

Reaction Prediction Section

In order to incorporate reaction prediction into your Advanced Placement Chemistry course, AP style practice sets are provided on the following pages. Twenty-five reproducible reaction prediction sets are included for your use in any preferred manner. It is very important to emphasize to students the general scoring rubric that is used to score the equations in the reaction prediction section of the exam and for you to use similar scoring guidelines in your classroom.

General Scoring

- Students are to write balanced, net ionic equations for 3 different reactions and answer a question about each reaction.
- Each equation is worth a maximum of 5 points.
- The points are generally distributed as: 1 point for reactant(s), 2 points for product(s), 1 point for correct balancing (in the lowest whole number ratio), and 1 point for answering the question.
- Descriptive symbols do not need to be included and will not be graded if they are.
- Both reactants and products need to be written appropriately and all spectator ions must be eliminated from the final answer.

Other Tips

- Charges should be written on any individual ion, but no charges may be written on any compound.
- Points can be earned even if part of the equation is wrong. For example, if students were given a hydrocarbon combustion reaction, they may earn product points even if their hydrocarbon formula is incorrect. They can also earn a balancing point if their equation, as written, is balanced correctly. They can earn the point for the question if they answer and justify correctly based on their equation.
- Keep in mind that the 5-point scoring distribution may be altered a little from year to year, but there will still be a maximum of 5 points distributed for each reaction.
- The final equation is written in a box and the question is answered on the line(s) below the box. If students do any rough draft work, their final answer must be clearly shown in the equation box. Rough draft work would be best done on the green sheets.

In order for the following pages of practice sets to be helpful rather than overly intimidating (especially at the outset), consider doing some reactions or reaction sets as a class using the Chapter 14 *Summary of Reactions* as a guide if necessary. As a class, work through the stepwise process writing the molecular, overall ionic, and net ionic equations. It is difficult for students to apply the rules regarding what should be written in ion form and which ions are spectators, all at once. Also, talk through some potential follow-up questions as you work through the sets; point out that the answers for most of the questions should be quite short.

Also, if you grade student attempts on the equations, be generous at first and then steadily less forgiving. Since the practice sets have 5 equations for a theoretical maximum of 25 points, consider a top score a 15 rather than a 25. Many students will begin with scores like 3 or 4, but with time and practice, tremendous improvement will be apparent.

Note: The reactions on the answer keys on the twenty-five reaction prediction pages do include descriptive symbols. This is simply a teaching aid and may be useful to the teacher when "discussing" the answers. Also, these sets cover all types of reactions and are written in net ionic form. You may want to start using them for practice after you've completed the types of reactions and Exercises in Chapters 1–13.

Reaction Prediction — 1

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Solid calcium carbonate is strongly heated.

What evidence of a chemical change would be observed in this reaction?

- b) Hydrogen sulfide gas is bubbled into a solution of mercury(II) chloride.

Draw a Lewis structure for the hydrogen sulfide molecule.

- c) Phosphorus(V) oxide powder is sprinkled over distilled water.

Would the pH of the resulting solution be acidic, neutral, or basic? Explain.

- d) A bar of zinc metal is immersed in a solution of copper(II) sulfate.

What evidence of a chemical change would be observed in this reaction?

- e) Solutions of manganese(II) sulfate and ammonium sulfide are mixed.

Identify the spectator ion(s) in this reaction.

Reaction Prediction — 2

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) A small piece of sodium metal is added to distilled water.

If a drop of phenolphthalein was added to the resulting solution, what color would be observed? Explain.

- b) Solid barium oxide is added to distilled water.

Which compound would you predict has a higher lattice energy—barium oxide or magnesium oxide? Explain.

- c) Solid ammonium carbonate is heated.

If a piece of wet litmus paper was held over the mouth of the test tube as the sample is heated, what would you observe? Explain.

- d) Carbon disulfide vapor is burned in excess oxygen.

If 2.0 moles of carbon disulfide are burned, how many total moles of product(s) would be made?

- e) Solutions of sodium iodide and lead(II) nitrate are combined.

Name the product(s) in this reaction.

Reaction Prediction — 3

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Dilute hydrochloric acid is added to a solution of potassium carbonate.

