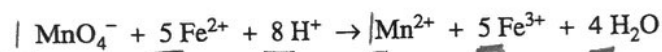


STOICHIOMETRY PLUS

Compound	Molar Mass (grams)
Na ₂ O	62.0
MgO	40.3
K ₂ O	94.2
CaO	56.1

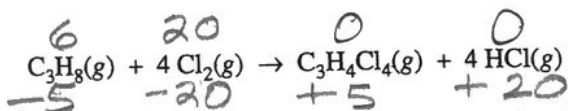
1. According to the information in the table above, a 1.00 g sample of which of the following contains the greatest mass of oxygen?

- (A) Na₂O $\frac{1}{62.0}$
 (B) MgO $\frac{1}{40.3}$
 (C) K₂O $\frac{1}{94.2}$
 (D) CaO $\frac{1}{56.1}$



26. In the reaction represented above, the number of MnO₄⁻ ions that react must be equal to which of the following?

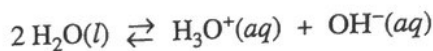
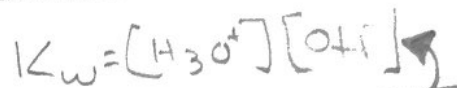
- (A) One-fifth the number of Fe²⁺ ions that are consumed
 (B) Eight times the number of H⁺ ions that are consumed
 (C) Five times the number of Fe³⁺ ions that are produced
 (D) One-half the number of H₂O molecules that are produced



48. A 6.0 mol sample of C₃H₈(g) and a 20. mol sample of Cl₂(g) are placed in a previously evacuated vessel, where they react according to the equation above. After one of the reactants has been totally consumed, how many moles of HCl(g) have been produced?

- (A) 4.0 mol
 (B) 8.0 mol
 (C) 20. mol
 (D) 24 mol

Name KEY



↑T ↑K

20. The autoionization of water is represented by the equation above. Values of pK_w at various temperatures are listed in the table below.

Temperature (°C)	pK _w
0	14.9
10	14.5
20	14.2
30	13.8
40	13.5

K_w -14.9
 1 × 10^{-14.9}
 -14.5
 1 × 10^{-14.5}
 -14.2
 1 × 10^{-14.2}
 -13.8
 1 × 10^{-13.8}
 -13.5
 1 × 10^{-13.5}

Based on the information above, which of the following statements is true?

- (A) The dissociation of water is an exothermic process.
 (B) The pH of pure water is 7.00 at any temperature.
 (C) As the temperature increases, the pH of pure water increases.
 (D) As the temperature increases, the pH of pure water decreases.

If K_w ↑, then [H⁺] and [OH⁻] also ↑. If [H⁺] ↑, then pH ↓.

39. If equal masses of the following compounds undergo complete combustion, which will yield the greatest mass of CO₂?

- (A) Benzene, C₆H₆ + O₂ → 6CO₂ + 3H₂O
 (B) Cyclohexane, C₆H₁₂
 (C) Glucose, C₆H₁₂O₆
 (D) Methane, CH₄ + 2O₂ → CO₂ + 2H₂O

32. A sample of a compound that contains only the elements C, H, and N is completely burned in O₂ to produce 44.0 g of CO₂, 45.0 g of H₂O, and some NO₂. A possible empirical formula of the compound is

- (A) CH₂N
 (B) CH₅N
 (C) C₂H₅N
 (D) C₃H₃N₂

CO₂ $\frac{44.0 \text{ g}}{44 \text{ g/mol}} = 1 \text{ mol CO}_2$
 1 mol C
 H₂O $\frac{45 \text{ g}}{18 \text{ g/mol}} = 2.5 \text{ mol H}_2\text{O}$
 5 mol H

Questions 8-10 refer to the following.

M^+ is an unknown metal cation with a +1 charge. A student dissolves the chloride of the unknown metal, MCl , in enough water to make 100.0 mL of solution. The student then mixes the solution with excess $AgNO_3$ solution, causing $AgCl$ to precipitate. The student collects the precipitate by filtration, dries it, and records the data shown below. (The molar mass of $AgCl$ is 143 g/mol.)

