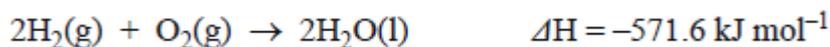


## Friday Worksheet

Name: .....

### Fuel cells worksheet 4

- 1) The reaction between hydrogen and oxygen was the basis of energy required for lift off during the Space Shuttle era. It was also the basis of electrical power generation in a number of fuel cells used in the Apollo Moon missions and are still used in Mars exploration vehicles today. The reaction is highly exothermic and is represented by the equation below.



An alkaline electrolyte is used in a particular hydrogen/oxygen fuel cell.

a) Write a balanced half-equation for the reaction occurring at the  
i. cathode

ii. anode.

b) Under standard conditions what is the maximum voltage 3 fuel cells connected in series can deliver?

c) What amount of heat energy is produced when 2.14 L of  $\text{O}_2$  gas is mixed with 3.14 L of  $\text{H}_2$  at S.T.P.



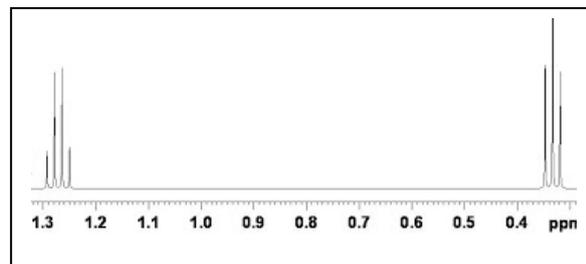
- 2) Much of the hydrogen used in fuel cells is produced from fossil fuels, such as methane, where the products are hydrogen and carbon monoxide gases. This process is known as steam reformation



- i. An unknown fossil fuel is used in the process of steam reformation to generate hydrogen gas. The  $^1\text{H}$ NMR of this compound is shown on the right.

- Using the n+1 rule identify the hydrocarbon.

- Write a balanced chemical equation for the steam reformation of this fuel.



- ii. Explain why this fuel, in i. above, is not renewable but methane generated by biomass is a renewable.