

AP CHEMISTRY



QUESTION CATALOGUE

AP Chemistry

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I. STRUCTURE OF MATTER
A. Atomic Theory and Atomic Structure

3. Periodic Relationships
b. Ionization energies

1657.

| | | | |
|----------------------------|------------------------------|-------------------------------|--------------------------------|
| IE ₁ | IE ₂ | IE ₃ | IE ₄ |
| 630 kJ • mol ⁻¹ | 1,680 kJ • mol ⁻¹ | 25,040 kJ • mol ⁻¹ | 126,000 kJ • mol ⁻¹ |

The chart is a Periodic Table with only fourteen main group elements.

| | | | | | |
|-----------|-----------|-----------|-----------|-----------|-----------|
| Aa | | | | | Bb |
| Cc | Dd | Ee | Ff | Gg | Hh |
| Ii | Jj | Kk | Ll | Mm | Nn |

Which element would have this sequence of ionization energies?

- (A) Ii (B) Jj (C) Kk (D) Mm (E) Nn

1. Base your answer to the following question on the following elements.

- (A) Sodium
 (B) Carbon
 (C) Cobalt
 (D) Chlorine
 (E) Neon

Has the highest first ionization energy

- (A) A (D) D
 (B) B (E) E
 (C) C

1165. Which atom has the lowest second ionization energy?

- (A) Be (D) Ar
 (B) Na (E) Mg
 (C) K

1182. Base your answer to the following question on the following compounds.

- (A) Carbon dioxide
 (B) Carbon monoxide
 (C) Water
 (D) Sodium chloride
 (E) Xenon pentafluoride

Which compound has the greatest lattice energy?

- (A) A (D) D
 (B) B (E) E
 (C) C

1355. If you start at Fr and end at Li in Group 1A of the periodic table, what general trend is observed?

- (A) Increasing metallic characteristics
 (B) Decreasing electron affinities
 (C) Decreasing ionization energies
 (D) **Decreasing atomic radii**
 (E) Increasing number of oxidation states

1332.

| Ionization Energies (kJ/mol ⁻¹) | | | |
|---|--------|--------|--------|
| First | Second | Third | Fourth |
| 737.7 | 1450.6 | 7732.6 | 10540 |

Based on the ionization energies listed above, the element is most likely

- (A) **Magnesium** (D) Silicon
 (B) Potassium (E) Nitrogen
 (C) Boron

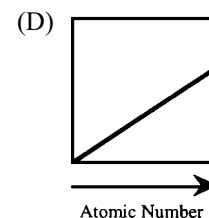
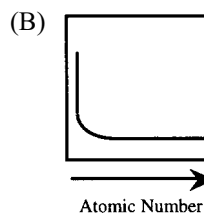
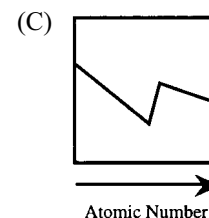
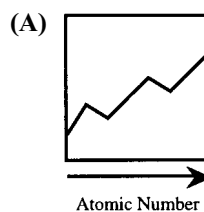
1333.

| Ionization Energies (kJ/mol ⁻¹) | | | | | |
|---|--------|-------|--------|-------|-------|
| First | Second | Third | Fourth | Fifth | Sixth |
| 786 | 1577 | 3232 | 4355 | 16091 | 19784 |

Based on the ionization energies listed above, the element is most likely

- (A) Sb (D) Ga
 (B) Ca (E) Se
 (C) Si

1661. Which graph best depicts the relationship between the ionization energy and atomic number from left to right in a period?