Would the potassium carbonate solution, before the acid was added, be acidic, basic, or neutral? Explain.

- b) A strip of magnesium is added to a solution of silver nitrate.

How many electrons, in total, are transferred in this reaction?

- c) Solid potassium chlorate is heated in the presence of a manganese dioxide catalyst.

Explain why the manganese dioxide was added to the reaction.

- d) A solution of hydrogen peroxide is heated.

What is the oxidation number of oxygen in hydrogen peroxide?

- e) Solid copper(II) sulfide is heated strongly in oxygen gas.

Which would have a larger radius, a sulfur atom or a sulfide ion? Explain.

Reaction Prediction — 4

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Sulfur trioxide gas is added to excess water.

If phenolphthalein is added to the resulting solution, what color will be observed? Explain.

- b) A piece of aluminum metal is added to a solution of silver nitrate.

Write the complete electron configuration for the silver ion that appears in silver nitrate.

- c) Solid ammonium carbonate is heated.

What evidence of a chemical change would be observed with this reaction?

- d) Propanol is burned completely in air.

What is the hybridization of the carbon atoms in propanol?

- e) An excess of sodium hydroxide solution is added to a solution of magnesium nitrate.

If 0.80 moles of sodium hydroxide are reacted with 0.80 moles of magnesium nitrate, how many moles of product would be made?

Reaction Prediction — 5

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) A piece of solid bismuth is heated strongly in oxygen.

Which has the higher ionization energy—bismuth or antimony? Explain.

- b) Equal volumes of 0.1 M sulfuric acid and 0.2 M potassium hydroxide are mixed.

Would the pH of the resulting solution be acidic, neutral, or basic? Explain.

- c) Solid lithium hydride is added to water.

If phenolphthalein is added to the resulting solution, what color will be observed? Explain.

- d) A concentrated solution of ammonia is added to a solution of zinc iodide.

Name the product(s).

- e) Excess chlorine gas is passed over hot iron filings.

How many electrons are transferred, in total, in this reaction?

Reaction Prediction — 6

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Concentrated hydrochloric acid is added to solid manganese(II) sulfide.

Which has the larger radius—the manganese atom or manganese(II) ion? Justify your choice.

- b) Water is added to a sample of solid magnesium nitride.

Which would have the greater lattice energy—magnesium nitride or magnesium oxide? Justify your choice.

- c) A solid sample of magnesium carbonate is heated strongly.

What evidence of a chemical reaction would you observe?

- d) Ethene (ethylene) gas is bubbled through a solution of bromine.

What is the hybridization of carbon in ethene?

- e) An excess of nitric acid solution is added to a solution of tetraamminecopper(II) sulfate.

In tetraamminecopper(II) sulfate, what serves as the Lewis acid? Explain.

Reaction Prediction — 7

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Dilute hydrochloric acid is added to a solution of potassium sulfite.

How many electrons would need to be shown in a Lewis structure for the sulfite ion?

- b) A piece of nickel metal is immersed in a solution of copper(II) sulfate.

What color change would you observe in this reaction?

- c) Solid ammonium nitrate is heated to temperatures above 300 °C.

Predict the algebraic sign of ΔS° for the reaction and explain your reasoning.

- d) Liquid bromine is shaken with a sodium iodide solution.

Would you predict the boiling point of bromine to be higher or lower than the boiling point of iodine? Justify your choice.

- e) A solution of sodium bromide is added to an acidified solution of potassium bromate.

What is the oxidation number of bromine in potassium bromate?

Reaction Prediction — 8

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Solutions of cobalt(II) nitrate and sodium hydroxide are mixed.

Rank cobalt, chromium, and copper atoms in terms of increasing ionization energy and explain your reasoning.

- b) Ethene gas is burned in air.

List the number of sigma and pi bonds present in an ethene molecule.

- c) Carbon dioxide gas is passed over hot, solid sodium oxide.

Is this a redox reaction? Explain why/why not.

- d) Equal volumes of equimolar solutions of phosphoric acid and potassium hydroxide are mixed.

Would you predict the pH of the resulting solution to be acidic, basic, or neutral? Explain.

- e) Aluminum metal is added to a solution of copper(II) chloride.

