# Net Ionic Equations

**The following is taken from Instructions to Candidates, page 2, TEE Chemistry paper.**

**CHEMICAL EQUATIONS**

For full marks, chemical equations should refer only to those species consumed in the reaction and the new species produced.
These species may be

ions [for example $Ag^+(aq)$],
molecules [for example $NH_3(g)$, $NH_3(aq)$, $CH_3COOH(l)$, $CH_3COOH(aq)$], or
solids [for example $BaSO_4(s)$, $Cu(s)$, $Na_2CO_3(s)$].

**Introduction:** Most ionic compounds dissociate , or separate, into cations and anions when they dissolve in water. For example, when sodium chloride dissolves in water it separates into sodium ions, $Na^+_{(aq)}$, and chloride ions, $Cl^-_{(aq)}$. Similarly, silver nitrate dissociates into silver ions, $Ag^+_{(aq)}$, and nitrate ions, $NO_3^-{}_{(aq)}$. When aqueous solutions of sodium chloride and silver nitrate react, a precipitate of silver chloride is formed.

The 3 ways in which this reaction can be represented

A. Equation using formula units

$$AgNO_{3(aq)} + NaCl_{(aq)} = AgCl_{(s)} + NaNO_{3(aq)}$$

B. Complete ionic equation

$$Ag^+_{(aq)} + NO_3^-{}_{(aq)} + Na^+_{(aq)} + Cl^-_{(aq)} = AgCl_{(s)} + Na^+_{(aq)} + NO_3^-{}_{(aq)}$$

C. Net ionic equation

$$Ag^+_{(aq)} + Cl^-_{(aq)} = AgCl_{(s)}$$

The **net ionic equation** (equation C.) is the more useful of the 3 equations as it eliminates the ions that do not participate in the reaction. Ions that are not directly involved in a reaction are **spectator ions** and the net ionic equation indicates only the particles that actually take part in the reaction.

## MASTERING WRITING NET IONIC EQUATIONS

1. only the particles that actually take part in the reaction are represented
2. the charge must also be balanced
3. you cannot have a **solid** –ve ion(or for that matter +ve ion) as they are locked together in an ionic lattice with no net charge.
4. plenty of practice

# PRECIPITATION REACTIONS

**Note:**
**The solubility rules for ionic solids in water are located on the CHEMISTRY DATA SHEET**

1. $Cation_{(aq)} + Anion_{(aq)} = Insoluble\ Salt_{(s)}$

1.1 $Ag^{+}_{(aq)} + Cl^{-}_{(aq)} = AgCl_{(s)}$

1.2 $Cu^{2+}_{(aq)} + 2OH^{-}_{(aq)} = Cu(OH)_{2(s)}$

1.3 $Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} = BaSO_{4\,(s)}$

## PREDICTING WHETHER A PRECIPITATION RACTION OCCURS & WRITING NET IONIC EQUATIONS

**Problem:** Predict whether a reaction occurs when each of the following pairs of solutions are mixed. If a reaction does occur write a net ionic equation and identify the spectator ions.

**a.** sodium sulphate & lead(II) nitrate
**b.** ammonium sulphate & sodium bromide

**Plan:** For each pair of solutions, we write the cation-anion combinations and refer to the solubility rules (copy on the next page) on the CHEMISTRY DATA SHEET. We write the soluble compounds as separate ions. For the net ionic equation we eliminate the spectator ions.

**Solution:** **a.** In addition to the reactants the other two ion combinations are lead(II) sulphate and sodium nitrate. The solubility rules tell us that lead(II) sulphate is insoluble, so a reaction does occur.

Writing the net ionic equation:

$$Pb^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} = PbSO_{4(s)}$$

The spectator ions are $Na^{+}$ and $NO_3^{-}$.

**b.** The product ion combinations are ammonium bromide and sodium sulphate. The solubility table shows that all ammonium and sodium salts are soluble, and that all bromides are soluble except $Ag^{+}$, $Pb^{2+}$, $Hg_2^{2+}$ and $Hg^{2+}$ and that all sulphates are soluble except $Ag^{+}$, $Pb^{2+}$, $Hg^{2+}$, $Sr^{2+}$, $Ba^{2+}$ and $Ca^{2+}$. Therefore no reaction between these ions. The compounds remain in solution as solvated ions.

