

2006 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS**CHEMISTRY****Part B**

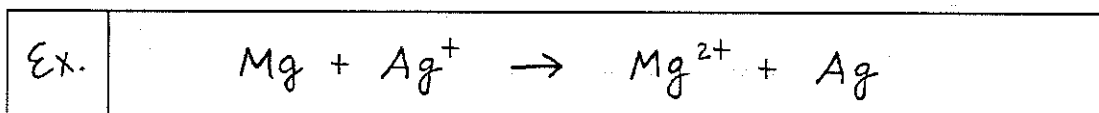
Time—50 minutes

NO CALCULATORS MAY BE USED FOR PART B.

Answer Question 4 below. The Section II score weighting for this question is 15 percent.

4. Write the formulas to show the reactants and the products for any FIVE of the laboratory situations described below. No more than five choices will be graded. In all cases, a reaction occurs. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solution as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. You need not balance the equations.

Example: A strip of magnesium is added to a solution of silver nitrate.



- (a) Solid potassium chlorate is strongly heated.
- (b) Solid silver chloride is added to a solution of concentrated hydrochloric acid.
- (c) A solution of ethanoic (acetic) acid is added to a solution of barium hydroxide.
- (d) Ammonia gas is bubbled into a solution of hydrofluoric acid.
- (e) Zinc metal is placed in a solution of copper(II) sulfate.
- (f) Hydrogen phosphide (phosphine) gas is added to boron trichloride gas.
- (g) A solution of nickel(II) bromide is added to a solution of potassium hydroxide.
- (h) Hexane is combusted in air.

2006 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS (Form B)

CHEMISTRY

Part B

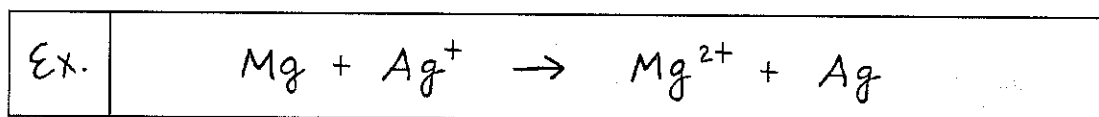
Time—50 minutes

NO CALCULATORS MAY BE USED FOR PART B.

Answer Question 4 below. The Section II score weighting for this question is 15 percent.

4. Write the formulas to show the reactants and the products for any FIVE of the laboratory situations described below. Answers to more than five choices will not be graded. In all cases, a reaction occurs. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solution as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. You need not balance the equations.

Example: A strip of magnesium is added to a solution of silver nitrate.



- (a) Solid calcium carbonate is strongly heated.
- (b) A strip of magnesium metal is placed in a solution of iron(II) chloride.
- (c) Boron trifluoride gas is mixed with ammonia gas.
- (d) Excess concentrated hydrochloric acid is added to a solution of nickel(II) nitrate.
- (e) Solid ammonium chloride is added to a solution of potassium hydroxide.
- (f) Propanal is burned in air.
- (g) A strip of aluminum foil is placed in liquid bromine.
- (h) Solid copper(II) sulfide is strongly heated in air.

2007 AP® CHEMISTRY FREE-RESPONSE QUESTIONS

CHEMISTRY

Part B

Time—40 minutes

NO CALCULATORS MAY BE USED FOR PART B.

Answer Question 4 below. The Section II score weighting for this question is 10 percent.

4. For each of the following three reactions, in part (i) write a balanced equation for the reaction and in part (ii) answer the question about the reaction. In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. You may use the empty space at the bottom of the next page for scratch work, but only equations that are written in the answer boxes provided will be graded.

EXAMPLE:

A strip of magnesium metal is added to a solution of silver(I) nitrate.

(i) Balanced equation:



(ii) Which substance is oxidized in the reaction?

Mg is oxidized.

- (a) A solution of sodium hydroxide is added to a solution of lead(II) nitrate.

(i) Balanced equation:

- (ii) If 1.0 L volumes of 1.0 M solutions of sodium hydroxide and lead(II) nitrate are mixed together, how many moles of product(s) will be produced? Assume the reaction goes to completion.