What is being oxidized in this reaction? Justify your choice.

Reaction Prediction — 9

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) A sample of lithium is burned in air.

List three physical properties of a piece of lithium.

- b) Manganese(II) nitrate solution is mixed with sodium hydroxide solution.

Is the radius of a manganese(II) ion larger or smaller than that of a zinc ion? Explain your reasoning.

- c) Gaseous hydrofluoric acid reacts with solid silicon dioxide.

Draw the Lewis structure for a silicon dioxide molecule.

- d) The hydrocarbon hexane is burned in excess oxygen.

What is the total number of sigma and pi bonds in a hexane molecule?

- e) Equal volumes of dilute equimolar solutions of sodium carbonate and hydrochloric acid are mixed.

Consider the statement, “sodium carbonate exhibits both ionic and covalent bonding.” State whether you agree or disagree with the statement and then explain your reasoning.

Reaction Prediction — 10

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Aqueous ammonia is added to solid zinc hydroxide.

Identify the Lewis acid in the reaction.

- b) Solid zinc sulfide is heated in an excess of oxygen.

What is the oxidation number of sulfur before and after the reaction?

- c) Hydrogen gas is passed over hot copper(II) oxide.

Does hydrogen act as the oxidizing or reducing agent in the reaction? Explain your reasoning.

- d) A mixture of solid calcium oxide and solid tetraphosphorus decaoxide is heated.

Name the product(s) formed.

- e) A saturated solution of calcium hydroxide is added to a solution of magnesium chloride.

What effect would be observed if an excess of hydrochloric acid were added to the product?

Reaction Prediction — 11

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) A limited amount of liquid bromine is added to an excess of benzene.

What is the hybridization of the carbon atoms in the benzene molecule?

- b) Dilute acetic acid solution is added to solid magnesium carbonate.

How would crushing the solid affect the rate of the reaction? Explain.

- c) Solid zinc strips are added to a solution of copper(II) nitrate.

Write the noble gas notation for the electron configuration in a zinc atom.

- d) A solution of hydrogen peroxide is catalytically decomposed.

Why is hydrogen peroxide commonly stored in a brown bottle?

- e) A solution of copper(II) sulfate is electrolyzed using inert electrodes.

Name the product formed at the anode.

Reaction Prediction — 12

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Hydrogen sulfide gas is bubbled through a solution of lead(II) nitrate.

Liquid hydrogen sulfide has a lower boiling point than water. Explain why.

- b) Dilute sulfuric acid solution is added to a solution of barium acetate.

Name the product(s) formed.

- c) Powdered iron is added to a solution of iron(III) sulfate.

What is the total number of electrons transferred in this reaction?

- d) Gaseous silane, SiH_4 , is burned in oxygen.

Will the products form a solution or a suspension? Justify your choice.

- e) Sodium phosphate crystals are added to water.

Would the pH of the solution formed be acidic, basic or neutral? Justify your choice.

Reaction Prediction — 13

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Hydrogen peroxide solution is added to acidified potassium iodide solution.

What is the reducing agent in this reaction?

- b) A saturated solution of barium hydroxide is mixed with a solution of iron(III) sulfate.

Name the product(s) of this reaction.

- c) Solutions of sodium fluoride and dilute hydrochloric acid are combined.

Would the pH of the initial sodium fluoride solution have been below 7, equal to 7, or above 7? Explain.

- d) Small chunks of solid sodium are added to water.

How many neutrons would an atom of the most abundant isotope of sodium have?

- e) Solid zinc carbonate is heated in a test tube.

After the reaction, would the mass of the test tube and contents be more than, less than, or equal to the mass of the test tube and contents before the reaction? Explain your reasoning.

Reaction Prediction — 14

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) A solution of ammonium sulfate is added to a potassium hydroxide solution.

Identify the Bronsted-Lowry acid in this reaction.

- b) Gaseous diborane, B_2H_6 , is burned in oxygen.

If 0.20 moles diborane are burned completely, how many total moles of product(s) will be made?

- c) Ammonia gas and carbon dioxide are bubbled into water.

How many sigma and pi bonds are represented in the Lewis structure of a carbon dioxide molecule?

