**Name Out of 32**

**AS Redox Reactions - Test**

**Section A**

**1.** (a) Define *reduction* in terms of electrons.

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(1)

(b) The oxide of nitrogen formed when copper reacts with nitric acid depends upon the concentration and the temperature of the acid. The reaction of copper with cold, dilute acid produces NO as indicated by the following equation.

3Cu + 8H+ + 2NO  3Cu2+ + 4H2O + 2NO

 In warm, concentrated acid, NO2 is formed.

(i) Give the oxidation states of nitrogen in NO, NO2 and NO

*Oxidation state in NO*....................................................................................

*Oxidation state in NO2*......................................................................................

*Oxidation state in NO*.......................................................................................

(ii) Identify, as oxidation or reduction, the formation of NO2 from NO in the presence of H+ and deduce the half-equation for the reaction.

*NO from NO*..................................................................................................

*Half-equation*....................................................................................................

(iii) Deduce the half-equation for the formation of NO2 from NO in the presence of H+.

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(iv) Deduce the overall equation for the reaction of copper with NO and H+ to produce Cu2+ ions, NO2 and water.

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(8)

(Total 9 marks)

**2.** (a) The following is an equation for a redox reaction.

2NO + 12H+ + 10I–  2NH4+ + 2H2O + 5I2

(i) Define *oxidation* in terms of electrons.

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(ii) Deduce the oxidation state of nitrogen in NO and of nitrogen in NH4+

*Oxidation state of nitrogen in NO* .................................................................

*Oxidation state of nitrogen in NH4+* ..............................................................

(iii) Identify the species formed by oxidation in this reaction...................................

(4)

(b) When chlorine gas is bubbled into an aqueous solution of sulphur dioxide, hydrogen ions, sulphate ions and chloride ions are formed.

(i) Write a half-equation for the formation of chloride ions from chlorine.

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(ii) Write a half-equation for the formation of hydrogen ions and sulphate ions from sulphur dioxide and water.

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(iii) Hence, deduce an overall equation for the reaction which occurs when chlorine is bubbled into aqueous sulphur dioxide.

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(3)

(Total 7 marks)

**3.** (a) By referring to electrons, explain the meaning of the term *oxidising agent*.

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(1)

(b) For the element **X** in the ionic compound **MX**, explain the meaning of the term *oxidation state*.

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(1)

(c) Complete the table below by deducing the oxidation state of each of the stated elements in the given ion or compound.

|  |  |
| --- | --- |
|  | Oxidation state |
| Carbon in CO |  |
| Phosphorus in PCl |  |
| Nitrogen in Mg3N2 |  |

(3)

(d) In acidified aqueous solution, nitrate ions, NO, react with copper metal forming nitrogen monoxide, NO, and copper(II) ions.

(i) Write a half-equation for the oxidation of copper to copper(II) ions.

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(ii) Write a half-equation for the reduction, in an acidified solution, of nitrate ions to nitrogen monoxide.

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(iii) Write an overall equation for this reaction.

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(3)

(Total 8 marks)

**Section B**

**4.** (a) In terms of electron transfer, what does the reducing agent do in a redox reaction?

 (1)

(b) What is the oxidation state of an atom in an uncombined element?

 (1)

(c) Deduce the oxidation state of nitrogen in each of the following compounds.

(i) NCl3 ; (ii) Mg3N2 ; (iii) NH2OH

(3)

(d) Lead(IV) oxide, PbO2, reacts with concentrated hydrochloric acid to produce chlorine, lead(II) ions, Pb2+, and water.

(i) Write a half-equation for the formation of Pb2+ and water from PbO2 in the presence of H+ ions.

(ii) Write a half-equation for the formation of chlorine from chloride ions.

(iii) Hence deduce an equation for the reaction which occurs when concentrated hydrochloric acid is added to lead(IV) oxide, PbO2

 (3)

(Total 8 marks)