2007 AP® CHEMISTRY FREE-RESPONSE QUESTIONS

(b) Excess nitric acid is added to solid calcium carbonate.

(i) Balanced equation:

(ii) Briefly explain why statues made of marble (calcium carbonate) displayed outdoors in urban areas are deteriorating.

(c) A solution containing silver(I) ion (an oxidizing agent) is mixed with a solution containing iron(II) ion (a reducing agent).

(i) Balanced equation:

(ii) If the contents of the reaction mixture described above are filtered, what substance(s), if any, would remain on the filter paper?

CHEMISTRY

Part B

Time—40 minutes

NO CALCULATORS MAY BE USED FOR PART B.

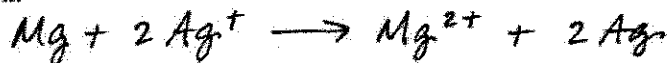
Answer Question 4 below. The Section II score weighting for this question is 10 percent.

4. For each of the following three reactions, in part (i) write a balanced equation for the reaction and in part (ii) answer the question about the reaction. In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. You may use the empty space at the bottom of the next page for scratch work, but only equations that are written in the answer boxes provided will be graded.

EXAMPLE:

A strip of magnesium metal is added to a solution of silver(I) nitrate.

(i) Balanced equation:



(ii) Which substance is oxidized in the reaction?

Mg is oxidized.

- (a) Solid ammonium carbonate decomposes as it is heated.

(i) Balanced equation:

(ii) Predict the algebraic sign of ΔS° for the reaction. Explain your reasoning.

2007 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS (Form B)

(b) Chlorine gas, an oxidizing agent, is bubbled into a solution of potassium bromide.

(i) Balanced equation:

(ii) What is the oxidation number of chlorine before the reaction occurs? What is the oxidation number of chlorine after the reaction occurs?

(c) A small piece of sodium is placed in a beaker of distilled water.

(i) Balanced equation:

(ii) The reaction is exothermic, and sometimes small flames are observed as the sodium reacts with the water. Identify the product of the reaction that burns to produce the flames.

2008 AP® CHEMISTRY FREE-RESPONSE QUESTIONS

CHEMISTRY

Part B

Time—40 minutes

NO CALCULATORS MAY BE USED FOR PART B.

Answer Question 4 below. The Section II score weighting for this question is 10 percent.

4. For each of the following three reactions, in part (i) write a balanced equation for the reaction and in part (ii) answer the question about the reaction. In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. You may use the empty space at the bottom of the next page for scratch work, but only equations that are written in the answer boxes provided will be graded.

EXAMPLE:

A strip of magnesium metal is added to a solution of silver(I) nitrate.

(i) Balanced equation:



(ii) Which substance is oxidized in the reaction?

Mg is oxidized.

- (a) Aqueous sodium hydroxide is added to a saturated solution of aluminum hydroxide, forming a complex ion.

(i) Balanced equation:

(ii) If the resulting mixture is acidified, would the concentration of the complex ion increase, decrease, or remain the same? Explain.

2008 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS

(b) Hydrogen chloride gas is oxidized by oxygen gas.

(i) Balanced equation:

(ii) If three moles of hydrogen chloride gas and three moles of oxygen gas react as completely as possible, which reactant, if any, is present in excess? Justify your answer.

(c) Solid potassium oxide is added to water.

(i) Balanced equation:

(ii) If a few drops of phenolphthalein are added to the resulting solution, what would be observed? Explain.

YOU MAY USE THE SPACE BELOW FOR SCRATCH WORK, BUT ONLY EQUATIONS THAT ARE WRITTEN IN THE ANSWER BOXES PROVIDED WILL BE GRADED.

2008 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS (Form B)

CHEMISTRY

Part B

Time—40 minutes

NO CALCULATORS MAY BE USED FOR PART B.

Answer Question 4 below. The Section II score weighting for this question is 10 percent.

4. For each of the following three reactions, in part (i) write a balanced equation for the reaction and in part (ii) answer the question about the reaction. In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. You may use the empty space at the bottom of the next page for scratch work, but only equations that are written in the answer boxes provided will be graded.

