

9.1 Redox Processes

Question Paper

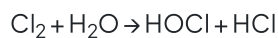
Course	DPIB Chemistry
Section	9. Redox Processes
Topic	9.1 Redox Processes
Difficulty	Easy

Time allowed: 60
Score: /45
Percentage: /100

Question 1a

a)

Chlorine reacts with water to form chlorine water via the following equation.



State the oxidation number of chlorine in the following species

Cl_2

HOCl

HCl

[3 marks]

Question 1b

b)

Chlorine is an *oxidising agent*.

Define *oxidising agent* in terms of electrons.

[1 mark]

Question 1c

c)

Nitrogen monoxide, NO , is formed when silver metal reduces nitrate ions, NO_3^- , ions in an acidic solution. State the oxidation numbers of nitrogen in NO and NO_3^- .

[2 marks]

Question 1d

d)

State the half equation for the formation of silver ions, $\text{Ag}^+(\text{aq})$, from silver metal.

[1 mark]

Question 2a

a)

Deduce the oxidation numbers of of the elements in the following species.

S^{2-}

Sn^{2+}

V^{3+}

Si

Sb^{3+}

H^-

[6 marks]

Question 2b

b)

Oxidation states are sometimes visible in the names of chemicals. Deduce the oxidation numbers of the stated elements in the following species.

Copper in copper(I) oxide

Iron in iron(III) oxide

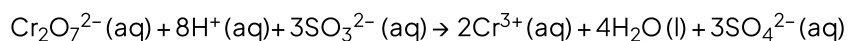
Phosphorus(V) oxide

[3 marks]

Question 2c

c)

The dichromate(VI) ion, $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$, reacts with sulfite ions, $\text{SO}_3^{2-}(\text{aq})$, as follows.



i)

State whether the sulfite ions, $\text{SO}_3^{2-}(\text{aq})$, are acting as an oxidising or reducing agent.

ii)

Justify your answer to part (i).

[2 marks]

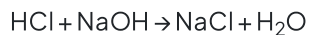
Question 2d

d)

Redox reactions can be identified by either reduction and oxidation occurring or the presence of a reducing agent and an oxidising agent.

i)

Deduce if the reaction between hydrochloric acid and sodium hydroxide is a redox reaction.



ii)

Justify your answer.

[3 marks]

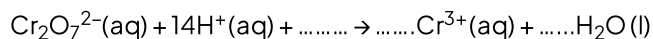
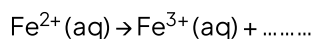
Question 3a

a)

An iron tablet, weighing 1.35 g was dissolved in dilute sulfuric acid. The sample was dissolved in sulfuric acid to oxidise all of the iron to Fe^{2+} ions.

The solution is then titrated with 0.02 mol dm^{-3} potassium dichromate, $\text{K}_2\text{Cr}_2\text{O}_7$, producing Fe^{3+} and Cr^{3+} ions in acidic solution. The titration requires 31.00 cm^3 of $\text{K}_2\text{Cr}_2\text{O}_7$ for 1.35 g of the sample.

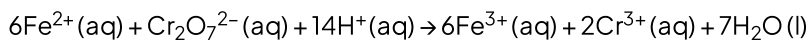
Balance the following half equations:

**[1 mark]**

Question 3b

b)

The overall equation for the reaction in part (a) is as follows.



i)

Using the information in part (a), calculate the number of moles of potassium dichromate, $\text{K}_2\text{Cr}_2\text{O}_7$ used.

ii)

Use your answer to part (b) (i) to determine the number of moles of Fe^{2+} in the sample.

[2 marks]

Question 3c

c)

Using the information in part (a) calculate the mass, in grams, of iron in the original sample.

[2 marks]

Question 3d

d)

Using the information in part (a) and your answer to part (c) calculate the percentage of iron in the original 1.35 g iron tablet.

[1 mark]

Question 4a

a)

Zinc metal will react with copper sulfate solution. State the equation for this reaction.

[2 marks]

Question 4b

b)

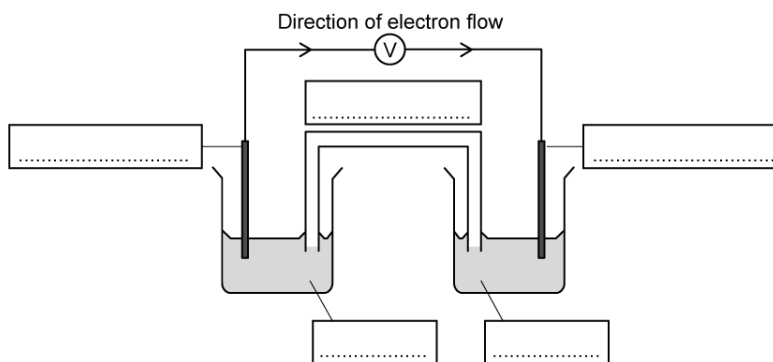
Predict the products, if any, of the reaction between lead(IV) oxide and zinc.

[1 mark]

Question 4c

c)

A voltaic cell is made from a half-cell containing a zinc electrode in a solution of zinc nitrate and a half-cell containing a silver electrode in a solution of silver nitrate. Using section 25 in the data booklet, label the following diagram.



[5 marks]

Question 4d

d)

State three differences between a voltaic cell and an electrolytic cells.

[3 marks]**Question 5a**

a)

A 500 cm³ sample of lake water was analysed using the Winkler Method. 0.0600 mol dm⁻³ sodium thiosulfate solution, Na₂S₂O₃ (aq), was titrated against liberated iodine. It was determined that the average titre of Na₂S₂O₃ was 19.30 cm³. Calculate the amount, in moles, of sodium thiosulfate used in the titration.

[1 mark]**Question 5b**

b)

In the Winkler method 1 mol of O₂ is equivalent to 4 mol of Na₂S₂O₃. Deduce the amount, in moles, of oxygen that has reacted.

[1]

[1 mark]**Question 5c**

c)

Use your answer to part (b) and section 6 in your data booklet to calculate the following

- The concentration, in mol dm⁻³, of oxygen in the water
- The concentration, in g dm⁻³, of oxygen in the water

[2 marks]

Question 5d

d)

Define the *biological oxygen demand (BOD)*.**[3 marks]**