

Chem 10 Chapter 7

Chemical Reactions

Additional Practice Questions

Worked solutions at the end

Use your course periodic table and a calculator as needed. Show the setup, include units, and round at the end. Question numbers match the numbers in the solutions. Use heading navigation to move between sections.

Additional Practice Questions

Question 1

Balanced chemical equations imply which of the following?

- A) Numbers of molecules are conserved in chemical change.
- B) Numbers of atoms are conserved in chemical change.
- C) Volume is conserved in chemical change.
- D) A and B
- E) B and C

Question 2

In balancing an equation, we change the _____ to make the number of atoms on each side of the equation balance.

- A) formulas of compounds in the reactants
- B) coefficients of compounds
- C) formulas of compounds in the products
- D) subscripts of compounds
- E) none of these

Question 3

What is the coefficient for oxygen when the following equation is balanced? $\text{NH}_3(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{NO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$

- A) 3
- B) 6
- C) 7
- D) 12
- E) 14

Question 4

Potassium forms an oxide containing 1 oxygen atom for every 2 atoms of potassium. What is the coefficient of oxygen in the balanced equation for the reaction of potassium with oxygen to form this oxide?

- A) 0
- B) 1
- C) 2
- D) 3
- E) 4

Question 5

When the equation $\text{C}_6\text{H}_{14} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$ is balanced with the smallest set of integers, the sum of the coefficients is

- A) 4
- B) 47
- C) 15
- D) 27
- E) 34

Question 6

Identify the precipitate(s) formed (if any) if we mix aqueous solutions of $\text{Pb}(\text{ClO}_4)_2$ and Na_2SO_4 .

- A) $\text{Pb}(\text{ClO}_4)_2$
- B) NaClO_4
- C) PbSO_4
- D) $\text{Pb}_2(\text{SO}_4)_2$
- E) No precipitate

Question 7

What is the complete ionic equation for the reaction that occurs if we mix aqueous solutions of $\text{Zn}(\text{ClO}_4)_2$ and KOH ?

- A) $\text{Zn}^{2+}(\text{aq}) + 2 \text{ClO}_4^{-}(\text{aq}) + 2\text{K}^{+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Zn}(\text{OH})_2(\text{s}) + 2\text{K}^{+}(\text{aq}) + 2\text{ClO}_4^{-}(\text{aq})$
- B) $\text{Zn}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Zn}(\text{OH})_2(\text{s})$
- C) $\text{Zn}(\text{ClO}_4)_2(\text{aq}) + 2\text{KOH}(\text{aq}) \rightarrow \text{Zn}(\text{OH})_2(\text{s}) + 2\text{KClO}_4(\text{aq})$
- D) $\text{Zn}^{2+}(\text{aq}) + 2\text{ClO}_4^{-}(\text{aq}) + 2\text{K}^{+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) + 2\text{K}^{+}(\text{aq}) + 2\text{ClO}_4^{-}(\text{aq})$
- E) $\text{Zn}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Zn}(\text{OH})_2(\text{aq})$

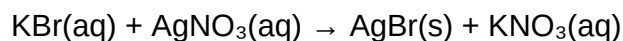
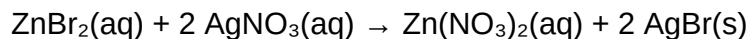
Question 8

What is the net ionic equation for the reaction that occurs if we mix aqueous solutions of AgNO_3 and Rb_3PO_4 ?

- A) $3\text{Ag}^+(\text{aq}) + 3\text{NO}_3^-(\text{aq}) + 3\text{Rb}^+(\text{aq}) + \text{PO}_4^{3-}(\text{aq}) \rightarrow \text{Ag}_3\text{PO}_4(\text{s}) + 3\text{Rb}^+(\text{aq}) + 3\text{NO}_3^-(\text{aq})$
- B) $3\text{Ag}^+(\text{aq}) + \text{PO}_4^{3-}(\text{aq}) \rightarrow \text{Ag}_3\text{PO}_4(\text{aq})$
- C) $3\text{AgNO}_3(\text{aq}) + \text{Rb}_3\text{PO}_4(\text{aq}) \rightarrow \text{Ag}_3\text{PO}_4(\text{s}) + 3\text{RbNO}_3(\text{aq})$
- D) $3\text{Ag}^+(\text{aq}) + 3\text{NO}_3^-(\text{aq}) + 3\text{Rb}^+(\text{aq}) + \text{PO}_4^{3-}(\text{aq}) \rightarrow \text{Ag}^+(\text{aq}) + \text{PO}_4^{3-}(\text{aq}) + 3\text{Rb}^+(\text{aq}) + 3\text{NO}_3^-(\text{aq})$
- E) $3\text{Ag}^+(\text{aq}) + \text{PO}_4^{3-}(\text{aq}) \rightarrow \text{Ag}_3\text{PO}_4(\text{s})$

