Year 12 Chemistry **Topic Test #5 - 2011**

Name:_____ Mark = _____ / 40

Part 1: Multiple Choice Section **10 marks**

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1. For the reaction:

$$5\ I^- + IO_3^- + 6\ H^+ \rightarrow 3\ I_2 + 3\ H_2O$$

which of the following statements is CORRECT?

A. The iodate ions act as the reducing agent.

B. The iodide ions act as the oxidisng agent.

C. The iodate ions are reduced.

D. The hydrogen ions are oxdised by the iodate ions.

2. When arsenious acid, H_3AsO_3, is oxidised to arsenic acid, H_3AsO_4, the number of moles of electrons supplied per mole of arsenious acid is:

A. 1

B. 2

C. 3

D. 4

3. For the reaction:

$$3\ Au^+(aq) \rightarrow Au^{3+}(aq) + 2\ Au(s)$$

which of the following statements is TRUE?

A. $Au^+(aq)$ disproportionates

B. $Au^{3+}(aq)$ is a reducing agent

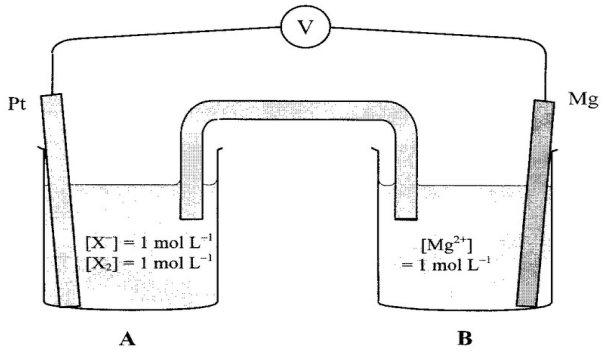
C. Au(s) is oxidised

D. A, B, or C are not true

4. Consider the following cell for which E^o values are:

$X_2 + 2\ e^- \rightleftharpoons 2\ X^-$ +0.54 V

$Mg^{2+} + 2\ e^- \rightleftharpoons Mg$ –2.37 V



Which of the following statements is correct?

A. The voltmeter reading is 1.83 volt.

B. In half cell B, the reaction is $Mg^{2+} + 2\ e^- \rightleftharpoons Mg$.

C. The Mg electrode will become negatively charged with respect to the Pt electrode and electrons will flow long the wire from Mg to the Pt.

D. If a piece of Mg is placed in 1.0 mol L^{-1} KX solution, X_2 is formed.

Questions 5 and 6 refer to the following reactions and their standard reduction potentials

$Co^{3+}(aq) + e^- \rightleftharpoons Co^{2+}(aq)$ + 1.30 V

$Sn^{4+}(aq) + 2\ e^- \rightleftharpoons Sn^{2+}(aq)$ + 0.15 V

$Sn^{2+}(aq) + 2\ e^- \rightleftharpoons Sn(s)$ – 0.14 V

$Cr^{3+}(aq) + 3\ e^- \rightleftharpoons Cr(s)$ – 0.74 V

$Be^{2+}(aq) + 2\ e^- \rightleftharpoons Be(s)$ – 1.85 V

5. The strongest reducing agent is:

A. Sn^{2+}

B. Be^{2+}

C. Sn

D. Be

6. Which of the following would proceed substantially to the right?

A. $2\ Co^{2+}(aq) + Sn^{2+}(aq) \rightleftharpoons 2\ Co^{3+}(aq) + Sn(s)$

B. $Sn^{2+}(aq) + Be^{2+}(aq) \rightleftharpoons Sn^{4+}(aq) + Be(s)$

C. $Be(s) + Sn^{2+}(aq) \rightleftharpoons Be^{2+}(aq) + Sn(s)$

D. $2\ Cr^{3+}(aq) + 3\ Sn^{2+}(aq) \rightleftharpoons 2\ Cr(s) + 3\ Sn^{4+}(aq)$

7. Potassium permanganate crystals would not be suitable for use as a primary standard in a redox titration for which of the following reasons?

