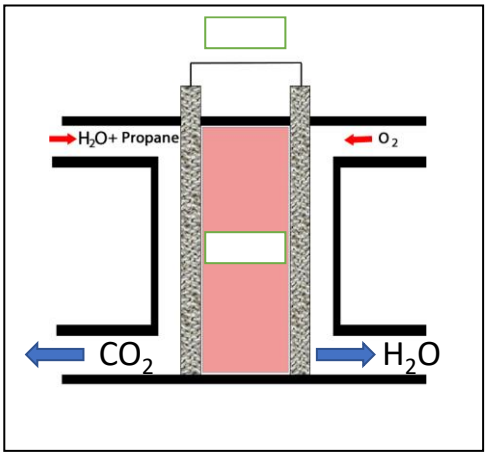
Video worksheet – Fuel cells

1. An PEMFC runs on propane gas.
   a. Write a balanced chemical equation of the complete combustion of propane gas in oxygen gas. States not required
   b. Write the balanced half equation for the reaction taking place at the:
      - negative electrode of the fuel cell. States not required

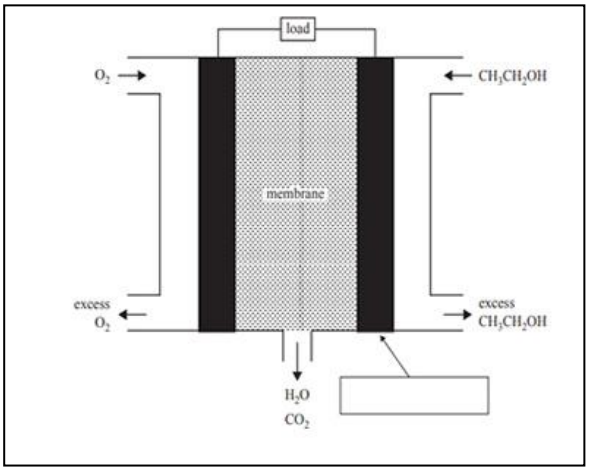
      - positive electrode . States not required

   c. i. Name the species that crosses the membrane to enable the fuel cell to operate.
   ii. In the box provided on the diagram on the right, indicate the direction of flow of the species named in part c. i.
   iii. Indicate the direction of electron flow in the box provided.



2. Some car manufacturers are exploring the use of an acidic ethanol fuel cell to power vehicles. In this fuel cell, the ethanol at one electrode reacts with water that has been produced at the other electrode. A membrane is used to transport ions between the electrodes. A diagram of an acidic ethanol fuel cell is shown on the right.

   a. Identify the electrode as either the cathode or the anode in the box provided in the diagram on the right. Give the polarity of the electrode.



   b. Write the half-equation for the reaction occurring at the anode.

   c. This cell can also burn octane. Write the half-equation for the reaction occurring at the anode

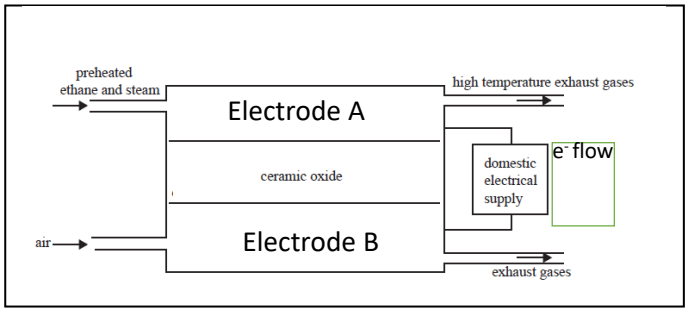
   d. The combustion of ethanol and the combustion of octane release about the same amount of energy per mole of carbon dioxide produced. Identify two advantages of powering a vehicle using an ethanol fuel cell instead of an internal combustion engine powered by octane.

3. A solid oxide fuel cell burns liquid butane using atmospheric oxygen. Liquid water and carbon dioxide gas are vented into the atmosphere from the negative terminal of the cell.
   a. Write the half-equation for the reaction occurring at the anode. States not required.

   b. Write the half-equation for the reaction occurring at the cathode. States not required.
   c. State the function of the electrolyte in this fuel cell.

4. 4. A solid oxide fuel cell, shown on the right, operates at 600 °C and burns ethane gas in atmospheric oxygen.
   a. Write the balanced equation, states included, for the overall reaction taking place in the fuel cell.

   b. Write the half-equation for the reaction occurring at electrode A. States not required.

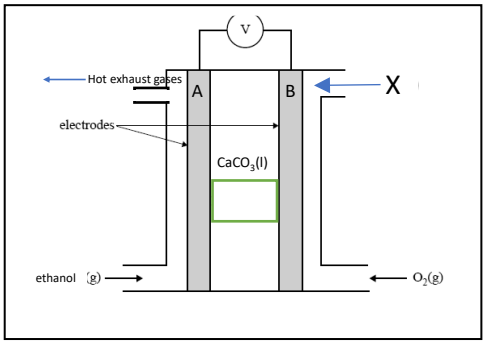


   c. Write the half-equation for the reaction occurring at electrode B. States not required.

   d. What is the polarity of electrode B?
   e. Indicate in the box provided the direction of electron flow.
   f. State three differences between this fuel cell and a secondary cell.

5. An experimental fuel cell, shown below, operates at 800 °C and burns ethanol in atmospheric oxygen.
   a. Identify electrode B as either the anode or cathode and give its polarity.
   b. Write the half-equation for the reaction occurring at electrode A. States required.
   c. Identify substance X

   d. What charged particle flows through the electrolyte? Indicate its direction of flow by placing an arrow in the box provided.



6. A molten carbonate fuel cell is shown below. It burns methane gas
   a. Write the half-equation for the reaction occurring at the anode. States required.

   b. Identify reactants supplied at the cathode.
   c. What volume of methane gas is consumed by the fuel cell in order to produce a total charge of 1.93×10^5 C if the cell operates at 80% efficiency methane is fed into the cell at 204 kPa and 100 °C?