

Friday Worksheet

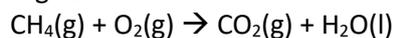
Name:

Fuel cells worksheet 3

1) Indicate if the following statements are true or false for both fuel cells and rechargeable cells. Give an explanation

- a) Reactants and products are stored within the cell.
- b) Reaction products are continuously removed from the cell.
- c) Electrons pass from the oxidant to the cathode as electricity is produced.
- d) Electrical energy is converted to chemical energy as the cell is recharged.

2) Methane can be obtained from natural gas deposits **or** as a biochemical fuel from biomass. A methane fuel cell is being considered, using an acidic electrolyte. The overall, unbalanced reaction is given below



- a) What species is being oxidised?
- b) Give the equation for the half-reaction that occurs at the anode.
- c) Give the equation for the half reaction that occurs at the cathode.
- d) Give a balanced overall equation

3) Fuel cells are being developed that use fuels other than hydrogen as their energy sources. Potential fuels include ethane and ethane-1,2-diol. These fuels are reacted with oxygen gas to produce $\text{CO}_2(\text{g})$ and $\text{H}_2\text{O}(\text{l})$ using an acidic electrolyte.

a) Write the reaction occurring at the anode for, for simplicity do not include states:
ethane -----

ethane-1, 2-diol ----

b) Which one of the two fuels would produce the greatest amount of CO_2 per coulomb of electrical charge generated?

c) The ethane fuel cell operates at a voltage of 0.842 V.

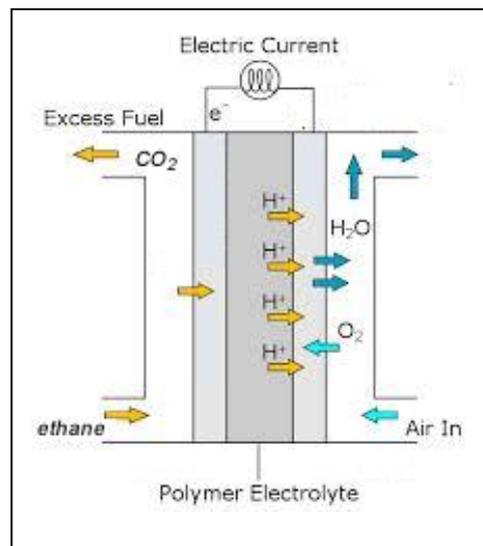
i. Calculate the amount of energy, in kJ, delivered by one mol of ethane.

ii. Using the molar heat of combustion of ethane, calculate the energy efficiency of this fuel cell.

iii. Name one difference between the electrodes of a fuel cells and the electrodes of most galvanic cells.

iv. Indicate on the diagram:

- the direction of electron flow,
- cathode,
- anode.



v. What is the difference between the electrolyte in a fuel cell and the salt bridge in a galvanic cell?

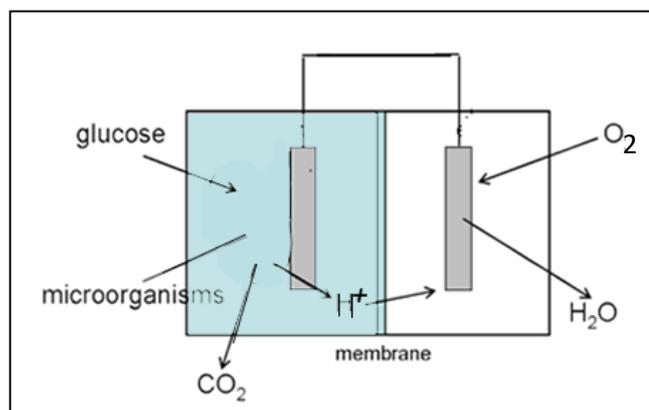
vi. Write the equation for the reaction taking place at the anode if an ethane fuel cell using an alkaline electrolyte, such as KOH paste.

d) A microbial fuel cell is a device that converts chemical energy into electrical energy by the catalytic reaction of microorganisms. The image on the right shows the schematic of a microbial fuel cell, where glucose ($C_6H_{12}O_6$) in solution is broken down by bacteria to CO_2 .

i. What is the oxidation state of carbon in:

- $C_6H_{12}O_6$,
- CO_2

ii. Write the equation to the reaction that occurs at the anode.



iii. Write the equation for the reaction that occurs at the cathode.

iv. The cell operates for 6.00 hours producing a constant current of 1.05 Amps. What amount of glucose, in grams, is consumed by the cell?