III. REACTIONS

A. Reaction Types

24. How much of 0.500 *M* NaOH is needed to neutralize 100. mL of 1.00 *M* H₂SO₄?
- (A) 50.0 mL (D) **400. mL**
(B) 100. mL (E) 800. mL
(C) 200. mL
43. The ionization constant of HNO₂ is 5.00 × 10⁻⁴. How much of a 10.0 *M* HNO₂ solution will be needed to neutralize 10.0 mL of 0.001 *M* Mg(OH)₂ solution?
- (A) 1.00 L (D) **40.0 mL**
(B) 2.00 L (E) 400. mL
(C) 10.0 mL
226. Vinegar was titrated with Mg(OH)₂ to find the content of Acetic acid (HC₂H₃O₂). If 20.0 mL of vinegar required 5.00 mL of 0.800 *M* Mg(OH)₂ to reach the end point, what is the concentration of acetic acid?
- (A) 0.200 *M* (D) 0.800 *M*
(B) **0.400 *M*** (E) 1.60 *M*
(C) 0.600 *M*
278. What volume of 0.600 *M* HNO₃ needed to neutralize 60.0 mL of 0.180 *M* Mg(OH)₂?
- (A) 9.00 mL (D) 60.0 mL
(B) 18.0 mL (E) 60.0 mL
(C) **36.0 mL**
279. What volume of 0.500 *M* HBr is needed to neutralize 25.0 mL of 0.150 NaOH?
- (A) 5.00 mL (D) 30.0 mL
(B) **7.50 mL** (E) 50.0 mL
(C) 15.0 mL
750. A student titrates 25.00 mL of tap water with 18.2 mL of 0.100 *M* AgNO₃ to completely precipitate the chloride ion. The concentration of the chloride ion is
- (A) 1.82 × 10⁻³ *M* (D) 2.17 × 10⁻¹ *M*
(B) **7.28 × 10⁻² *M*** (E) 1.50 × 10⁻¹ *M*
(C) 1.37 × 10⁻¹ *M*
757. What volume of 0.250 *M* H₂SO₄ is required to neutralize 25.00 mL of 2.50 *M* KOH?
- (A) **125. mL** (D) 500. mL
(B) 150. mL (E) 650. mL
(C) 250. mL
785. When a 1.0 *M* acidic solution is titrated with a 1.0 *M* basic solution, the pH at the equivalence point is 8.5. Which of the following could be the reactants?
- (A) HCl and KOH (D) HNO₃ and NH₃
(B) **HNO₂ and NaOH** (E) HCl and NaOH
(C) HBr and KOH

1. Acid-Base Reactions

d. Titration

791. $2\text{MnO}_4^- + 5\text{H}_2\text{O}_2 + 6\text{H}^+ \rightarrow 5\text{O}_2 + 2\text{Mn}^{2+} + 8\text{H}_2\text{O}$
- In an experiment, 2.00 × 10⁻⁴ mol of MnO₄⁻ is required to titrate 10.0 mL of H₂O₂ to the equivalence point as shown in the reaction above. The concentration of H₂O₂ is
- (A) 5.00 × 10⁻³ *M* (D) 2.00 × 10⁻² *M*
(B) 8.00 × 10⁻³ *M* (E) 2.00 × 10⁻¹ *M*
(C) **5.00 × 10⁻² *M***
792. $\text{Ag}^+(aq) + \text{SCN}^-(aq) \rightarrow \text{AgSCN}(s)$
- A 20.00 mL sample of 0.200 *M* NH₄SCN is used to titrate a 30.00 mL sample containing Ag⁺ as shown in the reaction above. What is the [Ag⁺] in the original sample?
- (A) **0.133 *M*** (D) 0.567 *M*
(B) 0.179 *M* (E) 0.927 *M*
(C) 0.262 *M*
803. At the equivalence point in a titration involving 0.1 *M* solutions, which of the following combinations will have the lowest conductivity?
- (A) **Nitric acid and barium hydroxide**
(B) Acetic acid and sodium hydroxide
(C) Sulfuric acid and barium hydroxide
(D) Hydrochloric acid and sodium hydroxide
(E) Hydrobromic acid and sodium hydroxide
806. Which of the following titrations would have an equivalence point less than pH 7?
- (A) HCl and NaOH (D) KOH and CH₃COOH
(B) NaOH and HNO₃ (E) **NH₃ and HCl**
(C) Ba(OH)₂ and H₂SO₄
836. To determine the [Fe²⁺] in a solution of FeSO₄ by a redox titration, a suitable reagent would be an acidified solution of
- (A) CN⁻ (D) Mn²⁺
(B) SO₄²⁻ (E) Cr³⁺
(C) **Cr₂O₇²⁻**
850. Which equation represents a neutralization reaction?
- (A) Na⁺(aq) + Cl⁻(aq) → NaCl(aq)
(B) **HCl(aq) + NH₃(aq) → NH₄Cl(aq)**
(C) Pb²⁺(aq) + 2Cl⁻(aq) → PbCl₂(s)
(D) BaI₂(aq) + MgSO₄(aq) → BaSO₄(s) + MgI₂(aq)
(E) $\text{MnO}_4^-(aq) + 5\text{Fe}^{2+}(aq) + 8\text{H}^+(aq) \rightarrow \text{Mn}^{2+}(aq) + 5\text{Fe}^{3+} + 4\text{H}_2\text{O}(l)$
851. In a titration, 10.0 mL of H₂SO₄(aq) is required to neutralize 0.0400 mol of NaOH. What is the [H₂SO₄]?
- (A) 10.00 *M* (D) **2.00 *M***
(B) 8.00 *M* (E) 0.0200 *M*
(C) 4.00 *M*