- d) Solutions of silver nitrate and sodium chromate are mixed.

What color is the product?

- e) Sodium hydroxide solution is added to a precipitate of aluminum hydroxide in water.

Name the product(s) formed in this reaction.

Reaction Prediction — 15

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Excess sodium cyanide solution is added to a silver nitrate solution.

Name the Lewis base in this reaction.

- b) Hydrogen gas is passed over hot iron(II) oxide powder.

What is the oxidizing agent in this reaction?

- c) Hydrogen sulfide gas is bubbled through excess potassium hydroxide solution.

What is the molecular geometry of a hydrogen sulfide molecule?

- d) Magnesium metal is reacted with nitrogen gas.

What is the bond order in a nitrogen molecule?

- e) Lead foil is immersed in silver nitrate solution.

What evidence of a chemical reaction will be observed?

Reaction Prediction — 16

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) A dilute solution of sulfuric acid is electrolyzed between platinum electrodes.

What substance forms at the cathode?

- b) Liquid titanium(IV) chloride is added to liquid water.

Write the complete electron configuration for the titanium(IV) ion.

- c) Solid calcium oxide is exposed to a stream of carbon dioxide gas.

Predict the algebraic sign of ΔS° for the reaction and justify your choice.

- d) Liquid bromine is added to a solution of potassium iodide.

What is being oxidized in the reaction?

- e) A sample of solid ammonium carbonate is heated.

If 0.14 mole of ammonium carbonate is heated, how many total moles of products will be made?

Reaction Prediction — 17

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) An excess of ammonia gas is bubbled through a solution saturated with silver chloride.

What is the molecular geometry of an ammonia molecule?

- b) Hydrogen sulfide gas is added to a solution of cadmium nitrate.

What function do cadmium rods have in a nuclear power plant?

- c) Ethanol is completely burned in air.

Predict the algebraic sign of ΔH° for the reaction and justify your choice.

- d) A solution of tin(II) sulfate is added to a solution of iron(III) sulfate.

Which is a better oxidizing agent tin(II) sulfate or iron(III) sulfate?

- e) A sample of potassium chlorate is heated.

If a barely burning splint was placed in the test tube towards the end of the reaction, what would be observed?

Reaction Prediction — 18

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Solid lithium oxide is added to excess water.

Would the final pH of the resulting solution be acidic, basic or neutral? Justify your choice.

- b) Propene reacts with excess oxygen.

What is the hybridization of carbon on the product side?

- c) Solid calcium sulfite is heated in a vacuum.

If 0.16 mole of calcium sulfite is heated, how many total moles of product(s) would be formed?

- d) Hydrogen peroxide is added to an acidified solution of potassium dichromate.

What is the oxidation number of chromium before and after the reaction?

- e) Excess hydrobromic acid is added to a solution of potassium hydrogen carbonate.

If the product(s) of this reaction were added to water, would the final solution have a pH above, below or equal to 7? Explain.

Reaction Prediction — 19

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Solutions of ammonia and hydrofluoric acid are mixed.

Identify the Bronsted-Lowry base in this reaction and justify your choice.

- b) Carbon dioxide gas is passed over hot, solid sodium oxide.

Which would be predicted to have the greater lattice energy—sodium oxide or magnesium oxide? Justify your choice.

- c) Solid copper(II) sulfide is heated strongly in oxygen gas.

Solid copper(II) sulfide does not conduct electricity, but molten copper(II) sulfide does. Explain.

- d) A suspension of copper(II) hydroxide is treated with an excess of ammonia water.

Describe how a suspension differs from a solution.

- e) A solution of nickel(II) chloride is added to a solution of lithium sulfide.

What evidence of a chemical change would be observed in this reaction?

Reaction Prediction — 20

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Calcium metal is added to a dilute solution of hydrochloric acid.

Place the elements calcium, chromium, and barium in order of increasing atomic radius. Justify your choice.

- b) Chlorine gas is bubbled into a solution of sodium bromide.

Would you predict the boiling point of bromine to be higher or lower than the boiling point of chlorine? Justify your choice.

- c) Drops of liquid dinitrogen trioxide are added to distilled water.

Would the final pH of the resulting solution be acidic, basic or neutral? Justify your choice.

