B5 · Extra practice

Worked solutions | Items 1-2

Extra practice for this lesson. Original questions, not released diploma items. Select one option for multiple choice; other tasks state the required response.

Use the givens and conditions in each prompt. Enter the requested count, coefficient, oxidation number or potential with the stated unit and precision.

B5-D01 · Multiple choice

Which pair of particles may remain in a final balanced equation for a basic solution?

A. H^+ and H_2O

B. OH^- and H_2O

C. H^+ and OH^- in equal amounts

D. Only H^+

1. Basic water has extra OH^- and no extra H^+, so a final equation for base may contain OH^- and H_2O. B is correct.

2. H^+ should not be left over in a basic equation. Equal amounts of both do not describe a basic condition.

B5-D02 · Numerical response

How many chlorine atoms are on each side of $3ClO^- \rightarrow ClO_3^- + 2Cl^-$? Enter an integer.

1. The left has 3 chlorine atoms. The right has 1 + 2 = 3.

2. Atoms and charge are both conserved: the charge is −3 on each side.

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Worked solutions | Items 3-4

B5-D03 · Numerical response

Given, in basic solution: the reduction $ClO^- + H_2O + 2e^- \rightarrow Cl^- + 2OH^-$ and the oxidation $Fe(OH)_2 + OH^- \rightarrow Fe(OH)_3 + e^-$. What number must the oxidation half be multiplied by? Enter a whole number.

1. The reduction takes 2 electrons and the oxidation gives 1. So multiply the oxidation by 2.

2. Multiply every part of the oxidation half, including the OH^-.

B5-D04 · Multiple choice

In $2H_2O_2 \rightarrow O_2 + 2H_2O$, the $2H^+$ and $2e^-$ that were in the two halves are not in the final equation. Why?

A. They were destroyed in the reaction

B. They were on both sides in equal amounts, so they cancelled

C. They are never needed in half-reactions

D. They turned into OH^-

1. The oxidation half makes $2H^+$ and $2e^-$. The reduction half uses $2H^+$ and $2e^-$. What is the same on both sides cancels.

2. Nothing was destroyed. They were made in one half and used in the other.

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Worked solutions | Items 5-6

B5-D05 · Select all that apply

Select every correct statement about $BrO_3^- + 3H_2O + 6e^- \rightarrow Br^- + 6OH^-$.

A. Oxygen is 6 on each side

B. Charge is −7 on each side

C. It contains H^+

D. The electrons on the left show reduction

1. Oxygen is 3 + 3 = 6 on the left and 6 on the right. Charge is −1 − 6 = −7 on the left and −1 − 6 = −7 on the right. Electrons on the left mean reduction.

2. There is no H^+ in the half, which fits a basic solution, so the statement about H^+ is false.

B5-D06 · Numerical response

A reduction half takes 6 electrons. The oxidation half is $2I^- \rightarrow I_2 + 2e^-$. What number must the oxidation half be multiplied by? Enter a whole number.

1. Six electrons are needed, and the oxidation gives two. 6 ÷ 2 = 3.

2. Multiply every part of the oxidation half by 3. This gives $6I^- \rightarrow 3I_2 + 6e^-$.

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Worked solutions | Items 7-8

B5-D07 · Numerical response

In $2MnO_4^- + 4H_2O + 6I^- \rightarrow 2MnO_2 + 3I_2 + __OH^-$, what coefficient of OH^- balances the equation? Enter an integer.

1. Oxygen is 8 + 4 = 12 on the left. The $2MnO_2$ has 4 oxygen, so 8 more are needed in $8OH^-$.

2. Check hydrogen: $4H_2O$ has 8 H on the left and $8OH^-$ has 8 H on the right. Charge is −8 on each side.

B5-D08 · Ordering / ranking

Arrange the steps for combining two given half-reactions for a basic solution.

First to last

1. Add the halves
2. Check atoms, charge and what is left against the condition
3. Multiply every term so the electrons match
4. Cancel what is the same on both sides
5. Compare the electrons taken and given

1. Compare the electrons, multiply every term to match, add the halves, cancel what is the same on both sides, then check atoms, charge and the condition.

2. The check comes last because it tests the finished equation.

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Worked solutions | Items 9-10

B5-D09 · Matching

Match each kind of solution to what may remain in the final equation.

Items to match:

1. Acidic
2. Basic
3. Neutral

Targets:

A. H_2O and OH^-

B. H_2O, and H^+ or OH^- only if the reaction makes them

C. H_2O and H^+

1. Acidic allows H_2O and H^+. Basic allows H_2O and OH^-. Neutral allows H_2O, and a real product H^+ or OH^- may stay.

2. The condition decides what may remain. The conservation steps are the same in every condition.

B5-D10 · Numerical response

What is the total charge on each side of $3ClO^- \rightarrow ClO_3^- + 2Cl^-$? Enter a signed integer.

1. The left has $3(-1) = -3$. The right has $-1 + 2(-1) = -3$.

2. Each side has charge -3, so charge is conserved even though the totals are not zero.

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Worked solutions | Items 11-12

B5-D11 · Multiple choice

A student writes “basic” beside $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$. Which statement is correct?

A. The label makes it a basic half

B. The half still takes in $8H^+$ and is acidic

C. The half is wrong because it has electrons

D. The half is basic because it has water

1. The half takes in eight H^+, so it needs an acidic solution. A label does not change what is in the equation.

2. Electrons and water appear in halves for any solution. Only the H^+ shows that this half is acidic.

B5-D12 · Written response

In basic solution Cl_2 becomes ClO^- and Cl^-. Use oxidation numbers to explain why this is disproportionation.

1. Chlorine is 0 in Cl_2. It becomes +1 in ClO^- (oxidation) and −1 in Cl^- (reduction).

2. The same reactant is both oxidized and reduced. The balanced equation is $Cl_2 + 2OH^- \rightarrow ClO^- + Cl^- + H_2O$.