EXAMPLE:

A strip of magnesium metal is added to a solution of silver(I) nitrate.

(i) Balanced equation:



(ii) Which substance is oxidized in the reaction?

Mg is oxidized.

- (a) Chlorine gas, an oxidizing agent, is bubbled into a solution of potassium bromide at 25°C.

(i) Balanced equation:

(ii) Predict the sign of ΔS° for the reaction at 25°C. Justify your prediction.

2008 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS (Form B)

(b) Solid strontium hydroxide is added to a solution of nitric acid.

(i) Balanced equation:

(ii) How many moles of strontium hydroxide would react completely with 500. mL of 0.40 *M* nitric acid?

(c) A solution of barium chloride is added drop by drop to a solution of sodium carbonate, causing a precipitate to form.

(i) Balanced equation:

(ii) What happens to the pH of the sodium carbonate solution as the barium chloride is added to it?

2009 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS

CHEMISTRY

Part B

Time—40 minutes

NO CALCULATORS MAY BE USED FOR PART B.

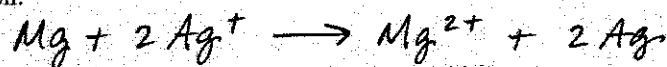
Answer Question 4 below. The Section II score weighting for this question is 10 percent.

4. For each of the following three reactions, write a balanced equation in part (i) and answer the question in part (ii). In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. You may use the empty space at the bottom of the next page for scratch work, but only equations that are written in the answer boxes provided will be graded.

EXAMPLE:

A strip of magnesium metal is added to a solution of silver(I) nitrate.

(i) Balanced equation:



(ii) Which substance is oxidized in the reaction?

Mg is oxidized.

- (a) A sample of solid iron(III) oxide is reduced completely with solid carbon.

(i) Balanced equation:

(ii) What is the oxidation number of carbon before the reaction, and what is the oxidation number of carbon after the reaction is complete?

2009 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS

(b) Equal volumes of equimolar solutions of ammonia and hydrochloric acid are combined.

(i) Balanced equation:

(ii) Indicate whether the resulting solution is acidic, basic, or neutral. Explain.

(c) Solid mercury(II) oxide decomposes as it is heated in an open test tube in a fume hood.

(i) Balanced equation:

(ii) After the reaction is complete, is the mass of the material in the test tube greater than, less than, or equal to the mass of the original sample? Explain.

YOU MAY USE THE SPACE BELOW FOR SCRATCH WORK, BUT ONLY EQUATIONS THAT ARE WRITTEN IN THE ANSWER BOXES PROVIDED WILL BE GRADED.

CHEMISTRY

Part B

Time—40 minutes

NO CALCULATORS MAY BE USED FOR PART B.

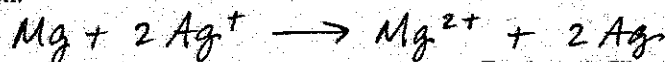
Answer Question 4 below. The Section II score weighting for this question is 10 percent.

4. For each of the following three reactions, write a balanced equation in part (i) and answer the question in part (ii). In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. You may use the empty space at the bottom of the next page for scratch work, but only equations that are written in the answer boxes provided will be graded.

EXAMPLE:

A strip of magnesium metal is added to a solution of silver(I) nitrate.

(i) Balanced equation:



(ii) Which substance is oxidized in the reaction?

Mg is oxidized.

- (a) A barium nitrate solution and a potassium fluoride solution are combined and a precipitate forms.

(i) Balanced equation:

- (ii) If equimolar amounts of barium nitrate and potassium fluoride are combined, which reactant, if any, is the limiting reactant? Explain.

2009 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS (Form B)

- (b) A piece of cadmium metal is oxidized by adding it to a solution of copper(II) chloride.

(i) Balanced equation:

(ii) List two visible changes that would occur in the reaction container as the reaction is proceeding.

- (c) A hydrolysis reaction occurs when solid sodium sulfide is added to distilled water.

(i) Balanced equation:

(ii) Indicate whether the pH of the resulting solution is less than 7, equal to 7, or greater than 7. Explain.