A. The end point for the titration is difficult to pick.

B. It needs heat to make the reaction proceed.

C. Its oxidising power makes its purity questionable.

D. It needs an acid present to control its reduction to $Mn^{2+}(aq)$.

8. In reacting metals A, B and C with solutions of $A(NO_3)_2$, $B(NO_3)_2$ and $C(NO_3)_2$, a student made the following observations:

- metal A did not react with 1.0 mol L^{-1} $B(NO_3)_2$
- metal B dissolved in 1.0 mol L^{-1} $C(NO_3)_2$ and crystals of C appeared
- metal C did not react with 1.0 mol L^{-1} $A(NO_3)_2$

The order of strength as a reducing agent is:

A. A > B > C

B. A > C > B

C. B > C > A

D. B > A > C

9. Which of the following cells would you expect to produce the highest EMF?
(*Assume all electrolytes to be 1 mol L^{-1} aqueous solutions.)*

A. Mg/Mg^{2+} // Zn^{2+}/Zn

B. Mg/Mg^{2+} // Fe^{2+}/Fe

C. Mg/Mg^{2+} // Ni^{2+}/Ni

D. Mg/Mg^{2+} // Cu^{2+}/Cu

10. Although aluminium is a strong reducing agent and is situated near the bottom of the table of Standard Reduction Potentials, it does not corrode appreciably under normal conditions.

Which of the following best explains this?

A. Al forms a thin protective coating of oxide on its surface, preventing further corrosion.

B. It is alloyed with other metals to prevent corrosion.

C. The reaction between oxygen water and Al has a positive potential but the activation energy for the reaction is too high for it to occur under normal conditions.

D. The reaction between Al and oxygen and water has a negative potential.

Part 2: Short Answer Section **30 marks**

Question 11 **(5 marks)**

Balance this unbalanced redox reaction; **show all working**. Complete the oxidation and reduction half equations and write the coefficients in the spaces provided.

____ MnO_4^- + ____$C\ell O_2^-$ + ____H^+ □ _____MnO_2 + _____$C\ell O_4^-$ + ____ H_2O

Oxidation _____

Reduction _____

Question 12 **(6 marks)**

Write a fully balanced, ionic equation and give an observation for any reaction that occurs in the following procedure. If no reaction occurs, write 'no reaction'.

(a) Acidified hydrogen peroxide is added to potassium iodide solution.

Equation _____

*Observation*_____

_____

(3 marks)

(b) Concentrated nitric acid solution is added to zinc metal filings.

Equation _____

*Observation*_____

_____

(3 marks)

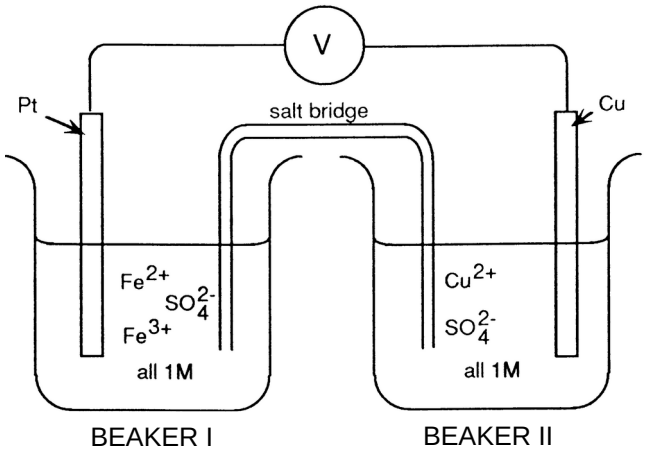
Question 13 **(2 marks)**

Give the oxidation number (state) of the underlined atoms in these examples:

(a) **Cr**$(OH)_4^-$ _____ (b) H_2**S**$_2O_7$ _____

Question 14 **(9 marks)**

Consider the electrochemical cell below:



$Fe^{3+} + e^- \longrightarrow Fe^{2+}$	$E^0 = 0.77$ V
$Cu^{2+} + 2e^- \longrightarrow Cu$	$E^0 = 0.34$ V
$Fe^{2+} + 2e^- \longrightarrow Fe$	$E^0 = -0.44$ V

(a) (i) Determine the overall cell reaction.

_____

(1 mark)

(ii) Determine the EMF of the cell. _____

(1 mark)

(b) The platinum electrode is now replaced by an iron electrode.

What happens to the direction of electron flow? Circle an alternative below.

Stays the same *Stops flowing* *Reverses direction*

(1 mark)

Explain your choice using appropriate equations.

_____

_____

_____

(3 marks)

(c) 0.2 moles of electrons passes through the external circuit of the cell described in part (a). What will be the change in mass of the anode?

_____

_____

_____

_____

(3 marks)

Question 15 **(8 marks)**

Dichromate ion ($Cr_2O_7^{2-}$) may be used in a titration to analyse hydrogen peroxide solutions.

