SCH4U Unit 5 - Practice Questions B

SECTION 1: Short Answer

For each of the following questions:

i. Identify the reducing agent *(1 mark)*
ii. Identify the oxidizing agent *(1 mark)*
iii. Write balanced oxidation and reduction half-reactions *(2 marks; 1 mark per half-reaction)*

1. $8H^+ + 2MnO_4^-(aq) + 6I^-(aq) \rightarrow 3I_2(s) + 2MnO_2(s) + 2H_2O(el)$

Oxidizing Agent: _____ **Reducing Agent:** _____

Balanced Half-Reactions

Oxidation Half-Reaction:

Reduction Half-Reaction:

2. $2H^+ + H_2O_2(el) + 2I^-(aq) \rightarrow I_2(s) + 2H_2O(el)$

Oxidizing Agent: _____ **Reducing Agent:** _____

Balanced Half-Reactions

Oxidation Half-Reaction:

Reduction Half-Reaction:

SECTION 2: Short Answer

Balance the following equation by the specific method. *(T/I, 2 each) – 1 mark for correct method*
Identify the oxidizing agent and reducing agent. *(A, 1 each)*

3. Balance the following equation using the **oxidation number** method:

$$CuO + NH_3 \rightarrow Cu + H_2O + N_2$$

Oxidizing Agent: _____ **Reducing Agent:** _____

Balanced Equation:

4. Balance the following equation using the **oxidation number** method:

$$H_2S + HNO_3 \rightarrow S + NO + H_2O$$

Oxidizing Agent: _____ **Reducing Agent:** _____

Balanced Equation:

5. Balance the following equation using the **half-reactions** method in **acidic solution**:

$$Cr_2O_7^{2-}{}_{(aq)} + Ag_{(s)} \rightarrow Ag^{+}{}_{(aq)} + Cr^{3+}{}_{(aq)} \qquad (acidic)$$

Oxidizing Agent: _____ **Reducing Agent:** _____

Balanced Equation:

6. Balance the following equation using the **half-reactions** method in **basic solution**:

$$Cd(s) + NO_3^-(aq) \rightarrow Cd^{2+}(aq) + NO(g)$$

Oxidizing Agent: _____ **Reducing Agent:** _____

Balanced Equation:

SECTION 3: Short Answer

Use the Standard Reduction Table at the end of the test to determine whether each reaction is spontaneous or not spontaneous.

Calculations: 2 each [T/I]
Correct Spontaneity: 1 each [A]

7. Balance the equation and determine whether each reaction is spontaneous or not spontaneous.

$$3Br_{2(l)} + 2Cr^{3+}_{(aq)} + 7H_2O_{(l)} \rightarrow Cr_2O_7^{2-}{}_{(aq)} + 14H^{+}_{(aq)} + 6Br^{-}_{(aq)}$$

8. Balance the equation and determine whether each reaction is spontaneous or not spontaneous.

$$Cl_{2(g)} + 2Br^{-} \rightarrow Br_2 + 2Cl^{-}$$

SECTION 4: Short Answer

9. A galvanic cell is constructed using the following materials:

- Strip of zinc metal
- Strip of iron metal
- $Fe(NO_3)_2$ solution
- $Zn(NO_3)_2$ solution
- $NaNO_3$ (aq)
- 2 beakers
- U-shaped tube
- Connecting wires

a) Explain the process of galvanizing. *(A, 1)*
b) Identify the anode and the cathode. *(A, 1)*
c) What direction will the electrons flow? *(A, 0.5)*
d) Identify the oxidizing agent. *(A, 0.25)*
e) Identify the reducing agent. *(A, 0.25)*
f) Write the equations for the half-reactions in each cell. *(A, 0.5)*
g) Write the net ionic equation for the cell reaction. *(A, 0.5)*

Oxidizing Agent: _____ **Reducing Agent:** _____

Oxidation Half-Reaction:

Reduction Half-Reaction:

Balanced Net Ionic Equation:

SECTION 5: Long Answer

The following questions will be graded according to the following rubric:

Criteria	Level 4	Level 3	Level 2	Level 1
APPLICATION Making connections between science, technology, society, and environment	makes connections between science, technology, society, and the environment with a high degree of effectiveness **(3 marks)**	makes connections between science, technology, society, and the environment with considerable effectiveness **(2 marks)**	makes connections between science, technology, society, and the environment with some effectiveness **(1 mark)**	makes connections between science, technology, society, and the environment with limited effectiveness **(0 - 0.5 mark)**
COMMUNICATION Information and ideas are communicated with complete and correct answers	Information and ideas are communicated clearly and precisely **(2 mark)**	Information and ideas are communicated with considerable clarity and precision **(0.1 marks)**	Information and ideas are communicated with some clarity and precision **(0.5 marks)**	Information and ideas are communicated limited clarity and precision **(0 marks)**

10. In a copper-hydrogen fuel cell, the chemical energy of this compound is converted into electrical energy that can power a vehicle.

