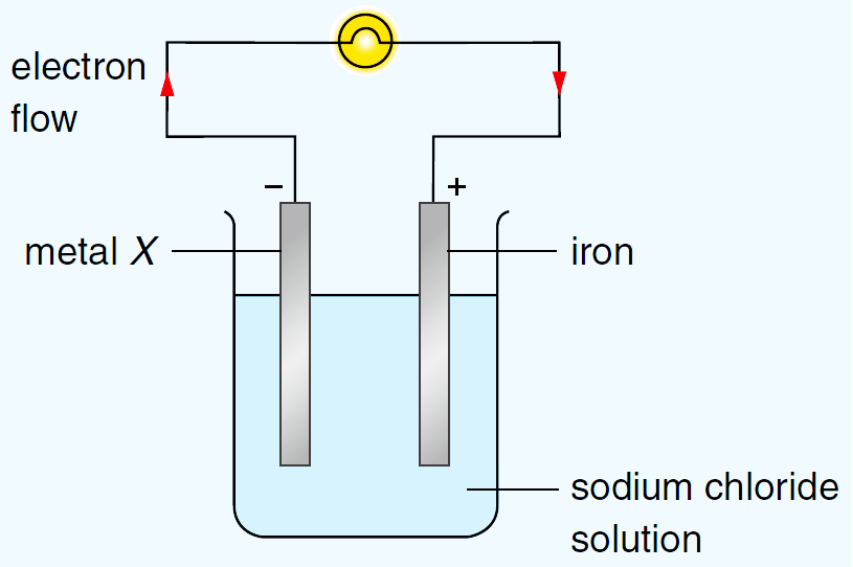
(e) What would happen to the voltage on the multimeter if the magnesium strip is replaced with
(i) a zinc strip?
(ii) a copper strip?
(iii) a silver strip?
Explain your answers.

4. Consider the following chemical cells:
   Cu/Pb, Mg/Pb, Ag/Pb, Fe/Pb, Zn/Pb

   (a) Which of the above cells give(s) a positive voltage when lead is the positive electrode?

   (b) Among these cells, which one gives the highest voltage? Explain your answer.

5. The following diagram shows a simple chemical cell.



   (a) Which metal, *X* or iron, is at a higher position in the Electrochemical Series? Explain your answer.

   (b) A student replaces metal *X* with a silver strip.
   (i) What would happen to the flow of electrons in the external circuit?
   (ii) What would happen to the mass of the iron electrode?
   (iii) What would happen to the sodium chloride solution?

Suggested Answer

1. (a) X is a bulb / voltmeter / digital multimeter.
It is used to show that electrons are flowing in the external circuit.

(b) From zinc to copper

(c) $Zn(s) \longrightarrow Zn^{2+}(aq) + 2e^-$

(d) (i) Malic acid ionizes in water, providing mobile ions for the chemical cell to complete the circuit.

(ii) Lemon / kiwi fruit (Accept other reasonable answers.)

2. Calcium is at a higher position than sodium in the Electrochemical Series. In the metal reactivity series, however, calcium is at a lower position than sodium. This is due to the use of different experimental conditions when establishing the two series. The E.C.S. is based on **voltage measurements**. The metal reactivity series is based on **vigour of chemical reactions**.

3. (a) The lemon contains citric acid which can act as an electrolyte in the chemical cell.

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

(ii) $2H^+(aq) + 2e^- \longrightarrow H_2(g)$

(c) $Mg(s) + 2H+(aq) \longrightarrow Mg^{2+}(aq) + H_2(g)$

(d) From magnesium to copper

(e) (i) The voltage decreases. This is because zinc and copper are less far apart in the Electrochemical Series than magnesium and copper are. Thus, zinc loses electrons to copper less readily than magnesium does.

(ii) The voltage becomes zero. The lemon cell does not generate electricity any more because there is no difference in the tendency of losing electrons between the two copper strips.

(iii) The voltage reading becomes negative. This is because silver is at a lower position than copper in the Electrochemical Series. Copper would lose electrons to silver and so electrons flow from copper to silver in the external circuit.

4. (a) Mg/Pb, Fe/Pb and Zn/Pb

   (b) Mg/Pb. This is because Mg and Pb are the furthest apart in the Electrochemical Series among all metal couples which give a positive voltage.

5. (a) Metal X is at a higher position in the Electrochemical Series because metal X loses electrons to iron.

   (b) (i) The direction of the flow of electrons in the external circuit is reversed (I.e. from iron to silver).

   (ii) The mass of the iron electrode decreases.

   (iii) The solution turns pale green gradually.