
# Oxidation & Reduction

## Chemistry Past Exam Questions

## Higher Level

# 2013

**Section B - Question 10 B**

(*b*) The following redox reaction is highly exothermic and is used to produce molten iron for welding pieces of steel together, e.g. sections of railway track:

$$8Al + 3Fe_3O_4 \rightarrow 4Al_2O_3 + 9Fe$$

(*i*) Define *oxidation* in terms of change in oxidation number.

Show using oxidation numbers that this is a redox reaction.

Identify the reducing agent. (12)

(*ii*) What mass of aluminium powder is required to produce 1008 g of molten iron for a single railway track weld?

What mass of aluminium oxide is produced as waste in the process? (13)

## 2012

**Section B - Question 4 E**

(*e*) Using oxidation numbers, or otherwise, balance the following equation.

$$Cu + NO_3^- + H^+ \longrightarrow Cu^{2+} + NO_2 + H_2O$$

**Section B - Question 10 C**

(*c*) A bracelet, originally made of pure silver, became tarnished over time with black silver sulfide ($Ag_2S$) forming on the surface. The bracelet was cleaned by converting the silver sulfide back to metallic silver using aluminium in the following reaction. The mass of the bracelet decreased by 0.0096 g in the cleaning process.

$$3Ag_2S + 2Al \longrightarrow 6Ag + Al_2S_3$$

(*i*) What substance was oxidised in this cleaning process? (4)

(*ii*) How many moles of sulfur (S) were removed from the bracelet when the silver sulfide ($Ag_2S$) was converted to aluminium sulphide ($Al_2S_3$)? (6)

(*iii*) What mass of aluminium was used in the reaction? (9)

(*iv*) What would the loss in mass of the tarnished bracelet have been if it had been cleaned by the alternative method of removing all of the silver sulfide by polishing? (6)

## 2010

**Section B - Question 4 K (i)**

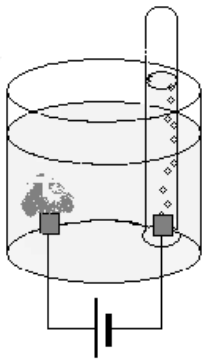
**A** Write a balanced equation for the reduction of iron(III) oxide by carbon monoxide in a blast furnace.

# 2009

**Section B - Question 10 B**

(*b*) Define oxidation in terms of electron transfer. (4)

The electrolysis, using inert electrodes, of aqueous potassium iodide, **KI**, to which a few drops of phenolphthalein indicator have been added, is shown in the diagram.



(*i*) Name a suitable material for the electrodes. (3)

(*ii*) Write balanced half equations for the reactions that take place at the electrodes. (12)

(*iii*) Explain the colour change observed at the positive electrode (anode). (6)

# 2007

## Section A - Question 1

1. A solution of sodium thiosulfate was prepared by weighing out a certain mass of crystalline sodium thiosulfate ($Na_2S_2O_3.5H_2O$) on a clock glass, dissolving it in deionised water and making the solution up carefully to 500 $cm^3$ in a volumetric flask. A burette was filled with this solution and it was then titrated against 25.0 $cm^3$ portions of previously standardised 0.05 M iodine solution in a conical flask. The average titre was 20.0 $cm^3$.

   The equation for the titration reaction is

   $$2S_2O_3^{2-} + I_2 \rightarrow 2I^- + S_4O_6^{2-}$$

   (*a*) Sodium thiosulfate is not a primary standard. Explain fully the underlined term. (8)

   (*b*) Describe how the crystalline thiosulfate was dissolved, and how the solution was transferred to the volumetric flask and made up to exactly 500 $cm^3$. (15)

   (*c*) Pure iodine is almost completely insoluble in water. What must be added to bring iodine into aqueous solution? (3)

   (*d*) A few drops of freshly prepared starch solution were added near the end point as the indicator for this titration. What sequence of colours was observed in the conical flask from the start of the titration until the end point was reached? (12)

   (*e*) Calculate the molarity of the sodium thiosulfate solution and its concentration in grams of crystalline sodium thiosulfate ($Na_2S_2O_3.5H_2O$) per litre. (12)

## Section B - Question 10 C

(*c*) The halogens are good oxidising agents.

(*i*) How does the oxidation number of the oxidising agent change during a redox reaction? (4)

(*ii*) Assign oxidation numbers in each of the following equations to show clearly that the halogen is the oxidising agent in each case. (12)

$$Br_2 + 2Fe^{2+} \rightarrow 2Br^- + 2Fe^{3+}$$

$$Cl_2 + SO_3^{2-} + H_2O \rightarrow Cl^- + SO_4^{2-} + H^+$$

Hence or otherwise balance the second equation. (6)

(*iii*) Why does the oxidising ability of the halogens decrease down the group? (3)

## 2006

**Section B - Question 10 B**

(*b*) Define *oxidation* in terms of change in oxidation number. (4)

What is the oxidation number of (*i*) chlorine in **NaClO** and (*ii*) nitrogen in $NO_3^-$? (6)

State and explain the oxidation number of oxygen in the compound $OF_2$. (6)

Using oxidation numbers or otherwise, identify the reducing agent in the reaction between acidified potassium manganate(VII) and potassium iodide solutions represented by the balanced equation below. Use your knowledge of the colours of the reactants and products to predict the colour change you would expect to see if you carried out this reaction. (9)

$$2MnO_4^- + 10I^- + 16H^+ \longrightarrow 2Mn^{2+} + 5I_2 + 8H_2O$$

## 2005

**Section B - Question 10 B**

**11.** Answer any **two** of the parts (*a*), (*b*) and (*c*). (2 × 25)

(*a*) (*i*) Define *oxidation* in terms of change in oxidation number. (4)

(*ii*) What is observed when chlorine gas is bubbled into an aqueous solution of sodium bromide?

Explain your answer in terms of oxidation and reduction. (9)

(*iii*) A solution of acidified water (dilute sulfuric acid) is electrolysed by passing an electric current through it using inert electrodes.

At which electrode **A** or **B** does oxidation occur?

Which species is oxidised?

Write a balanced half equation for the oxidation reaction. (12)