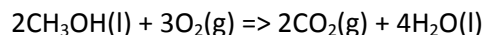**Friday Worksheet**   Name: ……………….

Fuel cells worksheet 2

1) Methanol is suitable for use in a micro fuel cell that is used to power laptop computers and similar small electrical items. The methanol is mixed with air and oxidised to carbon dioxide and water.
The overall reaction is given below

$$2CH_3OH(l) + 3O_2(g) => 2CO_2(g) + 4H_2O(l)$$

A METHANOL FUEL CELL

    i.   On the diagram on the right label the following
             - the cathode
             - the anode
             - the direction of electron flow
    ii.   Write a balanced half-equation for the cathode reaction.

    iii.   Write a balanced half-equation for the anode reaction.

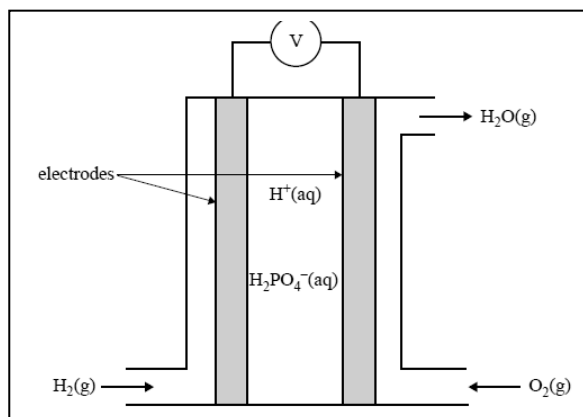   iv.   A finely divided platinum/ruthenium catalyst is used in this cell.
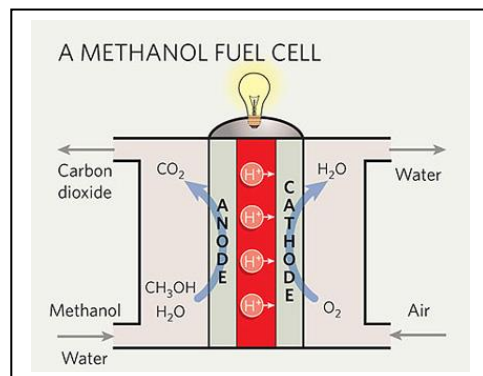
           i.   What is the purpose of this catalyst?

           ii.   Give a reason why a catalyst is necessary for the fuel cell reaction

    v.   What mass of methanol is used to produce a charge of 4.50 X 10³ Coulombs?

    vi.   The cell provides a current of 1.89 Amps for a period of 35.8 seconds. What mass of carbon dioxide is produced?

2) The phosphoric acid fuel has concentrated phosphoric acid as the electrolyte and hydrogen and oxygen gases as the reactants. A simplified view of the cell is shown on the right.
The overall reaction is $2H_2(g) + O_2(g) => 2H_2O(g)$

  a) Write the equation for the half-cell reaction at the:
     I. anode
     ii. Cathode
  b) Indicate on the diagram the:
     i. direction of electron flow,
     ii. direction of cation movement,
     iii. direction of anion movement.
  c) Given that energy can be calculated using the formula E = VIt, where E is energy in Joules, V is volts, I is current in Amps and t is time in seconds, how much energy, in kJ, is delivered per mole of hydrogen in this fuel cell if it operates at a voltage of 0.750V?
  d) Compare the energy delivered per mole of hydrogen in the fuel cell, as calculated in c) above and the heat of combustion of hydrogen, calculate the energy efficiency of this fuel cell.