

**AP Chemistry Final Exam  
Version N KEY  
Fall 2005**

**50 Multiple Choice questions, 60 minutes**

**NO CALCULATORS MAY BE USED. You will have a periodic table.**

**Note: For all questions, assume that the temperature is 298 K, the pressure is 1.00 atmospheres, and solutions are aqueous unless otherwise specified.**

**Guessing: One-fourth of the number of questions you answer incorrectly will be subtracted from the number of questions you answer correctly.**

**You may write on this exam; however, you will only be given credit for answers recorded on the Scantron sheet.**

**NAME:**

**PERIOD:    1       2       3       4**

**January 10-12, 2006**

## Version N

- Which of the following does not contain oxygen?
  - An aldehyde
  - An ester
  - An alcohol
  - An ether
  - All of the above contain oxygen.**
- Which of the following has “cis-trans” isomerism?
  - PF<sub>4</sub>
  - H<sub>2</sub>O
  - CCl<sub>2</sub>F<sub>2</sub>
  - H<sub>2</sub>SO<sub>2</sub>
  - None of the above or not enough information has been provided.**
- Which should have the largest bond polarity?
  - S–O
  - P–F**
  - C–B
  - C–N
  - Cl–Br
- What is the oxidation state of manganese in permanganate?
  - 1
  - +3
  - +5
  - +7**
  - None of the above or not enough information has been provided.
- The correct name for the compound K<sub>3</sub>P is:
  - Potassium hypophosphite
  - Potassium phosphate
  - Potassium phosphide**
  - Tripotassium monophosphide
  - None of the above or not enough information has been provided.
- An alkyne has:
  - At least four sigma bonds.
  - At least two pi bonds.**
  - A tetrahedral geometry
  - Delocalization.
  - None of the above or not enough information has been provided.
- As the frequency of electromagnetic radiation decreases, the wavelength
  - Decreases
  - Increases**
  - Remains constant
  - Varies exponentially
  - None of the above or not enough information has been provided.
- Which of the following is a temperature-dependent concentration unit?
  - Molarity**
  - Mole fraction
  - Weight percent
  - Molality
  - None of the above or not enough information has been provided.

9. Which of the following lists the electromagnetic spectral regions in order of increasing energy?
- X-ray, ultraviolet, visible
  - Infrared, visible, ultraviolet**
  - Ultraviolet, visible, infrared
  - X-ray, visible, infrared
  - None of the above or not enough information has been provided.
10. An element in its ground state:
- Is an element that is unreactive and found free in nature
  - Has all of its electrons paired
  - Has all of its electrons in the lowest possible energy levels**
  - Is an element as found in nature
  - None of the above or not enough information has been provided.
11. Which of the following molecules is expected to have the lowest normal boiling point?
- CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>**
  - CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH
  - CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>Cl
  - CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>F
  - None of the above or not enough information has been provided.
12. Hydrogen can be liquefied at approximately 14 K because of:
- Induced dipoles**
  - Dipole-dipole attractive forces
  - Hydrogen bonding
  - Ionic attractions
  - None of the above or not enough information has been provided.
13. Monatomic ions of the representative elements are often:
- Isoelectronic with a noble gas**
  - Highly colored
  - Very soluble
  - Radioactive
  - None of the above or not enough information has been provided.
14. An atom that has four sigma bonding pairs of electrons and two nonbonding pair of electrons is expected to have which of the following types of molecular geometry and bonding?
- Tetrahedral, sp<sup>3</sup>
  - Square planar, sp<sup>3</sup>d<sup>2</sup>**
  - Octahedral, sp<sup>3</sup>d<sup>2</sup>
  - Square pyramidal, sp<sup>3</sup>d<sup>2</sup>
  - None of the above or not enough information has been provided.
15. Hund's rule states that, in an atom:
- No two electrons can have the same energy
  - No two electrons with the same spin can occupy an orbital
  - No two electrons can pair if there is an empty degenerate orbital available**
  - No two electrons can have the same four quantum numbers
  - None of the above or not enough information has been provided.
16. Which of the following is true?
- All chlorides, bromides, and iodides are soluble.
  - All sulfates are soluble.
  - All hydroxides are soluble.
  - All acetate compounds are soluble.**
  - All of the above are false.