Question 9

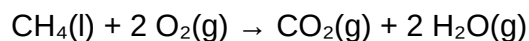
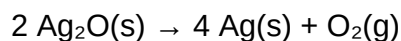
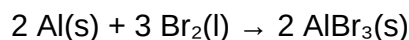
The following reactions are examples of which type of reaction?



- A) oxidation-reduction reactions
- B) acid-base reactions
- C) precipitation reactions
- D) A and C
- E) none of these

Question 10

All of the following reactions can be classified as which type?



- A) oxidation-reduction reactions
- B) combustion reactions
- C) precipitation reactions
- D) A and B
- E) A and C

Question 11

Aqueous solutions of sodium sulfide and copper(II) chloride are mixed together. Which statement is correct?

- A) Both NaCl and CuS precipitate from solution.
- B) No reaction will occur.
- C) CuS will precipitate from solution.
- D) NaCl will precipitate from solution.
- E) A gas is released.

Question 12

Which of the following compounds is soluble in water?

- A) $\text{Ni}(\text{OH})_2$
- B) K_3PO_4
- C) BaSO_4
- D) CoCO_3
- E) PbCl_2

Question 13

Which pair of ions would not be expected to form a precipitate when dilute solutions of each are mixed?

- A) Al^{3+} , S^{2-}
- B) Pb^{2+} , Cl^-
- C) Ba^{2+} , PO_4^{3-}
- D) Pb^{2+} , OH^-
- E) Mg^{2+} , SO_4^{2-}

Question 14

In writing the complete ionic equation for the reaction (if any) that occurs when aqueous solutions of KOH and $\text{Mg}(\text{NO}_3)_2$ are mixed, which of the following would not be written as separate ions?

- A) KOH
- B) $\text{Mg}(\text{NO}_3)_2$
- C) $\text{Mg}(\text{OH})_2$
- D) KNO_3
- E) All of the above would be written as separate ions..

Question 15

When solutions of strontium chloride and sodium sulfate react, which of the following is a spectator ion?

- A) strontium ion
- B) chloride ion
- C) sodium ion
- D) sulfate ion
- E) two of these

Question 16

In the reaction $2\text{Ca(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{CaO(s)}$, which species is oxidized?

- A) O_2
- B) O^{2-}
- C) Ca
- D) Ca^{2+}
- E) none of these

Question 17

In the reaction $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$, which, if any, element is oxidized?

- A) zinc
- B) hydrogen
- C) sulfur
- D) oxygen
- E) none of these

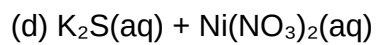
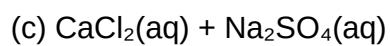
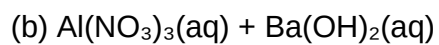
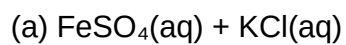
Question 18

On the basis of the general solubility rules used in this chapter, predict which substances are likely to be soluble in water.

- (a) aluminum nitrate
- (b) magnesium chloride
- (c) rubidium sulfate
- (d) nickel(II) hydroxide
- (e) lead(II) sulfide
- (f) magnesium hydroxide
- (g) iron(III) phosphate

Question 19

When each pair of solutions is mixed, what precipitate, if any, will form?



Solutions

Find the solution with the same question number.

Question 1 Solution

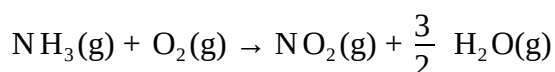
B. Balanced chemical equations conserve the number of atoms of each element. The number of molecules may change, and volumes need not be equal.

