Chemistry 1B, Fall 2015 Quiz #9A KEY

The Nernst Equation and related constants are given below:
$E_{Cell} = E°_{Cell} - \frac{0.0592}{n} logQ$ F = Faraday's constant = 96,485 C/mol e
$\Delta G = -nFE°$ 1 A (amp) = 1 C/s

You must show your work for full credit. You will need a periodic table.

Exp 10 Questions

1. The following electrochemical cell is made:
$Cu(s)|Cu^{2+}(aq, 0.1\ M)||I^-(aq, 0.1\ M)|I_2(s)|C(s)$
a) Write balanced chemical equations for both the anode and the cathode according to the cell notation given above. (Note: C = carbon – an inert electrode) (**2 pt**)
anode: oxidation (left side of cell notation):
$Cu(s) \leftrightarrow Cu^{2+}(aq) + 2e^-$
cathode: reduction (right side of cell)
$I_2(s) + 2e^- \leftrightarrow 2I^-(aq)$

b) Write a net balanced equation (**1 pt**)
we combine the two: ***$I_2(s) + Cu(s) \leftrightarrow Cu^{2+}(aq) + 2I^-(aq)$***

c) The cell potential was measured and found to be 0.279 V. Calculate $E°_{cell}$. **(2 pts)**
$E_{cell} = E°_{cell} - (0.0592/2)\log\{[Cu^{2+}][I^-]^2\}$
or $E°_{cell} = E_{cell} + (0.0592/2)\log\{[Cu^{2+}][I^-]^2\} = 0.279\ V + (0.0592/2)\log(0.1)^3$
$E°_{cell} = 0.279\ V - 0.0888\ V =$ ***$0.190\ V$***

Additional Electrochemistry Problems

2. A NiCad battery works using the following reactions:
Anode reaction: $Cd(s) + 2OH^-(aq) \leftrightarrow Cd(OH)_2(s) + 2e^-$.
Cathode reaction: $NiO(OH)(s) + H_2O(l) + e^- \leftrightarrow Ni(OH)_2(s) + OH^-(aq)$
For the combined reaction, $E°_{cell} = 1.30$ V
a) Does the cell potential depend on $[OH^-]$? Write a net balanced reaction to support your answer. (**1 pt**)
Net reaction: $Cd(s) + 2OH^-(aq) + 2NiO(OH)(s) + 2H_2O(l) \leftrightarrow Cd(OH)_2(s) + 2Ni(OH)_2(s) + 2OH^-(aq)$
or (cancelling out OH^-), $Cd(s) + 2NiO(OH)(s) + 2H_2O(l) \leftrightarrow Cd(OH)_2(s) + 2Ni(OH)_2(s)$
Since OH^- is not in the net reaction the answer is ***No****.*

b) If the cell used 10.0 g of NiO(OH)(s) (and a stoichiometric amount of Cd), how many hours could the battery power a motor with a 0.50 A draw? (**2 pts**)
*FW(NiO(OH)(s)) = 58.69 + 16.00*2 + 1.01 g/mol = 91.7 g/mol*
moles e = (10.0 g NiO(OH))(1 mol/91.7 g NiO(OH))(1 mol e/1 mol NiO(OH)) = 0.1091 mol
*Charge = q = nF = (0.1091 mol e)(96,485 C/mol e) = 10,522 C = I*t*
t = (10,522 C)(1 s/0.5 C)(1 min/60 s)(1 hr/60 min) = ***5.8 hr***

(one more on back)

3. A solution contains Ni^{2+}, Cd^{2+}, and Fe^{2+} that is being reduced in **an electrolytic cell** to the metal form.

a) Given the reduction potentials below, which element will be reduced first? (**1 pt**)

Ni, because it has the greatest reduction potential.

Ion	Ni^{2+}	Cd^{2+}	Fe^{2+}
E° (for reduction to M(s))	-0.23 V	-0.40 V	-0.45 V

b) Give the charge of and name of the electrode where the reduction will occur. (**2 pts**)

Reduction will occur on the cathode and it will be negatively charged.