## PROBLEMS on NET IONIC EQUATIONS 1

1. Write net ionic equations for the reactions (if any) which occur when solutions of the following pairs of substances are mixed. If there is no reaction write **no rxn**.

   a. sodium chloride & silver nitrate
   b. barium chloride & sodium sulphate
   c. copper sulphate & potassium hydroxide
   d. nickel chloride & potassium sulphate
   e. sodium carbonate & iron(II) sulphate
   f. zinc nitrate & ammonium sulphide
   g. ammonium bromide & lead nitrate
   h. mercury(I) nitrate & hydrochloric acid
   i. potassium carbonate & calcium chloride
   j. iron(II) sulphate & potassium iodide
   k. silver nitrate & sulphuric acid
   l. potassium sulphate & magnesium chloride
   m. nickel chloride & sodium hydroxide
   n. copper nitrate & hydrogen sulphide

2. Solutions of what substances would you mix in order to prepare the following compounds by precipitation? Write net ionic equations for your reactions.

   a. magnesium carbonate
   b. magnesium hydroxide
   c. lead sulphate
   d. iron(II) sulphide
   e. silver bromide
   f. lead iodide

3. What cations (+ve ions) could be present in a solution which gave a precipitate with

   a. sodium sulphate solution but not with sodium chloride?
   b. sodium sulphate solution and with sodium chloride?
   c. sodium sulphate solution but not with sodium hydroxide?
   d. sodium carbonate solution but not with sodium hydroxide?
   e. potassium hydroxide but not with ammonium sulphate?
   f. sodium carbonate but not with ammonium sulphide?

4. Predict whether a reaction occurs when solutions of the following are added together and write balanced net ionic equations.

   a. iron(III) chloride & caesium phosphate
   b. potassium hydroxide & lead nitrate
   c. magnesium iodide & sodium sulphate
   d. silver sulphate & barium chloride

5. Use the solubility rules to predict which of the following combinations lead to reaction.

   a. calcium nitrate & potassium chloride
   b. sodium chloride & lead(II) nitrate

6. For each of the following pairs of aqueous solutions state whether a precipitation reaction occurs when they are mixed. Write the formulae and names of any precipitates that form.

a. sodium nitrate & copper(II) sulphate
b. ammonium iodide & silver nitrate
c. potassium carbonate & barium hydroxide
d. aluminium nitrate & sodium phosphate
e. potassium chloride & iron(II) nitrate
f. ammonium sulphate & barium chloride
g. sodium sulphide & nickel(II) sulphate
h. lead(II) nitrate & potassium bromide

7. Complete the following precipitation reactions with balanced net ionic equations and identify the spectator ions.

a. $Hg_2(NO_3)_{2(aq)}$ & $KI_{(aq)}$
b. $FeSO_{4(aq)}$ & $Ba(OH)_{2(aq)}$
c. $CaCl_{2(aq)}$ & $Cs_3PO_{4(aq)}$
d. $Na_2S_{(aq)}$ & $ZnSO_{4(aq)}$
e. $KOH_{(aq)}$ & $Ca(NO_3)_2$
f. $Na_2S_{(aq)}$ & $Pb(CH_3COO)_{2(aq)}$
g. $(NH_4)_3PO_{4(aq)}$ & $CaCl_{2(aq)}$

8. Use the solubility rules to predict whether each of the following ionic compounds is soluble in water.

a. $BaSO_4$ b. $Pb(NO_3)_2$ c. $PbI_2$ d. $Na_2S$

9. The following combinations of aqueous solutions are mixed. In each case
i predict whether a precipitate will form
ii if a precipitate does form, write a balanced net ionic equation for its formation and give its correct chemical name

| | | | |
|---|---|---|---|
| a. | ammonium hydroxide | & | copper(II) nitrate |
| b. | sodium carbonate | & | calcium chloride |
| c. | barium chloride | & | potassium hydroxide |
| d. | ammonium sulphate | & | sodium chloride |
| e. | potassium hydroxide | & | calcium nitrate |
| f. | silver nitrate | & | potassium iodide |
| g. | sodium hydroxide | & | copper(II) nitrate |
| h. | copper(II) sulphate | & | sodium chloride |
| i. | potassium sulphate | & | barium nitrate |

