AP Multiple-Choice Review Questions

Use the following information to answer questions 1 and 2.

For a laboratory investigation, a student is instructed to place a 2.4-g sample of magnesium ribbon into 500 mL of a 2.0 M solution of hydrochloric acid. The student then records the following observations:

1) The magnesium ribbon is a bright, shiny, silvery metal.
2) The hydrochloric acid is clear and colorless with no detectable odor.
3) As soon as the magnesium ribbon is dropped into the hydrochloric acid:
   a. bubbles form,
   b. a sizzling sound is heard, and
   c. a clear, colorless gas with no detectable odor appears to be coming from the reaction vessel.
4) After 32 seconds, the magnesium ribbon has completely disappeared.
5) There appears to be only a clear, colorless solution after the reaction has taken place.

1. What is the balanced chemical equation for this reaction?
   (A) Mg + HCl → MgCl₂ + H₂
   (B) Mg + 2HCl → MgCl₂ + H₂
   (C) Mg + 2HCl → MgCl₂ + H₂
   (D) Mg + 2HCl → Mg + Cl₂ + H₂

2. Identify which substance is being oxidized and which substance is being reduced in this laboratory investigation.
   (A) Magnesium is being oxidized, and the chloride ion is being reduced.
   (B) Magnesium is being reduced, and the chloride ion is being oxidized.
   (C) Magnesium is being oxidized, and the hydrogen ion is being reduced.
   (D) Magnesium is being reduced, and the hydrogen ion is being oxidized.

3. If 200 mL of 0.60 M MgCl₂(aq) is added to 400 mL of distilled water, what is the concentration of Mg²⁺(aq) and Cl⁻(aq) in the resulting solution? (Assume volumes are additive.)

<table>
<thead>
<tr>
<th>[Mg²⁺(aq)] (mol/L)</th>
<th>[Cl⁻(aq)] (mol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) 0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>(B) 0.20</td>
<td>0.40</td>
</tr>
<tr>
<td>(C) 0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>(D) 2.0</td>
<td>2.5</td>
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</tbody>
</table>

4. Determine the volume of distilled water that should be added to 20.0 mL of 12.0 M HCl(aq) in order to prepare a 0.500 M HCl(aq) solution.
   (A) 120 mL
   (B) 140 mL
   (C) 460 mL
   (D) 480 mL

Use the following information to answer questions 5 and 6.

Solutions of lead(II) nitrate and potassium iodide react according to the following equation:

\[ \text{Pb(NO}_3\text{)}_2(aq) + 2\text{KI}(aq) \rightarrow \text{PbI}_2(s) + 2\text{KNO}_3(aq) \]

A molecular-level representation illustrating solutions of the reagents lead(II) nitrate and potassium iodide is shown below.

5. Which of the following would be the best molecular-level representation after the reaction has taken place?
   (A) ![Molecular-level representation A](image)
   (B) ![Molecular-level representation B](image)
   (C) ![Molecular-level representation C](image)
   (D) ![Molecular-level representation D](image)

6. Which species acts exclusively as spectator ions in this reaction?
   (A) K⁺ and NO₃⁻
   (B) Pb²⁺ and I⁻
   (C) K⁺ and Pb²⁺
   (D) I⁻ and NO₃⁻

7. What is the molarity of a solution containing ClO₄⁻(aq) if 15 mL of the solution is needed to react completely with 20 mL of 0.20 M KMnO₄ solution? The balanced equation is

\[ \text{2H}_2\text{O}(l) + 4\text{MnO}_4^-(aq) + 3\text{ClO}_4^-(aq) \rightarrow 4\text{MnO}_2(s) + 3\text{ClO}_4^-(aq) + 4\text{OH}^- (aq) \]

   (A) 0.10 M
   (B) 0.20 M
   (C) 0.30 M
   (D) 0.40 M

8. A sample of 25.0 mL of 0.120 M Ca(OH)₂(aq) is titrated with 0.150 M HCl(aq). What volume of HCl(aq) is needed to completely neutralize the Ca(OH)₂(aq)?
   (A) 20.0 mL
   (B) 40.0 mL
   (C) 60.0 mL
   (D) 80.0 mL
Use the following information to answer questions 9 and 10.

The photos of a reaction along with the molecular-level representations are shown below.

9. What is the correct balanced net ionic equation for the reaction illustrated?
   (A) KCl + AgNO₃ → KNO₃ + AgCl
   (B) K⁺ + NO₃⁻ → KNO₃
   (C) Ag⁺ + NO₃⁻ → AgNO₃
   (D) Ag⁺ + Cl⁻ → AgCl

10. Which species are the spectator ions in this reaction?
    (A) K⁺ and NO₃⁻
    (B) K⁺ and Cl⁻
    (C) Ag⁺ and NO₃⁻
    (D) Ag⁺ and Cl⁻

11. In which of the following species is the oxidation state for nitrogen the greatest?
    (A) NO
    (B) NO₂
    (C) N₂O
    (D) N₂O₅

12. A 1.0 M solution of table salt (NaCl) is considered to be 1.0 M Na⁺ and 1.0 M Cl⁻. This means table salt is a
    (A) strong electrolyte
    (B) weak electrolyte
    (C) nonelectrolyte
    (D) strong acid

13. Consider 100.0 mL of a 1.00 M solution of NaCl in a beaker. After several days, you test the solution and find that it has a concentration of 1.33 M. How much water must have evaporated?
    (A) 20.0 mL
    (B) 25.0 mL
    (C) 75.0 mL
    (D) 80.0 mL

14. Calculate the concentration of chloride ions when 200.0 mL of 1.00 M sodium chloride is mixed with 300.0 mL of 1.00 M magnesium chloride.
    (A) 1.00 M
    (B) 1.40 M
    (C) 1.60 M
    (D) 2.00 M

15. What volume of 0.2000 M sulfuric acid is required to neutralize 800.0 mL of 0.1000 M potassium hydroxide?
    (A) 200.0 mL
    (B) 400.0 mL
    (C) 800.0 mL
    (D) 1600. mL