(a) Use your table of Standard Reduction Potentials to obtain the oxidation and reduction half equations and then write an overall equation for the reaction that occurs when potassium dichromate solution is added to a solution containing hydrogen peroxide and sulfuric acid.

Oxidation _____

Reduction _____

Full _____

(2 marks)

(b) Hairdressers use hydrogen peroxide to bleach hair. An analyst uses a pipette to transfer 20.00 mL of commercial hairdressers' hydrogen peroxide to a 250.0 mL volumetric flask, and she makes the volume up to the mark with distilled water. She places 20.00 mL portions of this solution in a titration vessel, adds 5.00 mL of 2.00 mol L^{-1} sulfuric acid and titrates the mixture with 0.02056 mol L^{-1} potassium dichromate. She records the following titration figures:

Final reading (mL)	29.5	29.53	29.35	28.74	28.62
Initial reading (mL)	0.11	1.55	0.41	0.81	0.66
Titre volume (mL)					

Calculate the average titre.

_____

(1 mark)

(c) Calculate the concentration, in mol L^{-1}, of the original commercial hairdressers' hydrogen peroxide.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5 marks)

End of Test

SVACS

Year 12 Chemistry **Topic Test #5 - 2011**

Name: ANSWERS Mark = _____ / 40

Part 1: Multiple Choice Section **10 marks**

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1. **C** 2. **B** 3. **A** 4. **C** 5. **D** 6. **C** 7. **C** 8. **D** 9. **D** 10. **A**

Part 2: Short Answer Section **30 marks**

Question 11 **(5 marks)**

Balance this unbalanced redox reaction; **show all working**. Complete the oxidation and reduction half equations and write the coefficients in the spaces provided.

4 MnO_4^- + **3** $C\ell O_2^-$ + **4** H^+ → **4** MnO_2 + **3** $C\ell O_4^-$ + **2** H_2O ✓

Oxidation **$C\ell O_2^-$ + 2 H_2O → $C\ell O_4^-$ + 4 H^+ + 4 e^-** ✓✓

Reduction **MnO_4^- + 4 H^+ + 3 e^- → MnO_2 + 2 H_2O** ✓✓

Question 12 **(6 marks)**

Write a fully balanced, ionic equation and give an observation for any reaction that occurs in the following procedure. If no reaction occurs, write 'no reaction'.

(a) Acidified hydrogen peroxide is added to potassium iodide solution.

Equation **$H_2O_2(aq)$ + 2 $H^+(aq)$ + 2 $I^-(aq)$ → 2 $H_2O(l)$ + $I_2(aq)$** ✓✓

Observation **Two colourless solutions are mixed and the combined solution turns brown (or a dark grey ppt forms if I2(s)) is used** ✓

(3 marks)

(b) Concentrated nitric acid solution is added to zinc metal filings.

Equation **$Zn(s)$ + 4 $H^+(aq)$ + 2 $NO_3^-(aq)$ → $Zn^{2+}(aq)$ + 2 $NO_2(g)$ + 2 $H_2O(l)$** ✓✓

Observation ***A* silver metal dissolves in a colourless solution producing a brown pungent gas.** ✓

(3 marks)

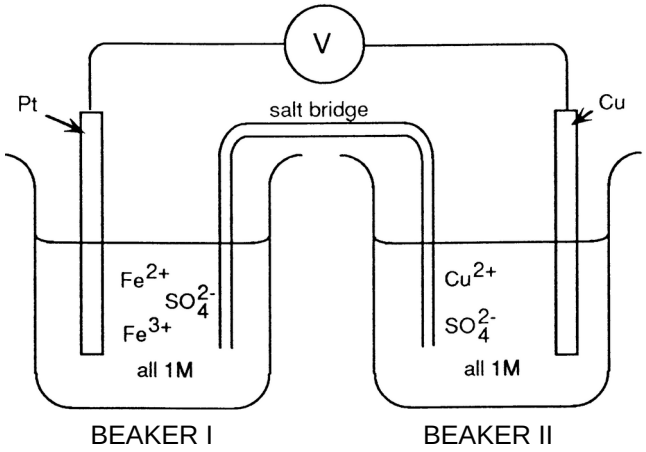
Question 13 **(2 marks)**

Give the oxidation number (state) of the underlined atoms in these examples:

(a) **Cr**$(OH)_4^-$ **+3** ✓ (b) H_2**S**$_2O_7$ **+6** ✓

Question 14 **(9 marks)**

Consider the electrochemical cell below:



$Fe^{3+} + e^- \longrightarrow Fe^{2+}$	$E^0 = 0.77$ V
$Cu^{2+} + 2e^- \longrightarrow Cu$	$E^0 = 0.34$ V
$Fe^{2+} + 2e^- \longrightarrow Fe$	$E^0 = -0.44$ V

(a) (i) Determine the overall cell reaction.