Question 2 Solution

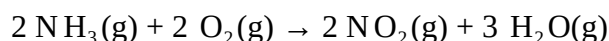
B. Change coefficients, which count whole formula units or molecules. Changing a subscript changes the substance itself.

Question 3 Solution

C. We need minimum whole-number coefficients, as implied by the question. N occurs in one compound on each side, so we start with that and proceed with H.

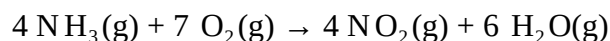


Let us get rid of 3/2 by multiplying the equation by 2.



Oxygens are still not balanced; of course multiplying everything by 2 would not balance anything. We balance oxygen by adjusting the coefficient of O_2 , as opposed to other molecules with oxygen, because that way we will not be destroying the balance of any other atoms. The reactant side has 4 oxygens and the product side has 7. We need to add 3/2 O_2 molecules to bring the reactant side to 7 oxygens.

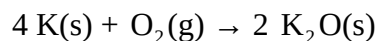
The coefficient of O_2 becomes $2 + 3/2 = 7/2$. Before we write it down, let us multiply everything by 2 to get rid of the fraction.



Question 4 Solution

B. The question starts by stating something that we should be able to derive from our knowledge of the periodic table. Potassium, a Group 1A metal, forms K^+ , and oxygen, a Group 6A nonmetal, forms O^{2-} when forming a binary ionic compound. The formula is K_2O in order to have a neutral compound.

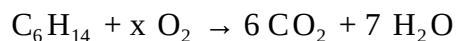
First set the coefficient of K_2O to 2 to have enough oxygen atoms on the product side. Then set the coefficient of K to 4 to have enough potassium atoms on the reactant side.



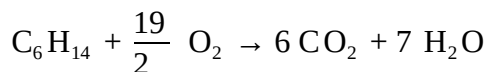
It is now balanced, with O_2 still having an unwritten coefficient of 1.

Question 5 Solution

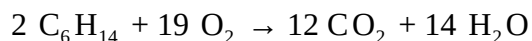
B. Balance C atoms with 6 CO₂ and H atoms with 7 H₂O. Then balance O atoms.



$$2x = (2)(6) + (1)(7) = 19; x = \frac{19}{2}$$



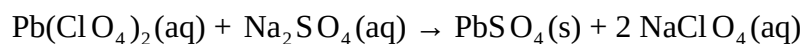
But we need the smallest set of integer coefficients, so we must multiply every coefficient by the denominator of the fractional coefficient, which is 2.



Sum of the coefficients = 2 + 19 + 12 + 14 = 47.

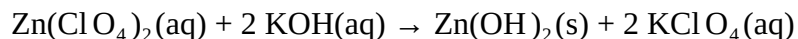
Question 6 Solution

C. PbSO₄ is insoluble and precipitates. Sodium perchlorate remains dissolved.

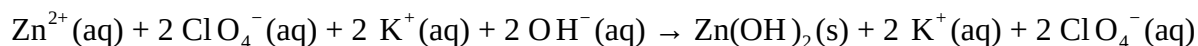
**Question 7 Solution**

A.

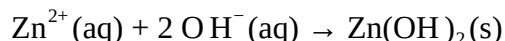
Molecular equation:



Complete ionic equation:

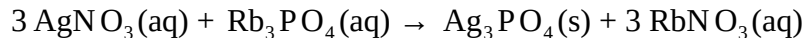


Net ionic equation:

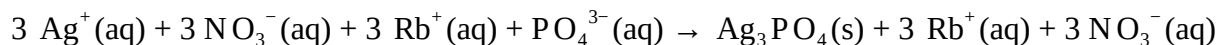
**Question 8 Solution**

E.

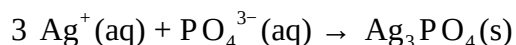
Molecular equation:



Complete ionic equation:

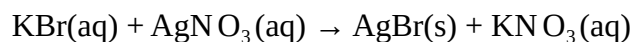
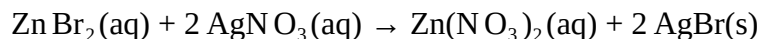


Net ionic equation:



Question 9 Solution

C. You should be able to recognize these reactions as precipitation reactions. In each case, Ag^+ and Br^- are the insoluble combination.

