81%

Electrochemistry In-Class Assignment

1. Provide the oxidation number of the underlined element. [KU – 6 marks]

(a) $\underline{N}O_3^-$
(b) $NiSO_4$
(c) $KClO_3$
(d) $\underline{Cr}_2O_7^{2-}$
(e) $\underline{Br}_2$
(f) $\underline{C}_2O_4^{2-}$

2. Balance the following equation using the ion-electron method. Show your work. [MC – 5 marks]

$MnO_4^-(aq) + H_2C_2O_4(aq) \rightarrow Mn^{2+}(aq) + CO_2(g)$ basic solution

3. Balance the following equation using the oxidation method. Show your work. [MC – 5 marks]

$I_2(s) + NO_3^-(aq) \rightarrow IO_3^-(aq) + NO_2(g)$ acidic solution

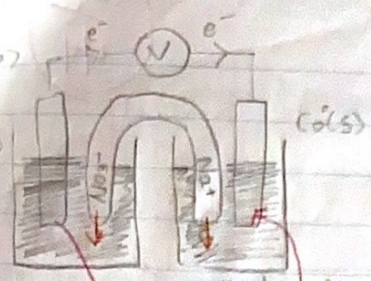
4. In an experiment, the following cell is set up, $Zn(s)|Zn^{2+}(aq)||Co^{2+}(aq)|Co(s)$.

(a) Draw a diagram of this cell. Include the beakers, salt bridge (with sodium nitrate), specific electrodes, specific electrolytes, external circuit and voltmeter. [I – 4 marks]
(b) Indicate the direction of electron flow on the diagram. [I – 1 mark]
(c) Indicate direction of ion flow, from the salt bridge, on the diagram. [2 marks]
(d) Label anode and cathode under the appropriate compartment. [I – 2 marks]
(e) Write out the ½-cell reactions occurring in each compartment under the appropriate compartment. Include the ½-cell potentials. [I – 4 marks]
(f) Write out the overall cell reaction and calculate the E_{cell}. [I – 2 marks]
(g) Circle and label the oxidizing and reducing agents. [I – 2 marks]

5. Predict anode, cathode and net cell reactions for each electrolytic cell. Calculate the minimum voltage that must be applied. [I – 8 marks]

(a) $C(s)|Na^+(aq), Br^-(aq)|C(s)$
(b) $Cu(s)|Cu^{2+}(aq), SO_4^{2-}(aq)|Cu(s)$

MC	/10 marks		
KU	/6 marks	TOTAL	/41 marks
I	/25 marks		



$Co^{2+}(aq) + 2e^- \rightarrow Co(s)$ $E^\circ_r = -0.277V$

$Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$ $E^\circ_o = +0.763\,V$

16 I

f) $Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$ $E^\circ_o = +0.763V$

$+ \; Co^{2+}(aq) + 2e^- \rightarrow Co(s)$ $E^\circ_r = -0.277V$

$Zn(s) + Co^{2+}(aq) \rightarrow Zn^{2+}(aq) + Co(s)$ $E^\circ = 0.486V$

g) Zn → reducing agent

Co^{2+} → oxidizing agent ✗

Ignore this line

5) a) ~~$2Na^+(aq) + 2e^- \rightarrow 2Na(s)$~~ $E^\circ_r = -2.71V$ → cathode ✗

$2Br^-(aq) \rightarrow 2e^- + Br_2(l)$ $E^\circ_o = -1.065V$ → anode

$2Na^+(aq) + 2Br^-(aq) \rightarrow 2Na(s) + Br_2(l)$ $E^\circ = -3.775V$

∴ the min. voltage is $-3.775\,V$

4 I

cathode b/c more likely to occur

put in H_2O rxn →

$2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$

$E^\circ_r = 0.83V$

b) $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$ $E^\circ_r = +0.337\,V$ → cathode

$SO_3^{2-}(aq) + 2OH^-(aq) \rightarrow SO_4^{2-}(aq) + H_2O(l) + 2e^-$ $E^\circ_o = +0.93V$ → anode ✗

$Cu^{2+}(aq) + SO_3^{2-}(aq) + 2OH^-(aq) \rightarrow Cu(s) + SO_4^{2-}(aq) + H_2O(l)$ $E^\circ = 1.267V$

∴ the min. voltage is $1.267\,V$

min. voltage → add up

$E^\circ \; -0.83 + (-1.065) = -1.895$

min voltage → flip so 1.895

881.

33/41

a) $x - 6 = -1$
$x = -1 + 6$
$\boxed{x = +5}$ ✓

b) $NiSO_4$
$+2 + x + (-8) = 0$
$x = 8 - 2$
$\boxed{x = +6}$ ✓

c) $KClO_3$
$+1 + x - 6 = 0$
$x = 6 - 1$
$\boxed{x = +5}$

6 pts

d) $Cr_2O_7^{2-}$
$2x - 14 = -2$
$2x = -2 + 14$
$2x = 12$
$\boxed{x = +6}$ ✓

e) 0 ✓

f) $C_2O_4^{2-}$
$2x - 8 = -2$
$x = \frac{-2+8}{2}$
$\boxed{x = +3}$ ✓

$5e^- + 8H_2O + MnO_4^- \rightarrow Mn^{2+} + 4H_2O + 8OH^-$ ·2
$2H^+ + H_2C_2O_4 \rightarrow 2CO_2 + 2H_2O + 2e^-$ ·5

↳ $\cancel{10e^-} + \cancel{16}^{6}H_2O + 2MnO_4^- \rightarrow 2Mn^{2+} + 8H_2O + \cancel{16}^{6}OH^-$
$\cancel{10OH^-} + 5H_2C_2O_4 \rightarrow 10CO_2 + \cancel{10H_2O} + \cancel{10e^-}$

$\cancel{6H_2O} + 2MnO_4^- + 5H_2C_2O_4 \rightarrow 2Mn^{2+} + 10CO_2 + \cancel{8}^{2}H_2O + 6OH^-$

$2MnO_4^- + 5H_2C_2O_4 \rightarrow 2Mn^{2+} + 10CO_2 + 2H_2O + 6OH^-$

5 mc

O_2 does not get involved in the redox

3) $I_2(s) \rightarrow IO_3^-(aq)$ $\quad NO_3^- (g) \rightarrow NO_2$

0 $\quad x - 6 = -1$ $\quad x - 4 = 0$
$x = -1 + 6$ $\quad x = +5$ $\quad x = 4$
$x = +5$

$1e^- \times 10$

2 mc

$5e^-$
$10e^-$ b/c I2

$10 NO_3^- \rightarrow 10 NO_2$

$\cancel{H_2O} + I_2 + \cancel{10} NO_3^- \rightarrow \cancel{12} IO_3^- + \cancel{10} NO_2 + \cancel{2H^+}$

$\cancel{8H^+}$ $\quad$ OR $\quad 4H_2O$

$-2 = -2$