10. Use the solubility rules to determine which

a. sodium compounds are soluble in water
b. potassium compounds are insoluble
c. silver compounds are soluble

11. Predict products and write balanced net ionic equations for

a. $KOH_{(aq)} + Ca(NO_3)_{2(aq)} \longrightarrow$
b. $Na_2S_{(aq)} + Pb(CH_3COO)_{2(aq)} \longrightarrow$
c. $(NH_4)_3PO_{4(aq)} + CaCl_{2(aq)} \longrightarrow$

12. A TEE Chemistry student was testing the solubility of a number of ionic compounds by mixing solutions and observing whether or not a precipitate formed. The solutions to be mixed were:

| | | | |
|---|---|---|---|
| i | $CuCl_{2(aq)}$ | & | $K_2CO_{3(aq)}$ |
| ii | $Pb(NO_3)_2$ | & | $CuSO_{4(aq)}$ |
| iii | $NH_4Br_{(aq)}$ | & | $NaOH_{(aq)}$ |

Before mixing the solutions the student tried to predict the results that would be obtained using their knowledge of the solubility rules for ionic compounds located on the back of the TEE Chemistry Data Sheet. For each of the mixtures i to iii:

a. Indicate whether a precipitate would form.
b. Write a balanced net ionic equation for any precipitate that you think would form.

13. "Milk of Magnesia" is a treatment for indigestion. Chemically it is magnesium hydroxide, $Mg(OH)_2$. The instructions on a bottle of milk of magnesia say that the bottle should be well shaken before it is taken. Why is this instruction given?

14. Write dissociation equations for

| | | | |
|---|---|---|---|
| a. | $NaOH_{(s)}$ | b. | $Na_3PO_{4(s)}$ |
| c. | $NH_4Cl_{(s)}$ | d. | $AlCl_{3(s)}$ |

15. Write net ionic equations for the following aqueous reactions

| | | | |
|---|---|---|---|
| a. | barium chloride | & | magnesium sulphate |
| b. | calcium nitrate | & | sodium carbonate |
| c. | potassium hydroxide | & | calcium nitrate |
| d. | sodium sulphide | & | lead ethanoate |
| e. | ammonium phosphate | & | calcium chloride |

16. Which of the following compounds would appear as a precipitate in solution?

| | | | |
|---|---|---|---|
| A. | ammonium sulphate | B. | barium nitrate |
| C. | barium sulphate | D. | ammonium hydroxide |

17. Which of the following is **NOT** a correctly balanced net ionic equation?

A. $Ba^{2+}_{(aq)} + SO_4^{2-}_{(aq)} \longrightarrow BaSO_{4(s)}$

B. $HSO_4^-{}_{(aq)} + H_2O_{(l)} \longrightarrow SO_4^{2-}{}_{(aq)} + H_3O^+_{(aq)}$

C. $2H^+_{(aq)} + SO_4^-{}_{(aq)} + 2K^+_{(aq)} + 2OH^-_{(aq)} \longrightarrow SO_4^{2-}{}_{(aq)} + 2K^+_{(aq)} + 2H_2O_{(l)}$

D. $H^+_{(aq)} + OH^-_{(aq)} \longrightarrow H_2O_{(l)}$

18. In which of the following instances does a chemical reaction **NOT** occur?

A. Solutions of ammonium chloride & potassium nitrate are mixed
B. Solutions of magnesium bromide & sodium hydroxide are mixed
C. Solutions of hydrochloric acid & silver nitrate are mixed
D. Solutions of barium hydroxide & sulphuric acid are mixed

Write net ionic equations for the reactions which do occur in 18. above.