2010 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS

CHEMISTRY

Part B

Time—40 minutes

NO CALCULATORS MAY BE USED FOR PART B.

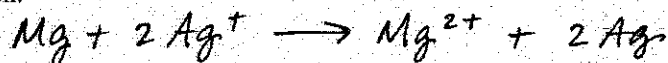
Answer Question 4 below. The Section II score weighting for this question is 10 percent.

4. For each of the following three reactions, write a balanced equation for the reaction in part (i) and answer the question about the reaction in part (ii). In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. You may use the empty space at the bottom of the next page for scratch work, but only equations that are written in the answer boxes provided will be scored.

EXAMPLE:

A strip of magnesium metal is added to a solution of silver(I) nitrate.

(i) Balanced equation:



(ii) Which substance is oxidized in the reaction?

Mg is oxidized.

- (a) A 0.2 M potassium hydroxide solution is titrated with a 0.1 M nitric acid solution.

(i) Balanced equation:

- (ii) What would be observed if the solution was titrated well past the equivalence point using bromthymol blue as the indicator? (Bromthymol blue is yellow in acidic solution and blue in basic solution.)

2010 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS

(b) Propane is burned completely in excess oxygen gas.

(i) Balanced equation:

(ii) When the products of the reaction are bubbled through distilled water, is the resulting solution neutral, acidic, or basic? Explain.

(c) A solution of hydrogen peroxide is heated, and a gas is produced.

(i) Balanced equation:

(ii) Identify the oxidation state of oxygen in hydrogen peroxide.

YOU MAY USE THE SPACE BELOW FOR SCRATCH WORK, BUT ONLY EQUATIONS THAT ARE WRITTEN IN THE ANSWER BOXES PROVIDED WILL BE SCORED.

CHEMISTRY

Part B

Time—40 minutes

NO CALCULATORS MAY BE USED FOR PART B.

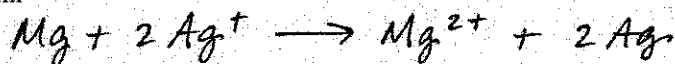
Answer Question 4 below. The Section II score weighting for this question is 10 percent.

4. For each of the following three reactions, in part (i) write a balanced equation and in part (ii) answer the question about the reaction. In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. You may use the empty space at the bottom of the next page for scratch work, but only equations that are written in the answer boxes provided will be scored.

EXAMPLE:

A strip of magnesium metal is added to a solution of silver(I) nitrate.

(i) Balanced equation:



(ii) Which substance is oxidized in the reaction?

Mg is oxidized.

- (a) Solid copper(II) sulfate pentahydrate is gently heated.

(i) Balanced equation:

(ii) How many grams of water are present in 1.00 mol of copper(II) sulfate pentahydrate?

2010 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS (Form B)

- (b) Excess concentrated aqueous ammonia is added to a solution of nickel(II) nitrate, leading to the formation of a complex ion.

(i) Balanced equation:

(ii) Which of the reactants acts as a Lewis acid?

- (c) Methylamine (CH_3NH_2) is added to a solution of hydrochloric acid.

(i) Balanced equation:

(ii) Methylamine dissolves in water to form a solution. Indicate whether this solution is acidic, basic, or neutral.

2011 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS

CHEMISTRY

Part B

Time—40 minutes

NO CALCULATORS MAY BE USED FOR PART B.

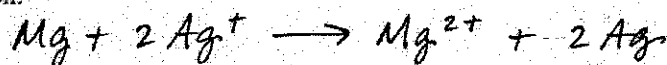
Answer Question 4 below. The Section II score weighting for this question is 10 percent.

4. For each of the following three reactions, write a balanced equation for the reaction in part (i) and answer the question about the reaction in part (ii). In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. You may use the empty space at the bottom of the next page for scratch work, but only equations that are written in the answer boxes provided will be scored.

EXAMPLE:

A strip of magnesium metal is added to a solution of silver(I) nitrate.

(i) Balanced equation:



(ii) Which substance is oxidized in the reaction?

Mg is oxidized.