Mass of unknown chloride, MCl	0.74 g
Mass of filter paper	0.80 g
Mass of filter paper plus $AgCl$ precipitate	2.23 g

Handwritten calculations:

$$2.23 \text{ g} - 0.80 \text{ g} = 1.43 \text{ g } AgCl$$

$$\frac{1.43 \text{ g}}{143 \text{ g/mol}} = 0.01 \text{ mol } Cl$$

$$0.01 \text{ mol } Cl \times \frac{35.45 \text{ g}}{1 \text{ mol } Cl} = 0.35 \text{ g } Cl$$

$$0.74 - 0.35 = 0.39 \text{ g } M \rightarrow K = 39 \text{ g}$$

Labels: 0.01 mol MCl, 0.01 mol Cl, 0.01 mol M

9. During the course of the experiment, which of the following happens to the NO_3^- ions?
- (A) They are oxidized by Cl^- ions. *Double replacement IS never Redox*
- (B) They are reduced to NO_2^- ions.
- (C) They are decomposed by reacting with M^+ ions.
- (D) They remain dissolved in the filtrate solution. *↑*



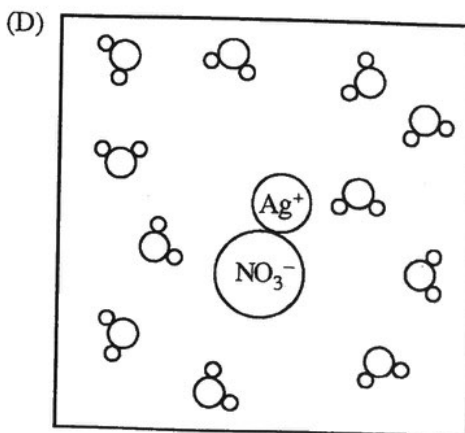
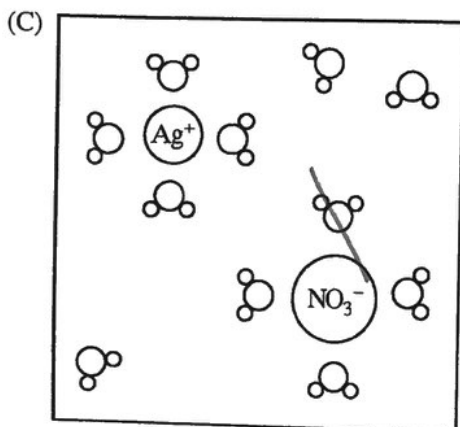
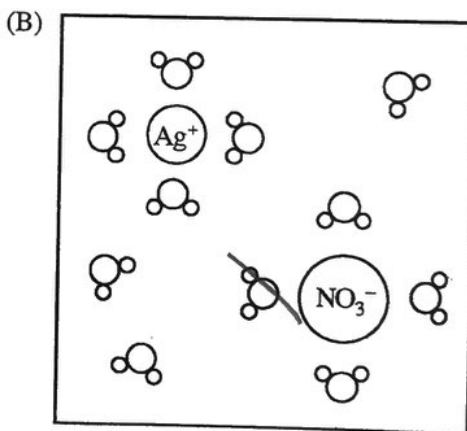
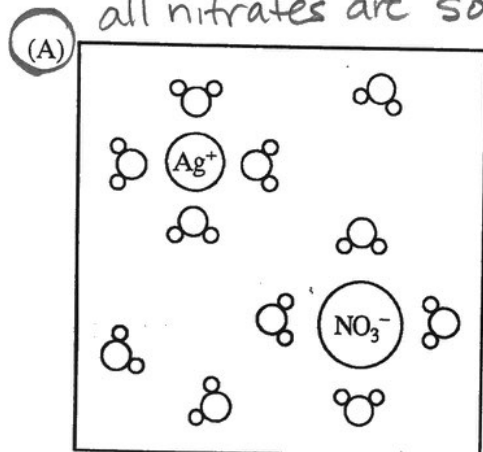
8. What is the identity of the metal chloride?