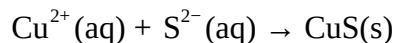
**Question 10 Solution**

A. Occurrence of free elements in the reactions, or the burning of a fuel with oxygen, points to redox reactions. You can confirm this by assigning oxidation states and observing changes in them.

For this chapter's electron-transfer interpretation: Al becomes Al^{3+} while bromine becomes Br^- ; Ag^+ becomes Ag while oxide becomes O_2 ; and combustion transfers electron density from the fuel toward oxygen.

Question 11 Solution

C. Na_2S supplies Na^+ and S^{2-} ; CuCl_2 supplies Cu^{2+} and Cl^- . Cu^{2+} and S^{2-} form the insoluble combination. CuS will precipitate.

**Question 12 Solution**

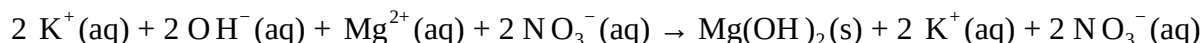
B. Any salt where the cation is K^+ would be soluble. K_3PO_4 is soluble. The others are insoluble according to the solubility rules.

Question 13 Solution

E. MgSO_4 is soluble, and the other choices are not according to the solubility rules. This applies the simplified solubility-rule model used in the question.

Question 14 Solution

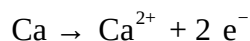
C. The precipitate is not written as separate ions in the complete ionic equation. KOH supplies K^+ and OH^- ; $\text{Mg(NO}_3)_2$ supplies Mg^{2+} and NO_3^- . $\text{Mg(OH)}_2(\text{s})$ is the precipitate and would be written as a chemical formula, not as separate ions.

**Question 15 Solution**

E. The ions that are not precipitating would be the spectator ions. Sr^{2+} and SO_4^{2-} would precipitate as $\text{SrSO}_4(\text{s})$. Cl^- and Na^+ would be spectator ions.

Question 16 Solution

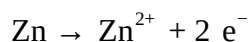
C. Calcium is oxidized: its charge changes from zero in $\text{Ca}(\text{s})$ to +2 in CaO . Oxygen is reduced from zero in O_2 to -2 in oxide.



Losing electrons is oxidation.

Question 17 Solution

A. Zinc is oxidized from zero in Zn to +2 in ZnSO_4 . Hydrogen is reduced from +1 in the acid to zero in H_2 .



Zinc loses electrons.

Question 18 Solution

Apply the general solubility rules.

- (a) Soluble: most nitrate salts are soluble.
- (b) Soluble: most chloride salts are soluble except those of Ag^+ , Pb^{2+} , and Hg_2^{2+} .
- (c) Soluble: most sulfate salts are soluble except BaSO_4 , PbSO_4 , Hg_2SO_4 , and CaSO_4 . Rubidium salts are also soluble by the alkali-metal rule.
- (d) Insoluble: most hydroxides are only slightly soluble. For these qualitative predictions, classify “slightly soluble” as insoluble and “marginally soluble” as soluble. Thus $\text{Ba}(\text{OH})_2$, $\text{Sr}(\text{OH})_2$, and $\text{Ca}(\text{OH})_2$ are assumed soluble unless noted otherwise.
- (e) Insoluble: most sulfide salts are only slightly soluble; in problems like these, that means insoluble.
- (f) Insoluble: see the hydroxide rule in (d).
- (g) Insoluble: most phosphate salts are only slightly soluble.

Question 19 Solution

In these reactions, soluble ionic compounds are mixed together. To predict the precipitate, switch the anions and cations in the two reactant compounds to predict possible products; then use the solubility rules to predict if any of these possible products are insoluble, forming the precipitate. For these qualitative predictions, classify “slightly soluble” as insoluble and “marginally soluble” as soluble.

- (a) Possible products: FeCl_2 and K_2SO_4 . Both salts are soluble, so no precipitate forms.
- (b) Possible products: $\text{Al}(\text{OH})_3$ and $\text{Ba}(\text{NO}_3)_2$. Precipitate: $\text{Al}(\text{OH})_3(\text{s})$.
- (c) Possible products: CaSO_4 and NaCl . Precipitate: $\text{CaSO}_4(\text{s})$.
- (d) Possible products: KNO_3 and NiS . Precipitate: $\text{NiS}(\text{s})$.