19. Rewrite and complete the following equations as balanced net ionic equations.

a. $Ca(OH)_{2(s)} + H_3PO_{4(aq)} \longrightarrow$
b. $H_2SO_{4(aq)} + Al(OH)_{3(s)} \longrightarrow$
c. $Fe(OH)_{3(s)} + HCl_{(aq)} \longrightarrow$
d. $BaCl_{2(aq)} + (NH_4)_2CO_{3(aq)} \longrightarrow$
e. $AgNO_{3(aq)} + H_2S_{(g)} \longrightarrow$
f. $K_2CrO_{4(aq)} + Pb(NO_3)_{2(aq)} \longrightarrow$

20. Write a balanced net ionic equation, showing the physical states of reactants and products, for each of the following aqueous reactions.

a. silver nitrate & calcium chloride $\longrightarrow$
b. aluminium nitrate & sodium hydroxide $\longrightarrow$
c. barium chloride & potassium phosphate $\longrightarrow$

21. Hard water can be caused by the presence of calcium ions (in calcium chloride or calcium hydrogen carbonate). Hard water reacts with soap forming a precipitate, soap may be represented by the formula $NaOOC(CH_3)_{14}CH_3$. These calcium ions can be removed by adding sodium carbonate (washing soda) solution to the hard water.

a. Write a net ionic equation for the reaction of hard water with soap.
b. Write a net ionic equation for the reaction of hard water with sodium carbonate.

22. A precipitation reaction produces zinc phosphate as one of its products.

a. Suggest two reactants that may have participated in this reaction.
b. Write a balanced net ionic equation for this reaction.

23. Identify the substances from the following list which are soluble in water.

| | | | | | |
|---|---|---|---|---|---|
| a. | $CaI_2$ | b. | KOH | c. | $AgCl$ |
| d. | $BaSO_4$ | e. | AgI | f. | $NH_4Cl$ |
| g. | $Na_2S$ | h. | $MgCl_2$ | i. | CuS |
| j. | $Al(OH)_3$ | k. | $PbI_2$ | l. | $Fe(OH)_3$ |

24. Predict whether a precipitate will form when solutions of the following are mixed:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| a. | $AgNO_3$ | & | $KCl$ | b. | $H_2SO_4$ | & | $BaCl_2$ |
| c. | $H_2SO_4$ | & | $NaCl$ | d. | $NaNO_3$ | & | $KCl$ |
| e. | $(NH_4)_3PO_4$ | & | $CaCl_2$ | f. | $(NH_4)_2S$ | & | $Pb(NO_3)_2$ |
| g. | $(NH_4)_2S$ | & | $NaNO_3$ | h. | NaBr | & | $Hg(NO_3)_2$ |
| i. | $CaCl_2$ | & | NaBr | j. | $Na_2SO_4$ | & | $Hg_2(NO_3)_2$ |

25. Write net ionic equations for the reactions which did occur in 25. above.

26. What cations could be present in a solution which gave a precipitate with

a. sodium sulphate but **NOT** with sodium chloride
b. sodium sulphate and with sodium chloride
c. sodium sulphate but **NOT** with sodium hydroxide
d. sodium carbonate but **NOT** with sodium hydroxide

# Problems on Net Ionic Equations 1 — Solutions

1. a. $Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{(s)}$
   b. $Ba^{2+}_{(aq)} + SO_4^{2-}_{(aq)} \rightarrow BaSO_{4(s)}$
   c. $Cu^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Cu(OH)_{2(s)}$
   d. No Rxn.
   e. $Fe^{2+}_{(aq)} + CO_3^{2-}_{(aq)} \rightarrow FeCO_{3(s)}$
   f. $Zn^{2+}_{(aq)} + S^{2-}_{(aq)} \rightarrow ZnS_{(s)}$
   g. $Pb^{2+}_{(aq)} + 2Br^-_{(aq)} \rightarrow PbBr_{2(s)}$
   h. $Hg_2^{2+}_{(aq)} + 2Cl^-_{(aq)} \rightarrow Hg_2Cl_{2(s)}$
   i. No Rxn
   j. No Rxn
   k. $2Ag^+_{(aq)} + SO_4^{2-}_{(aq)} \rightarrow Ag_2SO_{4(s)}$
   l. No Rxn
   m. $Ni^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Ni(OH)_{2(s)}$

2. a. Magnesium Nitrate & Sodium Carbonate
   b. Magnesium Nitrate & Sodium Hydroxide
   c. Lead Nitrate & Sodium Sulphate
   d. Iron(II) Nitrate & Sodium Sulfide
   e. Silver Nitrate & Sodium Bromide
   f. Lead Nitrate & Potassium or Sodium Iodide.