(a) Using only the following half-reactions and reduction potentials, write a net reaction equation and determine the approximate potential for the copper-hydrogen fuel cell.

$$Cu^{2+}(aq) + 2\,e^- \rightarrow Cu(s) \quad Er = +0.34\ V$$

$$H_2(g) \rightarrow 2\,H^+(aq) + 2\,e^- \quad Er = 0V$$

(b) Discuss one advantages and one disadvantage of this technology for society.

11. How would you explain redox reactions to a chemistry student that has never studied the topic, but was interested in learning about them? Use vocabulary from the unit, but also be sure to give detailed explanations that would allow someone to understand what you are saying.

Standard Reduction Potentials:

	$E°_r$ (V)
$F_{2(g)} + 2e^- \rightleftharpoons 2F^-_{(aq)}$	+2.87
$PbO_{2(s)} + SO_{4(aq)}^{2-} + 4H^+_{(aq)} + 2e^- \rightleftharpoons PbSO_{4(s)} + 2H_2O_{(l)}$	+1.69
$MnO^-_{4(aq)} + 8H^+_{(aq)} + 5e^- \rightleftharpoons Mn^{2+}_{(aq)} + 4H_2O_{(l)}$	+1.51
$Au^{3+}_{(aq)} + 3e^- \rightleftharpoons Au_{(s)}$	+1.50
$ClO^-_{4(aq)} + 8H^+_{(aq)} + 8e^- \rightleftharpoons Cl^-_{(aq)} + 4H_2O_{(l)}$	+1.39
$Cl_{2(g)} + 2e^- \rightleftharpoons 2Cl^-_{(aq)}$	+1.36
$2HNO_{2(aq)} + 4H^+_{(aq)} + 4e^- \rightleftharpoons N_2O_{(g)} + 3H_2O_{(l)}$	+1.30
$Cr_2O_{7(aq)}^{2-} + 14H^+_{(aq)} + 6e^- \rightleftharpoons 2Cr^{3+}_{(aq)} + 7H_2O_{(l)}$	+1.23
$O_{2(g)} + 4H^+_{(aq)} + 4e^- \rightleftharpoons 2H_2O_{(l)}$	+1.23
$MnO_{2(s)} + 4H^+_{(aq)} + 2e^- \rightleftharpoons Mn^{2+}_{(aq)} + 2H_2O_{(l)}$	+1.22
$2IO^-_{3(aq)} + 12H^+_{(aq)} + 10e^- \rightleftharpoons I_{2(s)} + 6H_2O_{(l)}$	+1.20
$Br_{2(l)} + 2e^- \rightleftharpoons 2Br^-_{(aq)}$	+1.07
$Hg^{2+}_{(aq)} + 2e^- \rightleftharpoons Hg_{(l)}$	+0.85
$ClO^-_{(aq)} + H_2O_{(l)} + 2e^- \rightleftharpoons Cl^-_{(aq)} + 2OH^-_{(aq)}$	+0.84
$Ag^+_{(aq)} + e^- \rightleftharpoons Ag_{(s)}$	+0.80
$NO^-_{3(aq)} + 2H^+_{(aq)} + e^- \rightleftharpoons NO_{2(g)} + H_2O_{(l)}$	+0.80
$Fe^{3+}_{(aq)} + e^- \rightleftharpoons Fe^{2+}_{(aq)}$	+0.77
$O_{2(g)} + 2H^+_{(aq)} + 2e^- \rightleftharpoons H_2O_{2(l)}$	+0.70
$MnO^-_{4(aq)} + 2H_2O_{(l)} + 3e^- \rightleftharpoons MnO_{2(s)} + 4OH^-_{(aq)}$	+0.60
$I_{2(s)} + 2e^- \rightleftharpoons 2I^-_{(aq)}$	+0.54
$Cu^+_{(aq)} + e^- \rightleftharpoons Cu_{(s)}$	+0.52
$O_{2(g)} + 2H_2O_{(l)} + 4e^- \rightleftharpoons 4OH^-_{(aq)}$	+0.40
$Cu^{2+}_{(aq)} + 2e^- \rightleftharpoons Cu_{(s)}$	+0.34
$SO_{4(aq)}^{2-} + 4H^+_{(aq)} + 2e^- \rightleftharpoons H_2SO_{3(aq)} + H_2O_{(l)}$	+0.17
$Sn^{4+}_{(aq)} + 2e^- \rightleftharpoons Sn^{2+}_{(aq)}$	+0.15
