R1 · Review of B1 to B5 (optional)

Student notes - follow the slides, fill the blanks, work the questions

Goals: Use each method from B1 to B5 on a new question. Balance a redox equation in acidic and in basic solution, and check it. Choose the method a question needs.

Name: _____ Date: _____

Slide 1 of 7 · B1 review: oxidation, reduction and the two agents

A particle that loses electrons is _____. Its charge goes up.

A particle that gains electrons is _____. Its charge goes down.

The _____ is what is oxidized. The _____ is what is reduced.

An oxidation half shows electrons on the _____ side. A reduction half shows them on the _____ side.

Example. Given: $Zn(s) + Pb^{2+}(aq) \rightarrow Zn^{2+}(aq) + Pb(s)$. Name what is oxidized, what is reduced and both agents. Write the two half-reactions.

Work:

Answer: _____

Try it. Given: $Mg(s) + Ni^{2+}(aq) \rightarrow Mg^{2+}(aq) + Ni(s)$. Name what is oxidized, what is reduced and both agents. Write the two half-reactions.

Work:

Answer: _____

Slide 2 of 7 · B2 review: find an oxidation number

The oxidation numbers in a formula add to its _____, not always to zero.

Oxygen is usually _____ and hydrogen is usually _____.

In a _____, each oxygen is −1. In a metal _____, hydrogen is −1.

A Group 1 metal is _____ in a compound. Set it first.

Example. Find the oxidation number of sulfur in $S_2O_7^{2-}$. Then find the oxidation number of oxygen in Na_2O_2.

Work:

Answer: _____

Try it. Find the oxidation number of phosphorus in $P_2O_7^{4-}$. Then find the oxidation number of hydrogen in KH.

Work:

Answer: _____

Slide 3 of 7 · B2 review: what was oxidized and what was reduced

Number every atom on both sides. Then _____ each element before and after.

If the number goes up, the element is _____. If it goes down, it is _____.

The oxidizing agent is the whole reactant that is _____. The reducing agent is the whole reactant that is oxidized.

When one reactant is both oxidized and reduced, the reaction is a _____.

Example. Given: $SnO_2 + 2C \rightarrow Sn + 2CO$. Name what is oxidized, what is reduced and both agents. Count the electrons lost and gained.

Work:

Answer: _____

Try it. Given: $Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$. Name what is oxidized, what is reduced and both agents. Count the electrons lost and gained.

Work:

Answer: _____

Slide 4 of 7 · B3 review: balance a redox equation in acid

Find the changes with oxidation numbers. Then balance each half: other atoms, O with _____, H with _____, charge with _____.

Make the electrons _____. Multiply every term in a half by the same whole number.

Add the halves. Then _____ e^-, H^+ and H_2O that appear on both sides.

Check atoms and _____ on both sides. No electrons may be left.

Example. Given acidic solution: $Cr_2O_7^{2-} + NO_2 \rightarrow Cr^{3+} + NO_3^-$. No half-reactions are given. Write the balanced net equation and check it.

Work:

Answer: _____

Try it. Given acidic solution: $MnO_2 + NO_2 \rightarrow Mn^{2+} + NO_3^-$. No half-reactions are given. Write the balanced net equation and check it.

Work:

Answer: _____

Slide 5 of 7 · B5 review: neutral and basic solutions

First read the _____: acidic, neutral or basic.

An acidic equation may contain H_2O and _____. A basic equation may contain H_2O and _____ and no H^+.

In neutral water, H^+ or OH^- may stay only if the reaction _____ it. A counting H^+ must cancel.

An equation can balance and still be wrong if it does not fit the _____.

Example. Given basic solution: reduction $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$ and oxidation $Al + 4OH^- \rightarrow Al(OH)_4^- + 3e^-$. Write the lowest whole-number net equation and check it.

Work:

Answer: _____

Try it. Given basic solution: reduction $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$ and oxidation $Zn + 2OH^- \rightarrow Zn(OH)_2 + 2e^-$. Write the lowest whole-number net equation and check it.

Work:

Answer: _____

Slide 6 of 7 · B4 review: rank from tests and predict with the table

A metal that gives electrons to another metal’s ion is the stronger _____.

The ions run the other way: the weakest reducing agent has the strongest _____ ion.

E°reaction = E°(oxidizing agent) − E°(reducing agent). Use only what is in the _____.

A positive E°reaction means the reaction is _____. Do not multiply E° by coefficients.

Example. Given a strip of iron in $Cu^{2+}(aq)$ under standard conditions. From the Data Booklet table, page 7: $E°(Cu^{2+}/Cu) = +0.34$ V and $E°(Fe^{2+}/Fe) = -0.45$ V. Find E°reaction and say whether the reaction is spontaneous.

Work:

Answer: _____

Try it. Given a strip of aluminium in $Zn^{2+}(aq)$ under standard conditions. From the Data Booklet table, page 7: $E°(Zn^{2+}/Zn) = -0.76$ V and $E°(Al^{3+}/Al) = -1.66$ V. Find E°reaction, write the balanced equation and say whether the reaction is spontaneous.

Work:

Answer: _____

Slide 7 of 7 · Which method does this question need?

A question about agents, or who lost and gained electrons, uses the method from _____.

A question about one atom in a formula, or what was oxidized, uses oxidation numbers from _____.

A skeleton equation in acid uses _____. Halves given for a basic solution use _____.

A question that asks if a reaction is spontaneous uses the table and E°reaction from _____.