3. a. $Sr^{2+}_{(aq)}$, $Ba^{2+}_{(aq)}$, $Ca^{2+}_{(aq)}$ and $Hg^{2+}_{(aq)}$
   b. $Ag^+_{(aq)}$ and $Pb^{2+}_{(aq)}$
   c. $Ba^{2+}_{(aq)}$ and $Sr^{2+}_{(aq)}$
   d. $Ba^{2+}_{(aq)}$ and $Sr^{2+}_{(aq)}$
   e. $Hg^{2+}_{(aq)}$

4. a. $Fe^{3+}_{(aq)} + PO_4^{3-}_{(aq)} \rightarrow FePO_{4(s)}$
   b. $Pb^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Pb(OH)_{2(s)}$
   c. No Rxn
   d. $Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{(s)}$ and $Ba^{2+}_{(aq)} + SO_4^{2-}_{(aq)} \rightarrow BaSO_{4(s)}$

5. a. No Rxn
   b. $Pb^{2+}_{(aq)} + 2Cl^-_{(aq)} \rightarrow PbCl_{2(s)}$

6. a. No Rxn
   b. $AgI$ Silver Iodide
   c. $BaCO_3$ Barium Carbonate
   d. $AlPO_4$ Aluminium Phosphate
   e. No Rxn
   f. $BaSO_4$ Barium Sulphate
   g. $NiS$ Nickel(II) Sulphide
   h. $PbI_2$ Lead(II) Iodide

7. a. $Hg_2^{2+}_{(aq)} + 2I^-_{(aq)} \rightarrow Hg_2I_{2(s)}$
   b. This is a double precipitation
      $Fe^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Fe(OH)_{2(s)}$
      $Ba^{2+}_{(aq)} + SO_4^{2-}_{(aq)} \rightarrow BaSO_{4(s)}$
   c. $3Ca^{2+}_{(aq)} + 2PO_4^{3-}_{(aq)} \rightarrow Ca_3(PO_4)_{2(s)}$
   d. $Zn^{2+}_{(aq)} + S^{2-}_{(aq)} \rightarrow ZnS_{(s)}$
   e. $Ca(OH)_2$ is slightly soluble but you might get a precipitate formed
      $Ca^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Ca(OH)_{2(s)}$
   f. $Pb^{2+}_{(aq)} + S^{2-}_{(aq)} \rightarrow PbS_{(s)}$
   g. $3Ca^{2+}_{(aq)} + 2PO_4^{3-}_{(aq)} \rightarrow Ca_3(PO_4)_{2(s)}$

8. a. Insoluble
   b. Soluble
   c. Insoluble
   d. Soluble

9. a. $Cu^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Cu(OH)_{2(s)}$
b. $Ca^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} \rightarrow CaCO_{3(s)}$
c. No Rxn
d. No Rxn
e. $Ca(OH)_2$ is slightly soluble
f. $Ag^+_{(aq)} + I^-_{(aq)} \rightarrow AgI_{(s)}$
g. $Cu^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Cu(OH)_{2(s)}$
h. No Rxn
i. $Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow BaSO_{4(s)}$

10. a. All soluble, no exceptions
b. All soluble, no exceptions
c. Silver Nitrate & Silver Ethanoate

11. a $Ca(OH)_2$ is slightly soluble
b. $Pb^{2+}_{(aq)} + S^{2-}_{(aq)} \rightarrow PbS_{(s)}$
c. $3Ca^{2+}_{(aq)} + 2PO_4^{3-}{}_{(aq)} \rightarrow Ca_3(PO_4)_{2(s)}$

12. i $Cu^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} \rightarrow CuCO_{3(s)}$
ii $Pb^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow PbSO_{4(s)}$
iii No Rxn

13. $Mg(OH)_2$ is insoluble in water, shaking evenly suspends the solid throughout the solution.