- (A) $NaCl$
 (B) KCl
 (C) $CuCl$
 (D) $LiCl$

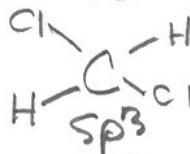
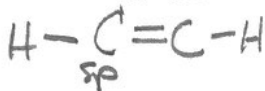
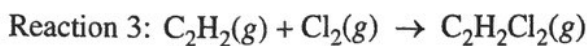
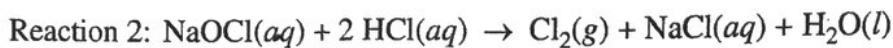
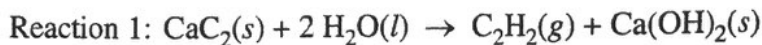
10. Which of the following diagrams best represents the $AgNO_3$ solution before the reaction occurs?

Note: water molecules are represented by the symbol H_2O .

all nitrates are soluble!



Questions 34-36 refer to the reactions represented below, which are involved in a demonstration commonly known as "underwater fireworks."



34. $\text{Ca}(\text{OH})_2(s)$ precipitates when a 1.0 g sample of $\text{CaC}_2(s)$ is added to 1.0 L of distilled water at room temperature. If a 0.064 g sample of $\text{CaC}_2(s)$ (molar mass 64 g/mol) is used instead and all of it reacts, which of the following will occur and why? (The value of K_{sp} for $\text{Ca}(\text{OH})_2$ is 8.0×10^{-8} .)

0.064
64 =
0.001 mol

$Q = (0.001)(0.002)^2 = 4 \times 10^{-9}$

- (A) $\text{Ca}(\text{OH})_2$ will precipitate because $Q > K_{sp}$.
 (B) $\text{Ca}(\text{OH})_2$ will precipitate because $Q < K_{sp}$.
 (C) $\text{Ca}(\text{OH})_2$ will not precipitate because $Q > K_{sp}$.
 (D) $\text{Ca}(\text{OH})_2$ will not precipitate because $Q < K_{sp}$.

35. Reaction 2 occurs when an excess of 6 M $\text{HCl}(aq)$ solution is added to 100. mL of $\text{NaOCl}(aq)$ of unknown concentration. If the reaction goes to completion and 0.010 mol of $\text{Cl}_2(g)$ is produced, then what was the molarity of the $\text{NaOCl}(aq)$ solution?

$0.010 \text{ mol Cl}_2 \times \frac{1 \text{ mol NaOCl}}{1 \text{ mol Cl}_2} = 0.010 \text{ mol NaOCl}$
 $\frac{0.010 \text{ mol NaOCl}}{0.100 \text{ L}} = 0.10 \text{ M}$

- (A) 0.0010 M
 (B) 0.010 M
 (C) 0.10 M
 (D) 1.0 M

36. When Reaction 3 occurs, does the hybridization of the carbon atoms change?

- (A) Yes; it changes from sp to sp^2 .
 (B) Yes; it changes from sp to sp^3 .
 (C) Yes; it changes from sp^2 to sp^3 .
 (D) No; it does not change.

31. To gravimetrically analyze the silver content of a piece of jewelry made from an alloy of Ag and Cu, a student dissolves a small preweighed sample in $\text{HNO}_3(aq)$. $\text{Ag}^+(aq)$ and $\text{Cu}^{2+}(aq)$ ions form in the solution. Which of the following should be the next step in the analytical process?

- (A) Centrifuging the solution to isolate the heavier ions
 (B) Evaporating the solution to recover the dissolved nitrates
 (C) Adding enough base solution to bring the pH up to 7.0
 (D) Adding a solution containing an anion that forms an insoluble salt with only one of the metal ions

$$\frac{1}{100} \rightarrow \frac{1}{100} \times \frac{10}{1} \rightarrow \frac{10}{100} \rightarrow \frac{1}{10} \rightarrow .1$$