- d) Silver chloride is dissolved in excess ammonia water.

Identify any spectator ion(s) in this reaction.

- e) A solution of ammonium sulfate is added to a saturated solution of barium hydroxide.

If the final product mixture were filtered, what would collect in the filter paper? Explain.

Reaction Prediction — 21

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Chlorine gas is bubbled into a cold, dilute solution of sodium hydroxide.

What are the oxidation numbers of chlorine after the reaction?

- b) Water is added to a sample of pure sodium hydride.

If a drop of phenolphthalein was added to the resulting solution, what color would be observed?

- c) Ammonium chloride crystals are added to a solution of sodium hydroxide.

Why would a capsule that contains crystals of ammonium chloride and sodium hydroxide cracked under the nose of someone unconscious help revive them?

- d) A solution of nickel(II) chloride is added to a solution of sodium sulfide.

Name the product(s) formed.

- e) Excess hydrochloric acid is added to a solution of diamminesilver(I) nitrate.

If the product mixture were filtered, what would collect on the filter paper? Explain.

Reaction Prediction — 22

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Solutions of silver nitrate and lithium bromide are mixed.

What evidence of a chemical reaction is observed?

- b) Solid calcium oxide is heated in the presence of sulfur trioxide gas.

Would the lattice energy of calcium oxide be less than or greater than the lattice energy of magnesium oxide? Explain.

- c) Octanol is burned in air.

Predict the algebraic sign of ΔS° for the reaction and justify your choice.

- d) A strip of zinc is added to a solution of hydrobromic acid.

Hydrochloric acid is a stronger acid than hydrobromic acid. Explain why.

- e) Equal volumes of equimolar solutions of disodium hydrogen phosphate and hydrochloric acid are mixed.

Is an aqueous solution of disodium hydrogen phosphate acidic, basic or neutral? Justify your choice.

Reaction Prediction — 23

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) A concentrated solution of ammonia is added to a solution of zinc iodide.

Identify the Lewis base in this reaction.

- b) Hydrogen gas is passed over hot iron(II) oxide powder.

Identify the substance being oxidized in the reaction.

- c) Ethanol is burned in oxygen.

How many sigma and pi bonds are found in an ethanol molecule?

- d) A solution of potassium iodide is electrolyzed.

What product is formed at the anode?

- e) A solution of ammonium thiocyanate is added to a solution of iron(III) chloride.

What type of reaction is this?

Reaction Prediction — 24

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Powdered magnesium oxide is added to a container of carbon dioxide gas.

If an acid were added to the product formed in the reaction, what would be observed?

- b) Acetic acid solution is added to a solution of sodium hydrogen carbonate.

Draw the Lewis structure for an acetic acid molecule.

- c) Calcium metal is heated strongly in nitrogen gas.

What is being reduced in this reaction? Justify your choice.

- d) A piece of iron is added to a solution of iron(III) sulfate.

How many electrons, in total, are transferred in this reaction?

- e) A solution of copper(II) sulfate is added to a solution of barium hydroxide.

What evidence of a chemical change would be observed in this reaction?

Reaction Prediction — 25

Write formulas for the reactants and predicted products for the chemical reactions that follow. Assume that in all cases a reaction occurs. The reaction must also be balanced, in the lowest whole number ratio, although descriptive symbols do not need to be included. Write all substances in their proper form—as ions if appropriate—and cancel any spectator ions. Assume that the reactions are in aqueous solutions unless otherwise stated. Answer the follow-up question also.

- a) Solid calcium is added to warm water.

Would the resulting solution be acidic, basic or neutral? Justify your choice.

- b) Solutions of lead(II) nitrate and lithium sulfate are combined.

Explain why substituting a solution of magnesium nitrate for the lead(II) nitrate would give substantially different results.

- c) Solid sodium sulfite is added to water.

What color would be observed after adding a couple of drops of bromthymol blue to the resulting solution?

- d) Magnesium turnings are added to a solution of iron(III) chloride.

What is being reduced in this reaction? Justify your choice.

- e) An excess of concentrated ammonia solution is added to freshly precipitated copper(II) hydroxide.

Describe the effect adding an acid would have on the product(s) of the reaction.