14. a. $NaOH_{(s)} \rightarrow Na^+_{(aq)} + OH^-_{(aq)}$
b. $Na_3PO_{4(s)} \rightarrow 3Na^+_{(aq)} + PO_4^{3-}{}_{(aq)}$
c. $NH_4Cl_{(s)} \rightarrow NH_4^+{}_{(aq)} + Cl^-_{(aq)}$
d. $AlCl_{3(s)} \rightarrow Al^{3+}_{(aq)} + 3Cl^-_{(aq)}$

15. a. $Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow BaSO_{4(s)}$
b. $Ca^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} \rightarrow CaCO_{3(s)}$
c. $Ca^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Ca(OH)_{2(s)}$ maybe
d. $Pb^{2+}{}_{(aq)} + S^{2-}{}_{(aq)} \rightarrow PbS_{(s)}$
e. $3Ca^{2+}_{(aq)} + 2PO_4^{3-}{}_{(aq)} \rightarrow Ca_3(PO_4)_{2(s)}$

16. c. Barium sulfate

17. c. $K^+$ ions & $SO_4^{2-}$ ions appear on both sides of equation.

18. A.
$Mg^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Mg(OH)_{(s)}$
$Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{(s)}$
$Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow BaSO_{4(s)}$

19. a. $3Ca^{2+}_{(aq)} + 2PO_4^{3-}{}_{(aq)} \rightarrow Ca_3(PO_4)_{2(s)}$
b. $Al(OH)_{3(s)} + 3H^+_{(aq)} \rightarrow Al^{3+}_{(aq)} + 3H_2O_{(l)}$
c. $Fe(OH)_{3(s)} + 3H^+_{(aq)} \rightarrow Fe^{3+}_{(aq)} + 3H_2O_{(l)}$
d. $Ba^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} \rightarrow BaCO_{3(s)}$
e. $H_2S_{(g)} + 2Ag^+_{(aq)} \rightarrow Ag_2S_{(s)} + 2H^+_{(aq)}$
f. $Pb^{2+}_{(aq)} + CrO_4^{2-}{}_{(aq)} \rightarrow PbCrO_{4(s)}$

20. a. $Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{(s)}$
b. $Al^{3+}_{(aq)} + 3OH^-_{(aq)} \rightarrow Al(OH)_{3(s)}$
c. $3Ba^{2+}_{(aq)} + 2PO_4^{3-}{}_{(aq)} \rightarrow Ba_3(PO_4)_{2(s)}$

21. a. $2NaOOC(CH_3)_{14}CH_{3(s)} + Ca^{2+}_{(aq)} \rightarrow (OOC(CH_3)_{14}CH_3)_2Ca_{(s)} + 2Na^+_{(aq)}$
b. $Ca^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} \rightarrow CaCO_{3(s)}$

22. a. Zinc Nitrate & Sodium Phosphate
b. $3Zn^{2+}_{(aq)} + 2PO_4^{3-}{}_{(aq)} \rightarrow Zn_3(PO_4)_{2(s)}$

23. a. $CaI_2$ b. KOH f. $NH_4Cl$ g. $Na_2S$
h. $MgCl_2$

24. a. $Ag^{+}_{(aq)} + Cl^{-}_{(aq)} \rightarrow AgCl_{(s)}$

b. $Ba^{2+}_{(aq)} + SO_4^{2-}_{(aq)} \rightarrow BaSO_{4(s)}$

c. No RXN

d. No RXN

e. $3\,Ca^{2+}_{(aq)} + 2\,PO_4^{3-}_{(aq)} \rightarrow Ca_3(PO_4)_{2(s)}$

f. $Pb^{2+}_{(aq)} + S^{2-}_{(aq)} \rightarrow PbS_{(s)}$

g. No RXN

h. $Hg^{2+}_{(aq)} + 2\,Br^{-}_{(aq)} \rightarrow HgBr_{2(s)}$

i No RXN

j. No RXN

25. AS ABOVE

26. a. $Sr^{2+}$ STONTIUM, $Ba^{2+}$ BARIUM, $Hg^{2+}$ MERCURY(II), $Ca^{2+}$ CALCIUM

b. $Ag^{+}$ SILVER, $Hg_2^{2+}$ MERCURY(I), $Pb^{2+}$ LEAD

c. $Ba^{2+}$ BARIUM, $Ca^{2+}$ CALCIUM

d. $Ba^{2+}$ BARIUM