**Year 12 Chemistry Topic Test #5 (Electrochemistry) - 2012**

Name: **ANSWERS** Mark = \_\_\_\_\_ / 43

# Part 1: Multiple Choice Section 10 marks

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

**Part 2: Short Answer Section 33 marks**

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11. Assign oxidation numbers to the element in bold type in each of following:

 (a) Na3**P**O4 **+5** (b) H2**C**2O4 **+3** (c) **Fe**(CN)63– **+3**

**✓ each** (3 marks)

12. Consider the following equation:

2 NaCO3 + SO2 + H2SO4 → 2 CO2 + 2 NaHSO4

 (a) Identify the oxidant. **NaCO3 ✓** (1 mark)

 (b) Give a reason for your answer.

 **The oxidant is reduced in a redox reaction. ✓**

 **NaCO3 contains chlorine, which is reduced from +5 to +4** (1 mark)

13. Consider the following electrochemical cell:



 (a) Identify the anode and cathode. **✓** (1 mark)

 (b) Indicate the direction of flow of electrons in the wire and of cations within the salt-bridge.

 **✓✓** (2 marks)

 (c) Write equations for the reactions occuring at the anode and cathode.

 anode: **Pb(s) → Pb2+(aq) + 2 e– ✓**

 cathode: **Fe3+(aq) + e– → Fe2+(aq) ✓** (2 marks)

 (d) Assuming standard conidtions, what will be the reading on the voltmeter? **+ 0.90 V ✓**

(1 mark)

 (e) Suggest a suitable solution for use in the salt bridge. **saturated KNO3(aq)**

 **saturated NH4NO3(aq)**

**✓** (1 mark)

14. (a) Construct half-equations and write a balanced redox equation for the reaction with the

 following observation:

  *An acidified purple solution reacts with a colourless solution to give a colourless gas.*

 **MnO4–(aq) + 8 H+(aq) + 5 e– → Mn2+(aq) + 4 H2O(l) ✓**

 **H2C2O4(aq) → 2 CO2(g) + 2 H+(aq) + 2 e– ✓**

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 **5 H2C2O4(aq) + 2 MnO4–(aq) + 6 H+(aq) → 10 CO2(g) + 2 Mn2+(aq) + 8 H2O(l) ✓**

 ***\* H2O2(aq) → O2(g) + 2 H+(aq) + 2 e– is an alternative oxidation reaction***

 (3 marks)

 (b) Is it wise to store copper(II) sulfate solution in an aluminium container?

 Explain, with the aid of equations.

 **No, there would be a spontaneous metal displacement reaction. ✓**

 **Assuming standard conditions:**

 **Cu2+(aq) + 2 e– → Cu(s) E°red = +0.34 V**

 **A(s) → A3+(aq) + 3 e– E°ox = + 1.68 V**

 **E°cell = +2.02 V ✓✓**

 (3 marks)

 (c) Consider the following description:

*A greenish-yellow gas is bubbled through waste water to remove hydrogen sulfide.*

(i) Write a balanced equation for the reaction.

 **C2(g) + 2 e– → 2 C–(aq) ✓**

 **H2S(aq) → S(s) + 2 H+(aq) + 2 e– ✓**

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 **C2(g) + H2S(aq) → 2 C–(aq) + S(s) + 2 H+(aq) ✓**

 (3 marks)

 (ii) Give an observation for the reaction.

 **A green-yellow gas bubbles through a colourless solution**

 **forming a pale yellow precipitate ✓**

 (1 mark)

15. Tellurite, TeO2, is used in the manufacture of optical fibres. The amount of tellurite in a sample of

 ore can be determined by reaction with a strong oxidising agent such as acidified dichromate

 solution, forming the tellurate ion, TeO42–.

 (a) Write a half equation for the oxidation of TeO2 to TeO42–.

 **TeO2(s) + 2 H2O(l) → TeO42–(aq) + 4 H+(aq) + 2 e– ✓✓**

(2 marks)

 (b) Write the full redox equation for the oxidation of TeO2 by reaction with acidified

 potassium dichromate solution.

 **Cr2O72–(aq) + 14 H+(aq) + 6 e– → 2 Cr3+(aq) + 7 H2O(l)**

 **TeO2(s) + 2 H2O(l) → TeO42–(aq) + 4 H+(aq) + 2 e– (x3)**

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 **Cr2O72–(aq) + 3 TeO2(s) + 2 H+(aq) → 2 Cr3+(aq) + 3 TeO42–(aq) + H2O(l) ✓✓**

 (2 marks)

 A sample of ore contaiing tellurite was analysed in the following manner:

 I A 1.054 g sample of ore was crushed and added to 50.00 mL of 0.03052 mol L–1

 potassium dichromate solution.

 II Excess dichromate was determined through titration with 0.0525 mol L–1 Fe(NO3)2

 solution, according to the following equation:

 Cr2O72–(aq) + 6 Fe2+(aq) + 14 H+(aq) → 2 Cr3+(aq) + 6 Fe3+(aq) + 7 H2O(l)

 A titre of 19.71 mL was required to reach equivalence.

 (c) Calculate the percentage, by mass, of tellurite in the sample.

(7 marks)

 **n(Cr2O72–)total = n(K2Cr2O7) = c.V = 0.03052 x 0.05000 = 0.001526 mol ✓**

 **n(Fe2+) = n(Fe(NO3)2) = c.V = 0.0525 x 0.01971 = 0.001035 mol ✓**

 **n(Cr2O72–)excess = 1/6 n(Fe2+) = 0.0001725 mol ✓**

 **n(Cr2O72–)reacted = 0.001526 – 0.0001725 = 0.001354 mol ✓**

 **n(TeO2) = 3.n(Cr2O72–)reacted = 0.004061 mol ✓**

 **m(TeO2) = n.M = 0.004061 x 159.6 = 0.6481 g ✓**

 **%(TeO2) = 0.6481 / 1.054 x 100 = 61.5% ✓**

**End of Test**