Example. Name the lesson whose method each question needs. Do not solve. (a) Name the agents in $Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$. (b) Find the oxidation number of Cl in ClO_2^-. (c) Is $2H_2 + O_2 \rightarrow 2H_2O$ a redox reaction? (d) Does tin react with Ag^+?

Work:

Answer: _____

Try it. Name the lesson whose method each question needs. Do not solve. (a) Find the oxidation number of N in NH_3. (b) In acidic solution, balance the change of MnO_4^- to Mn^{2+} and Cl^- to Cl_2. (c) Is $Ag + Cu^{2+}$ a spontaneous reaction? (d) Combine two halves given for a basic solution.

Work:

Answer: _____

R1 · Practice

Review of B1 to B5 (optional) | Questions 1-2 of 15

1. B1. Given: $Cl_2(g) + 2e^- \rightarrow 2Cl^-(aq)$. Is chlorine oxidized or reduced? Explain using the change in charge.

Work:

Final answer (with unit): _____

2. B1. Given: $2Al(s) + 3Pb^{2+}(aq) \rightarrow 2Al^{3+}(aq) + 3Pb(s)$. Name what is oxidized and what is reduced. Name both agents. Then write the two half-reactions.

Work:

Final answer (with unit): _____

R1 · Practice

Review of B1 to B5 (optional) | Questions 3-4 of 15

3. B2. Find the oxidation number of iodine in IO_4^-. Then find the oxidation number of oxygen in Li_2O_2 and say which usual value changed.

Work:

Final answer (with unit): _____

4. B2. Given: $WO_3 + 3H_2 \rightarrow W + 3H_2O$. Use oxidation numbers to name what is oxidized, what is reduced and both agents. Then count the electrons lost and gained.

Work:

Final answer (with unit): _____

R1 · Practice

Review of B1 to B5 (optional) | Questions 5-6 of 15

5. B2. Given: $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$. Find the oxidation number of manganese in MnO_4^{2-}, in MnO_4^- and in MnO_2. Is this disproportionation? Explain.

Work:

Final answer (with unit): _____

6. B3. In acidic solution, IO_3^- changes to I_2. Write the balanced half-reaction. Then say whether it is an oxidation or a reduction.

Work:

Final answer (with unit): _____

R1 · Practice

Review of B1 to B5 (optional) | Questions 7-8 of 15

7. B3. Given acidic solution: reduction $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$ and oxidation $Fe^{2+} \rightarrow Fe^{3+} + e^-$. Write the lowest whole-number net equation and check it.

Work:

Final answer (with unit): _____

8. B3. A student adds two acidic halves and stops here: $2NO_3^- + 8H^+ + 3H_2S \rightarrow 2NO + 4H_2O + 3S + 6H^+$. The electrons are already cancelled. Finish the equation and check it.

Work:

Final answer (with unit): _____

R1 · Practice

Review of B1 to B5 (optional) | Questions 9-10 of 15

9. B5. Given basic solution: reduction $MnO_4^- + 2H_2O + 3e^- \rightarrow MnO_2 + 4OH^-$ and oxidation $Zn + 2OH^- \rightarrow Zn(OH)_2 + 2e^-$. Write the lowest whole-number net equation and check it.

Work:

Final answer (with unit): _____

10. B5. A question says the solution is basic. A student answers $Zn + 2MnO_2 + 2H^+ \rightarrow Zn^{2+} + Mn_2O_3 + H_2O$. The atoms and the charge balance. Is this an acceptable final answer? Explain.

Work:

Final answer (with unit): _____

R1 · Practice

Review of B1 to B5 (optional) | Questions 11-12 of 15

11. B4. Given three tests under the same conditions. Magnesium in Fe^{2+} solution gets a coating of iron. Iron in Ni^{2+} solution gets a coating of nickel. Nickel in Fe^{2+} solution: nothing happens. Rank Mg, Fe and Ni as reducing agents. Then rank Mg^{2+}, Fe^{2+} and Ni^{2+} as oxidizing agents.

Work:

Final answer (with unit): _____

12. B4. Given a strip of lead in $Ni^{2+}(aq)$ under standard conditions. From the Data Booklet table, page 7: $E°(Pb^{2+}/Pb) = -0.13$ V and $E°(Ni^{2+}/Ni) = -0.26$ V. Find $E°_{reaction}$. Then say whether $Pb + Ni^{2+} \rightarrow Pb^{2+} + Ni$ is spontaneous.

Work:

Final answer (with unit): _____

R1 · Practice

Review of B1 to B5 (optional) | Questions 13-14 of 15

13. B3. Given acidic solution: $Cr_2O_7^{2-} + H_2O_2 \rightarrow Cr^{3+} + O_2$. No half-reactions are given. Use oxidation numbers to find what is oxidized and what is reduced. Write both half-reactions. Then write the lowest whole-number net equation and check it.

Work:

Final answer (with unit): _____

14. B5. Given basic solution: $MnO_4^- + S^{2-} \rightarrow MnO_2 + S$. No half-reactions are given. Use oxidation numbers to find what is oxidized and what is reduced. Balance as in acid. Then change the equation to basic and check it.

Work:

Final answer (with unit): _____

R1 · Practice

Review of B1 to B5 (optional) | Questions 15-15 of 15

15. Challenge: Given acidic solution. A strip of nickel is placed in a solution of MnO_4^-. From the Data Booklet table, page 7: $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$ has E° = +1.51 V, and $Ni^{2+} + 2e^- \rightarrow Ni$ has E° = −0.26 V. Find the oxidation number of Mn in MnO_4^-. Write the lowest whole-number net equation. Then find E°reaction and say whether the reaction is spontaneous.

Work:

Final answer (with unit): _____