$Cu(s) + 2\ Fe^{3+}(aq) \rightarrow Cu^{2+}(aq) + 2\ Fe^{2+}(aq)$ ✓

(1 mark)

(ii) Determine the EMF of the cell. **0.43 V** ✓

(1 mark)

(b) The platinum electrode is now replaced by an iron electrode.

What happens to the direction of electron flow? Circle an alternative below.

Stays the same ***Stops flowing*** *Reverses direction* ✓

(1 mark)

Explain your choice using appropriate equations.

$2\ Fe^{3+}(aq) + Fe(s) \rightarrow 3\ Fe^{2+}(aq)$ $E^o = 1.21$V ✓

This reaction has the highest E^o of the possible reactions and is therefore the favoured reaction. No electrons flow through the circuit ✓✓

(3 marks)

(c) 0.2 moles of electrons passes through the external circuit of the cell described in part (a). What will be the change in mass of the anode?

$Cu(s) \rightarrow Cu^{2+}(aq) + 2\ e^-$

$n(Cu) = ½\ n(e^-) = 0.1$ mole ✓

$m(Cu) = 0.1 \times 63.55 = 6.36$ g (lost) ✓✓

(3 marks)

Question 15 **(8 marks)**

Dichromate ion ($Cr_2O_7^{2-}$) may be used in a titration to analyse hydrogen peroxide solutions.

(a) Use your table of Standard Reduction Potentials to obtain the oxidation and reduction half equations and then write an overall equation for the reaction that occurs when potassium dichromate solution is added to a solution containing hydrogen peroxide and sulfuric acid.

Oxidation **$H_2O_2(l) \rightarrow O_2(g) + 2\ H^+(aq) + 2\ e^-$ (x 3)** ½

Reduction **$Cr_2O_7^{2-}(aq) + 14\ H^+(aq) + 6\ e^- \rightarrow 2\ Cr^{3+}(aq) + 7\ H_2O(l)$** ½

Full **$Cr_2O_7^{2-}(aq) + 8\ H^+(aq) + 3\ H_2O_2(aq) \rightarrow 2\ Cr^{3+}(aq) + 7\ H_2O(l) + 3\ O_2(g)$** ✓

(2 marks)

(b) Hairdressers use hydrogen peroxide to bleach hair. An analyst uses a pipette to transfer 20.00 mL of commercial hairdressers' hydrogen peroxide to a 250.0 mL volumetric flask, and she makes the volume up to the mark with distilled water. She places 20.00 mL portions of this solution in a titration vessel, adds 5.00 mL of 2.00 mol L^{-1} sulfuric acid and titrates the mixture with 0.02056 mol L^{-1} potassium dichromate. She records the following titration figures:

Final reading (mL)	29.5	29.53	29.35	28.74	28.62
Initial reading (mL)	0.11	1.55	0.41	0.81	0.66
Titre volume (mL)	**29.39**	**27.98**	**28.94**	**27.93**	**27.96**

Calculate the average titre.

Discarding readings 1 and 3, use average of other three readings.

(27.98 + 27.93 + 27.96) / 3 = 27.96 mL ✓

(1 mark)

(c) Calculate the concentration, in mol L^{-1}, of the original commercial hairdressers' hydrogen peroxide.

$n(Cr_2O_7^{2-}) = c.V = 0.02056 \times 0.02796 = 0.0005749$ mol ✓

$n(H_2O_2)_{20\ mL\ dil} = 3 \times n(Cr_2O_7^{2-}) = 0.001725$ mol ✓

$n(H_2O_2)_{250\ mL\ dil} = 250 / 20 \times n(H_2O_2)_{20\ mL dil} = 0.02156$ mol ✓

$n(H_2O_2)_{20\ mL\ conc} = n(H_2O_2)_{250\ mL\ dil} = 0.02156$ mol ✓

$\therefore [H_2O_2] = n/V = 0.02156 / 0.0200 = 1.078 = 1.08$ mol L^{-1} ✓

(5 marks)

End of Test