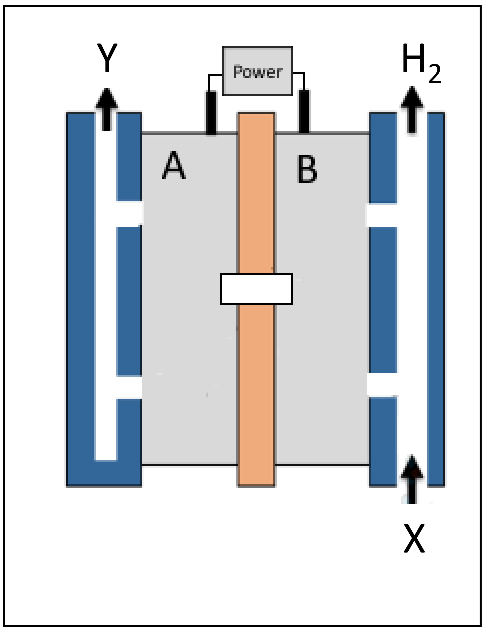
Video worksheet – green hydrogen and biohydrogen.

1. Pictured on the right is a generic template of an electrolyser.



a. Assuming the template represents a solid oxide electrolyser:

i. give the balanced chemical equation for the reaction taking place at each electrode. States not required

A ____________________

B ________________________

ii. give the polarity of electrode B

iii. identify the ions travelling through the electrolyte and their direction of travel in the box provided.

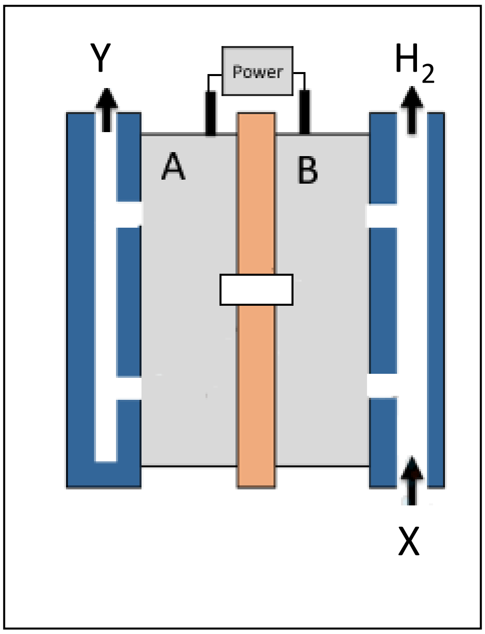
iv. identify the following species

Y _____________

X _____________

v. identify the anode.

2. Alkaline electrolysers are more durable than acidic electrolysers lasting decades long rather then years which is the case with acidic electrolysers. Alkaline electrolysers also require lower operating temperatures of around 70°C - 80°C which makes them cheaper to run. Pictured on the right is a generic template of an electrolyser.



a. Assuming the template represents an alkaline water electrolyser:

i. identify the following species

Y _____________

X _____________

ii. give the balanced chemical equation for the reaction taking place at each electrode. States required.

A _____________________________

B _____________________________

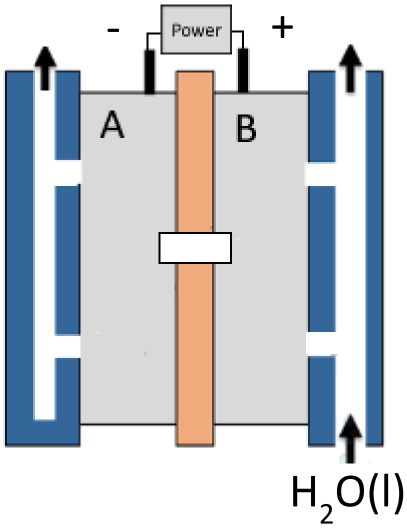
iii. give the polarity of electrode B

iv. identify the ions travelling through the electrolyte and their direction of travel in the box provided.

v. identify the anode.

vi. Give a possible electrolyte.

3. An acidic electrolyser runs for 48.0 hours at a current of 15.0 amps.
   a. Calculate the mass, in grams, of hydrogen produced assuming the electrolyser is 100% efficient.



   b. Give the balanced half equations, states required, for the reactions taking place at electrode:
   A ______________________________
   B ______________________________

   c. Using the box provided identify the ions moving through the electrolyte and their direction of flow.

4. An Australian company (HYSATA) in 2022, developed a capillary-fed electrolyser that reduced the energy cost of producing one kilogram of hydrogen (H_2) to 1.89 X 10^5 kJ, smashing efficiency records while also being cheaper to install and run. Chemists and engineers around the globe aim to get the cost of green hydrogen down to an economically viable US $1 per kilogram.
   a. Calculate the efficiency of the current, commercial electrolysers made by Hysata.

   b. Using the efficiency calculated in a. above, give the energy needed, in kJ, to produce 4.5 kg of hydrogen gas. Give the answer to the right number of significant figures.

5. Chlorine gas is a powerful oxidant that degrades expensive catalyst electrodes in water electrolysers. This is a major problem that must be overcome in the production of cheap hydrogen gas from abundant reserves of sea water.
   a. Using the electrochemical series provided in the data booklet justify why sea water must be purified before entering an electrolyser.

   b. Assuming chlorine gas is produced at the anode, calculate the mass of hydrogen gas produced at the cathode.