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)

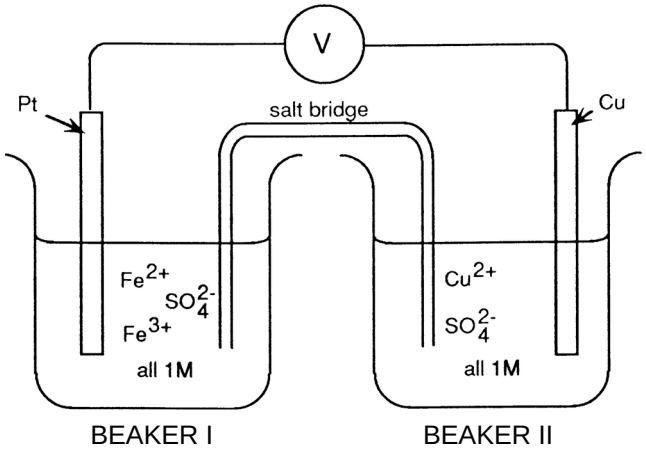
Question 13 **(2 marks)**

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

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

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

(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.

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

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

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

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

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

(5 marks)

End of Test