

Oxidation numbers and balancing redox equations

Chemistry grades 11-12 (A Level · IB · Class 11-12) · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test covers oxidation numbers, oxidising and reducing agents, half-equations, overall redox equations and a titration calculation. You have 45 minutes and may use a calculator. Show all working and write charges clearly.

Level: Chemistry grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** IB R3.2

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Oxidation numbers of sulfur (3 marks)

Give the oxidation number of sulfur in each species.

- a. H_2S (1 mark)
- b. SO_2 (1 mark)
- c. H_2SO_4 (1 mark)

Question 2 Ostwald process (2 marks)

In the manufacture of nitric acid, ammonia is burned in oxygen: $4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$.

- a. Give the oxidation numbers of nitrogen and oxygen before and after. (1 mark)
- b. State which element is oxidised, which is reduced, and name the reducing agent. (1 mark)

Question 3 Chlorate half-equation (3 marks)

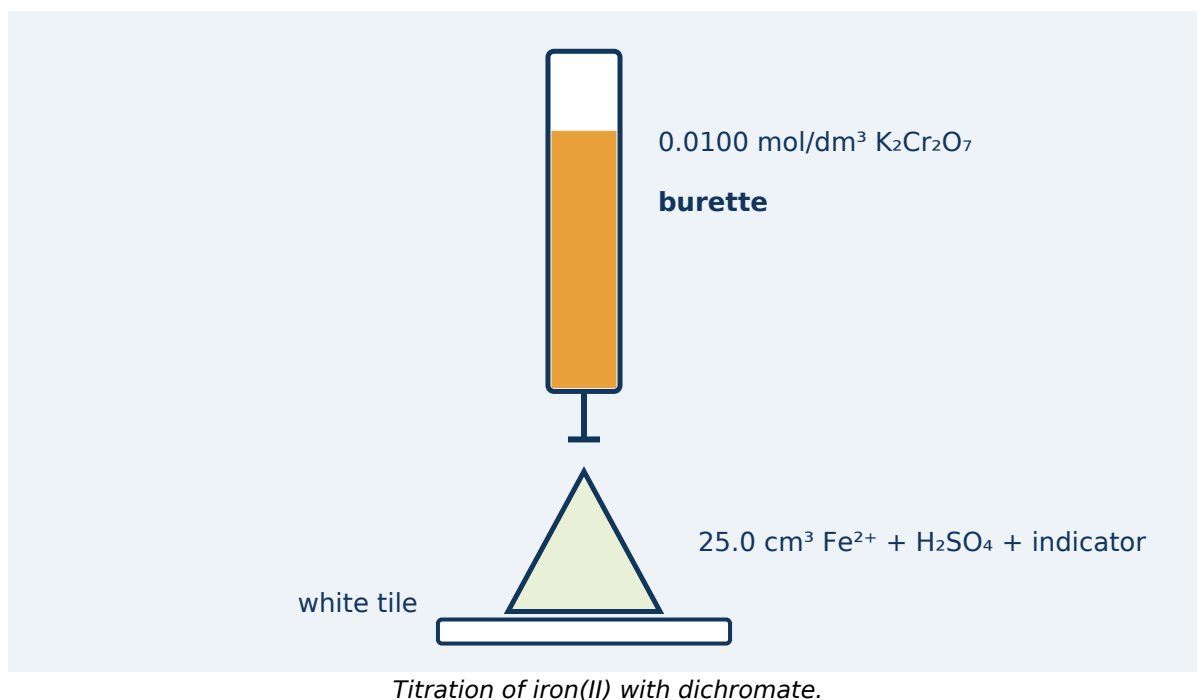
Write the half-equation for the reduction of chlorate(V) ions, ClO_3^- , to chloride ions in acidic solution.

Question 4 Chlorate and iron(II) (2 marks)

Using the half-equation $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + \text{e}^-$ and your answer to the previous question, write the overall equation for the reaction of chlorate(V) with iron(II) in acid.

Question 5 Dichromate titration (4 marks)

A 25.0 cm³ sample of iron(II) solution is titrated with 0.0100 mol/dm³ potassium dichromate(VI) in acid. The mean titre is 19.40 cm³. $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{Fe}^{2+} \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O} + 6\text{Fe}^{3+}$. Calculate the concentration of iron(II).

**Question 6 Hydrogen peroxide as two agents** (2 marks)

Explain why hydrogen peroxide can act as both an oxidising agent and a reducing agent. Use oxidation numbers in your answer.

Question 7 Copper(I) oxide in acid (2 marks)

Copper(I) oxide reacts with dilute sulfuric acid: $\text{Cu}_2\text{O} + \text{H}_2\text{SO}_4 \rightarrow \text{Cu} + \text{CuSO}_4 + \text{H}_2\text{O}$. Show that this is a disproportionation reaction.

Question 8 Zinc and acid (2 marks)

Zinc reacts with dilute hydrochloric acid: $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$. State the changes in oxidation number and identify the reducing agent.