- (a) Solid magnesium hydroxide is added to a solution of hydrobromic acid.

(i) Balanced equation:

- (ii) What volume, in mL, of 2.00 M hydrobromic acid is required to react completely with 0.10 mol of solid magnesium hydroxide?

2011 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS

- (b) Excess hydrochloric acid is added to a solution of cobalt(II) nitrate to produce a coordination complex.

(i) Balanced equation:

(ii) Which species in the reaction acts as a Lewis base?

- (c) A copper wire is dipped into a solution of silver(I) nitrate.

(i) Balanced equation:

(ii) Describe what is observed as the reaction proceeds.

YOU MAY USE THE SPACE BELOW FOR SCRATCH WORK, BUT ONLY EQUATIONS THAT ARE WRITTEN IN THE ANSWER BOXES PROVIDED WILL BE SCORED.

CHEMISTRY

Part B

Time—40 minutes

NO CALCULATORS MAY BE USED FOR PART B.

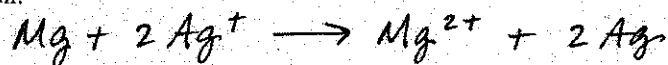
Answer Question 4 below. The Section II score weighting for this question is 10 percent.

4. For each of the following three reactions, write a balanced equation in part (i) and answer the question in part (ii). In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. You may use the empty space at the bottom of the next page for scratch work, but only equations that are written in the answer boxes provided will be scored.

EXAMPLE:

A strip of magnesium metal is added to a solution of silver(I) nitrate.

(i) Balanced equation:



(ii) Which substance is oxidized in the reaction?

Mg is oxidized.

- (a) Zinc metal is added to a hydrobromic acid solution.

(i) Balanced equation:

(ii) Write the oxidation half-reaction for the reaction.

2011 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS (Form B)

(b) Solid lithium oxide is added to distilled water.

(i) Balanced equation:

(ii) Indicate whether the pH of the resulting solution is less than 7, equal to 7, or greater than 7. Explain.

(c) A 100 mL sample of 1 *M* strontium chloride solution is mixed with a 100 mL sample of 1 *M* sodium carbonate solution, resulting in the formation of a precipitate.

(i) Balanced equation:

(ii) Describe what will occur if the precipitate is dried and a few drops of 1 *M* hydrochloric acid are added. Explain.

2012 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS

CHEMISTRY

Part B

Time—40 minutes

NO CALCULATORS MAY BE USED FOR PART B.

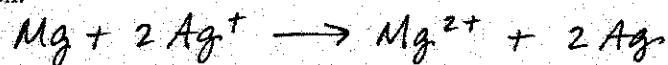
Answer Question 4 below. The Section II score weighting for this question is 10 percent.

4. For each of the following three reactions, write a balanced equation for the reaction in part (i) and answer the question about the reaction in part (ii). In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. You may use the empty space at the bottom of the next page for scratch work, but only equations that are written in the answer boxes provided will be scored.

EXAMPLE:

A strip of magnesium metal is added to a solution of silver(I) nitrate.

(i) Balanced equation:



(ii) Which substance is oxidized in the reaction?

Mg is oxidized.

- (a) A piece of solid strontium carbonate is dropped into a 0.1 M solution of hydrochloric acid.

(i) Balanced equation:

(ii) Indicate one thing that would be observed as the reaction occurs.

2012 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS

(b) Magnesium metal is strongly heated in oxygen gas.

(i) Balanced equation:

(ii) What is the oxidation number of magnesium before the reaction occurs, and what is the oxidation number of magnesium after the reaction is complete?

(c) A solution of nickel(II) chloride is added to a solution of sodium hydroxide, forming a precipitate.

(i) Balanced equation:

(ii) If equal volumes of 1.0 *M* nickel(II) chloride and 1.0 *M* sodium hydroxide are used, what ion is present in the solution in the highest concentration after the precipitate forms?

YOU MAY USE THE SPACE BELOW FOR SCRATCH WORK, BUT ONLY EQUATIONS THAT ARE WRITTEN IN THE ANSWER BOXES PROVIDED WILL BE SCORED.