V. LABORATORY

A. Short Answer

1970. Which of the following is something not to do, or is unnecessary when performing a titration?
- (1) Keeping the solution well mixed by constant stirring
 - (2) Rinsing the beaker that is to hold the solution to be titrated right before pouring the solution in**
 - (3) Draining the pipet by touching the tip to the side of the container that is catching
 - (4) Turning the stopcock immediately so that the titration stops when the indicator changes color
 - (5) Keeping track of the volume of the solution in the buret both at the beginning of the experiment and after the titration

1967. Two substances, A and B were separated after being in solution by distillation. Distillation works because A and B have different

- (1) crystal colors
- (2) solubilities
- (3) densities
- (4) boiling points**
- (5) melting points

1825. An experiment is designed to determine the enthalpy (heat) of solution of ammonium chloride, NH_4Cl .

| | |
|---|---------|
| Mass of NH_4Cl plus beaker | 48.67 g |
| Mass of beaker | 40.65 g |
| Mass of calorimeter plus solution of NH_4Cl | 211.0 g |
| Mass of empty calorimeter | 20.9 g |
| Initial temperature of water in calorimeter | 22.0 °C |
| Final temperature of solution in calorimeter | 18.3 °C |

Which will increase the precision of the heat of solution of NH_4Cl the most?

- (1) Measure the temperatures to the nearest 0.01 °C
- (2) Determine the mass of the NH_4Cl to the nearest 0.001 g.
- (3) Use a sample of NH_4Cl with a mass closer to 9.00 g rather than 8.00 g.**
- (4) Determine the mass of the solution in the calorimeter to the nearest 0.01 g.
- (5) Determine the mass of empty calorimeter to the nearest 0.0001 g.

1822. Which constituent of a sample of brass containing zinc, copper, tin, and lead can be determined using a spectrophotometer?

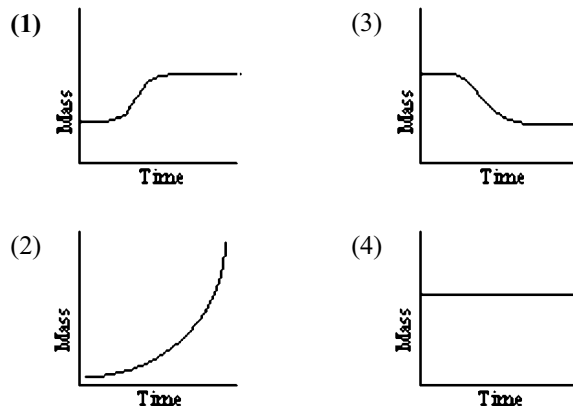
- (1) Zinc
- (2) Copper**
- (3) Tin
- (4) Lead
- (5) None of these elements can be determined using a spectrophotometer

1. Interpreting a. Interpreting labs

1817. Collection of a gas by the displacement of water is only possible if the gas is

- (1) lighter than air.
- (2) heavier than air.
- (3) water soluble.
- (4) water insoluble.**
- (5) a halogen or noble gas

1540. Iron is heated in a reaction vessel into which oxygen gas is fed. All of the iron is converted to iron(III) oxide (rust), Fe_2O_3 . The mass of the reaction vessel does not change during the reaction. Which graph shows the change in the combined mass of the reaction vessel and its contents?



1539. A narrow-necked, stoppered bottle contains concentrated sulfuric acid. When the acid is being poured into a beaker, the stopper should be

- (1) rinsed with distilled water.
- (2) placed into the reaction beaker.
- (3) placed out of the way on the lab table.
- (4) held inverted between the middle fingers.**
- (5) rinsed with sulfuric acid.

1421. Which number contains exactly 5 significant digits?

- (1) 5.02×10^{-5}
- (2) 34100
- (3) 0.00003
- (4) 0.0782×10^{-3}
- (5) 32312×10^{52}**

1311. To treat an acid splash on skin, the best emergency procedure is to flush the skin with water and what other substance?

- (1) NaOH
- (2) Na_2SO_4
- (3) NaHCO_3**
- (4) NaH_2PO_4
- (5) NaCl

1220. Which of the following are proper laboratory procedures?
I. Wait until hot objects have reached room temperature before finding their mass.

- II. Always rinse a buret with water before adding a titrant.
III. When mixing solutions, always add water to the acid.
- (1) I and II
 - (2) II and III
 - (3) I only**
 - (4) III only
 - (5) I, II, and III