$Cu^{2+}_{(aq)} + e^- \rightleftharpoons Cu^+_{(aq)}$	+0.15
$S_{(s)} + 2H^+_{(aq)} + 2e^- \rightleftharpoons H_2S_{(aq)}$	+0.14
$AgBr_{(s)} + e^- \rightleftharpoons Ag_{(s)} + Br^-_{(aq)}$	+0.07
$2H^+_{(aq)} + 2e^- \rightleftharpoons H_{2(g)}$	0.00
$Pb^{2+}_{(aq)} + 2e^- \rightleftharpoons Pb_{(s)}$	−0.13
$Sn^{2+}_{(aq)} + 2e^- \rightleftharpoons Sn_{(s)}$	−0.14
$AgI_{(s)} + e^- \rightleftharpoons Ag_{(s)} + I^-_{(aq)}$	−0.15
$Ni^{2+}_{(aq)} + 2e^- \rightleftharpoons Ni_{(s)}$	−0.26
$Co^{2+}_{(aq)} + 2e^- \rightleftharpoons Co_{(s)}$	−0.28
$H_3PO_{4(aq)} + 2H^+_{(l)} + 2e^- \rightleftharpoons H_3PO_{3(aq)} + H_2O_{(l)}$	−0.28
$PbSO_{4(s)} + 2e^- \rightleftharpoons Pb_{(s)} + SO_{4(aq)}^{2-}$	−0.36
$Se_{(s)} + 2H^+_{(aq)} + 2e^- \rightleftharpoons H_2Se_{(aq)}$	−0.40
$Cd^{2+}_{(aq)} + 2e^- \rightleftharpoons Cd_{(s)}$	−0.40
$Cr^{3+}_{(aq)} + e^- \rightleftharpoons Cr^{2+}_{(aq)}$	−0.41
$Fe^{2+}_{(aq)} + 2e^- \rightleftharpoons Fe_{(s)}$	−0.44
$Ag_2S_{(s)} + 2e^- \rightleftharpoons 2Ag_{(s)} + S^{2-}_{(aq)}$	−0.69
$Zn^{2+}_{(aq)} + 2e^- \rightleftharpoons Zn_{(s)}$	−0.76
$Te_{(s)} + 2H^+_{(aq)} + 2e^- \rightleftharpoons H_2Te_{(aq)}$	−0.79
$2H_2O_{(l)} + 2e^- \rightleftharpoons H_{2(g)} + 2OH^-_{(aq)}$	−0.83
$Cr^{2+}_{(aq)} + 2e^- \rightleftharpoons Cr_{(s)}$	−0.91
$SO_{4(aq)}^{2-} + H_2O_{(l)} + 2e^- \rightleftharpoons SO_{3(aq)}^{2-} + 2OH^-_{(aq)}$	−0.93
$Al^{3+}_{(aq)} + 3e^- \rightleftharpoons Al_{(s)}$	−1.66
$Mg^{2+}_{(aq)} + 2e^- \rightleftharpoons Mg_{(s)}$	−2.37
$Na^+_{(aq)} + e^- \rightleftharpoons Na_{(s)}$	−2.71
$Ca^{2+}_{(aq)} + 2e^- \rightleftharpoons Ca_{(s)}$	−2.87
$Ba^{2+}_{(aq)} + 2e^- \rightleftharpoons Ba_{(s)}$	−2.91
$K^+_{(aq)} + e^- \rightleftharpoons K_{(s)}$	−2.93
$Li^+_{(aq)} + e^- \rightleftharpoons Li_{(s)}$	−3.04

Periodic Table

Atomic masses are listed underneath each element

1 IA												13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 **H** 1.01	2 IIA																2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.1	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.88	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.61	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.29
55 **Cs** 132.9	56 **Ba** 137.3	57 **La*** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 **Ac^** (227)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (264)	108 **Hs** (265)	109 **Mt** (268)	110 **Ds** (271)	111 **Rg** (272)							

*	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
^	90 **Th** 232.0	91 **Pa** (231)	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)