NI · 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.

NI-D01 · Numerical response

One unit of $Al(NO_3)_3(aq)$ breaks into ions in water. How many ions form in total? Enter an integer.

1. $Al(NO_3)_3(aq) \rightarrow Al^{3+}(aq) + 3NO_3^-(aq)$.

2. One aluminium ion and three nitrate ions make 1 + 3 = 4 ions.

NI-D02 · Numerical response

How many Cl^- ions are written in a total ionic equation for $2FeCl_3(aq)$? Enter an integer.

1. Each $FeCl_3$ has three Cl^- ions, and there are two units.

2. Multiply the coefficient by the subscript: 2 × 3 = 6.

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Worked solutions | Items 3-4

NI-D03 · Multiple choice

Which substance is written as separate ions in a total ionic equation?

A. Cu(s)
B. $H_2O(l)$
C. $NaNO_3(aq)$
D. AgBr(s)

1. $NaNO_3(aq)$ is an ionic compound dissolved in water, so it is $Na^+(aq)$ and $NO_3^-(aq)$.

2. Cu(s) and AgBr(s) are solids and $H_2O(l)$ is a liquid, so they stay whole.

NI-D04 · Multiple choice

Given: $Sn(s) + 2AgNO_3(aq) \rightarrow Sn(NO_3)_2(aq) + 2Ag(s)$. Which ion is the spectator ion?

A. Ag^+
B. Sn^{2+}
C. NO_3^-
D. There is no spectator ion

1. Split the two dissolved compounds. $2NO_3^-(aq)$ is on both sides and does not change.

2. Ag^+ becomes Ag(s) and Sn(s) becomes Sn^{2+}, so those two change.

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Worked solutions | Items 5-6

NI-D05 · Multiple choice

Given: $Zn(s) + Pb(NO_3)_2(aq) \rightarrow Zn(NO_3)_2(aq) + Pb(s)$. Which is the net ionic equation?

A. $Zn(s) + Pb^{2+}(aq) \rightarrow Zn^{2+}(aq) + Pb(s)$
B. $Zn(s) + 2NO_3^-(aq) \rightarrow Zn(NO_3)_2(aq)$
C. $Zn^{2+}(aq) + Pb(s) \rightarrow Zn(s) + Pb^{2+}(aq)$
D. $Zn(s) + Pb(NO_3)_2(aq) \rightarrow Zn^{2+}(aq) + Pb(s)$

1. Split the two dissolved compounds and cancel $2NO_3^-(aq)$ from each side.

2. What is left is $Zn(s) + Pb^{2+}(aq) \rightarrow Zn^{2+}(aq) + Pb(s)$, with a charge of +2 on each side.

NI-D06 · Numerical response

For $2Cr(s) + 3Sn^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + 3Sn(s)$, what is the total charge on each side? Enter a positive integer.

1. Left side: three Sn^{2+} give $3 \times (+2) = +6$. The solid has no charge.

2. Right side: two Cr^{3+} give $2 \times (+3) = +6$. The two sides match.

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Worked solutions | Items 7-8

NI-D07 · Select all that apply

Select every substance that stays whole in a total ionic equation.

A. $Ag(s)$
B. $K_2SO_4(aq)$
C. $H_2(g)$
D. $PbCl_2(s)$

1. A solid, a liquid or a gas stays whole, so $Ag(s)$, $H_2(g)$ and $PbCl_2(s)$ stay whole.

2. $K_2SO_4(aq)$ is a dissolved ionic compound, so it is written as $2K^+(aq)$ and $SO_4^{2-}(aq)$.

NI-D08 · Ordering / ranking

Put the actions for writing a net ionic equation in order.

First to last

1. Cancel the spectator ions
2. Check atoms and charge
3. Write the balanced equation with states
4. Write what is left
5. Split the dissolved ionic compounds into ions

1. Start with the balanced equation with states. Then split every dissolved ionic compound.

2. Cancel the ions that are the same on both sides, write what is left, and check atoms and charge.

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Worked solutions | Items 9-10

NI-D09 · Multiple choice

Which net ionic equation shows a redox reaction?

A. $Ag^{+}(aq) + Cl^{-}(aq) \rightarrow AgCl(s)$
B. $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$
C. $Fe(s) + 2H^{+}(aq) \rightarrow Fe^{2+}(aq) + H_2(g)$
D. $Ca^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CaCO_3(s)$

1. Iron goes 0 → +2 and hydrogen goes +1 → 0, so oxidation numbers change.

2. In the other three, ions only join to make a solid. No oxidation number changes.

NI-D10 · Matching

Match each dissolved substance to its ions.

Items to match:

1. $Na_2CO_3(aq)$
2. $Ca(NO_3)_2(aq)$
3. $NH_4Cl(aq)$
4. $HNO_3(aq)$

Targets:

A. Ca^{2+} and $2NO_3^{-}$
B. $2Na^{+}$ and CO_3^{2-}
C. H^{+} and NO_3^{-}
D. NH_4^{+} and Cl^{-}

1. The subscript on an ion becomes its coefficient. An ion with several atoms stays together.

2. $HNO_3(aq)$ is a strong acid, so it is written as $H^{+}(aq)$ and $NO_3^{-}(aq)$.

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Worked solutions | Items 11-12

NI-D11 · Numerical response

Given: $3Mg(s) + 2FeCl_3(aq) \rightarrow 3MgCl_2(aq) + 2Fe(s)$. How many Cl^- ions cancel from each side? Enter an integer.

1. Left side: two $FeCl_3$ give $2 \times 3 = 6$ Cl^-. Right side: three $MgCl_2$ give $3 \times 2 = 6$ Cl^-.

2. Six Cl^- are on each side, so all six cancel.

NI-D12 · Written response

Nickel metal is put in copper(II) sulfate solution. A student says $Ni(s) + Cu^{2+}(aq) \rightarrow Ni^{2+}(aq) + Cu(s)$ is wrong because the sulfate ion is missing. Explain why the equation is correct.

1. The sulfate ion is in the solution before and after. It does not change, so it is a spectator ion.

2. A net ionic equation shows only the particles that change. Atoms and charge still match: +2 on each side.