Friday Worksheet **Name: …….**

Galvanic cells worksheet 3

1) The rechargeable, alkaline, nickel-cadmium cell is used to power small appliances such as portable computers. When the cell is being used, the electrode reactions are represented by the two half cells shown below.
$NiO_2(s)$ /$Ni(OH)_2(s)$
$Cd(s)$ /$Cd(OH)_2(s)$

a) Write the balanced half equations for the anode and the cathode.

b) Write the overall equation

c) What can you say about the pH of the electrolyte as the battery is discharging.

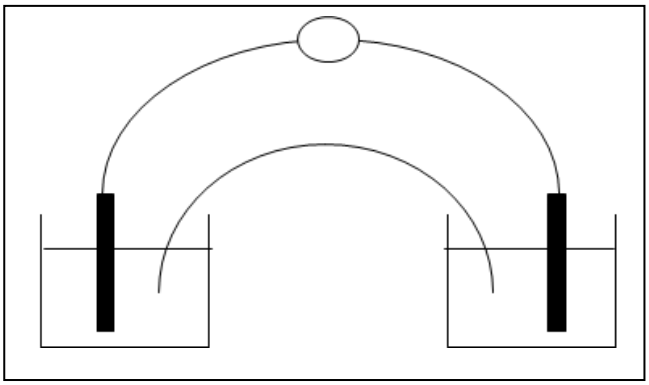
d) During recharging, what happens to the mass of the Cd electrode? Explain why.

e) In the nickel cadmium cell, the reactive ingredients are held tightly in small pockets in an inert grid of nickel plated steel. The net result of this technique is that the reactive compounds stay where they belong and the cell lasts much longer. Explain why.

f) NiO_2, on its own, cannot be used as an electrode. As a consequence the electrode is composed of nickel plated steel impregnated with NiO_2. Explain why.

2) Below is a diagram showing part of the electrochemical series and an unlabelled galvanic cell.

$Ag^+(aq) + e^- \rightleftharpoons Ag(s)$	+0.80
$Fe^{3+}(aq) + e^- \rightleftharpoons Fe^{2+}(aq)$	+0.77
$O_2(g) + 2H^+(aq) + 2e^- \rightleftharpoons H_2O_2(aq)$	+0.68
$I_2(s) + 2e^- \rightleftharpoons 2I^-(aq)$	+0.54
$O_2(g) + 2H_2O(l) + 4e^- \rightleftharpoons 4OH^-(aq)$	+0.40
$Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$	+0.34
$Sn^{4+}(aq) + 2e^- \rightleftharpoons Sn^{2+}(aq)$	+0.15



a) The E^o values shown above are measured at standard conditions. What are the standard conditions that E^o values for each half cell are measured at?

b) Using the diagram on the previous page as a template, construct a galvanic cell that will deliver 0.62V under standard conditions.

Clearly label or give the following

i. The direction of electron flow
ii. The anode and cathode
iii. The polarity of each electrode
iv. The material each electrode is made up of.
v. The substance forming the salt bridge
vi. Direction of anion and cation movement
vii. The oxidant
viii. The reductant
ix. The oxidation half equation
x. The reduction half equation
xi. Overall equation

3) A galvanic cell consists of one half cell that is made up of an inert graphite electrode in a solution containing 1.0 M $Sn^{2+}(aq)$ and 1.0 M $Sn^{4+}(aq)$ at 25°C.
Which one of the following could be used as the second half cell so that the polarity of the electrode in this second half cell is positive?

i. a lead electrode in a solution of 1.0 M $Pb^{2+}(aq)$

ii. a silver electrode in a solution of 1.0 M $Ag^{+}(aq)$

iii. A cobalt electrode in a solution of 1.0 M $Co^{2+}(aq)$

iv. an inert graphite electrode in a solution of 1.0 M Br^{-}(aq

$O_2(g) + 4H^+(aq) + 4e^- \rightleftharpoons 2H_2O(l)$ $Br_2(l) + 2e^- \rightleftharpoons 2Br^-(aq)$ $Ag^+(aq) + e^- \rightleftharpoons Ag(s)$ $Fe^{3+}(aq) + e^- \rightleftharpoons Fe^{2+}(aq)$ $O_2(g) + 2H^+(aq) + 2e^- \rightleftharpoons H_2O_2(aq)$ $I_2(s) + 2e^- \rightleftharpoons 2I^-(aq)$ $O_2(g) + 2H_2O(l) + 4e^- \rightleftharpoons 4OH^-(aq)$ $Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$ $Sn^{4+}(aq) + 2e^- \rightleftharpoons Sn^{2+}(aq)$ $S(s) + 2H^+(aq) + 2e^- \rightleftharpoons H_2S(g)$ $2H^+(aq) + 2e^- \rightleftharpoons H_2(g)$ $Pb^{2+}(aq) + 2e^- \rightleftharpoons Pb(s)$ $Sn^{2+}(aq) + 2e^- \rightleftharpoons Sn(s)$ $Ni^{2+}(aq) + 2e^- \rightleftharpoons Ni(s)$ $Co^{2+}(aq) + 2e^- \rightleftharpoons Co(s)$	