17. Which of the following pair of liquids is expected to be immiscible?
- A.  $\text{H}_2\text{O}$  and  $\text{CH}_3\text{OH}$
  - B.  $\text{C}_{10}\text{H}_{22}$  and  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$**
  - C.  $\text{CH}_3\text{CH}_2\text{NH}_2$  and  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
  - D.  $\text{C}_6\text{H}_6$  and  $\text{C}_5\text{H}_{12}$
  - E.  $\text{H}_2\text{O}$  and  $\text{H}_2\text{S}$
18. Which of the following best explains why diamonds are hard and graphite is soft?
- A. The carbon-carbon bonds in diamonds are of higher energy than those in graphite.
  - B. The melting point of diamonds is higher than that of graphite.
  - C. Diamond is  $\text{sp}^3$  hybridized, while graphite is  $\text{sp}^2$ .**
  - D. The carbon-carbon bonds in diamonds are shorter than those in graphite.
  - E. None of the above or not enough information has been provided.
19. When collecting a gas over water, it is important to:
- A. Set the temperature to  $0^\circ\text{C}$ .
  - B. Ensure the room pressure is 760 mm Hg.
  - C. Collect a gas that is not flammable.
  - D. Correct for the vapor pressure of water.**
  - E. None of the above or not enough information has been provided.
20. Which of the following atoms or ions is largest in size?
- A.  $\text{S}^{2-}$**
  - B.  $\text{Cl}^{1-}$
  - C.  $\text{K}^{1+}$
  - D.  $\text{Ca}^{2+}$
  - E. None of the above or not enough information has been provided.
21. Which lists the following solutions, 1.0-molal  $\text{AgBr}$ , 1.0-molal  $\text{Br}_2$ , and 1.0-molal  $\text{LiBr}$ , in order of decreasing boiling point?
- A.  $\text{AgBr} = \text{LiBr}, \text{Br}_2$
  - B.  $\text{LiBr}, \text{Br}_2, \text{AgBr}$
  - C.  $\text{Br}_2, \text{AgBr} = \text{LiBr}$
  - D.  $\text{LiBr}, \text{AgBr} = \text{Br}_2$**
  - E.  $\text{AgBr}, \text{LiBr}, \text{Br}_2$
22. How many moles of  $\text{O}_2$  are required in the combustion of 1 mole of butene?
- A. 2 moles
  - B. 6 moles**
  - C.  $9/2$  moles
  - D.  $5/2$  moles
  - E. None of the above or not enough information has been provided.
23. A measured mass of a non-reactive metal was dropped into a small graduated cylinder half-filled with water. The following measurements were made.
- |  |         |
|--|---------|
| Mass of metal =                            | 45.00 g |
| Volume of water before addition of metal = | 10 mL   |
| Volume of water after addition of metal =  | 25.0 mL |
- The density (in g/mL) of the metal should be reported as
- A. 3.0000
  - B. 3.000
  - C. 3.00
  - D. 3.0
  - E. 3**

24. Which of the following is not a characteristic of elemental potassium?
- A. A solid element at room temperature.
  - B. Has perceptible color at room temperature.
  - C. Conducts electricity.
  - D. Reacts with oxygen gas to produce a basic anhydride.
  - E. All of the above are characteristic.**
25. Of the following, the least ideal gas is:
- A. I<sub>2</sub>**
  - B. H<sub>2</sub>
  - C. O<sub>2</sub>
  - D. CH<sub>4</sub>
  - E. Ne
26. Which of the following molecules has the largest bond order?
- A. N<sub>2</sub>**
  - B. O<sub>2</sub>
  - C. Br<sub>2</sub>
  - D. S<sub>8</sub>
  - E. None of the above or not enough information has been provided.
27. Which of the following is associated with an emission line in the Paschen series?
- A. Far-infrared
  - B. Infrared**
  - C. Visible
  - D. Ultraviolet
  - E. None of the above or not enough information has been provided.
28. Which of the following elements would have the smallest first ionization energy?
- A. N
  - B. O**
  - C. F
  - D. Ne
  - E. None of the above or not enough information has been provided.
29. The quantum number  $m_l$  (i.e., subscript is a lowercase "l") signifies:
- A. The relative distance of the electron from the nucleus.
  - B. The orientation in space of a particular orbital**
  - C. The shape of an orbital
  - D. The spin of the electron
  - E. None of the above or not enough information has been provided.
30. The functional group that represents an aldehyde is commonly written as:
- I. -CHO
  - II. -COOH
  - III. -COH
- A. I only**
  - B. III only
  - C. I and II only
  - D. II and III only
  - E. I, II, and III

31. Raoult's law states that the partial pressure of a solvent above a solution is:
- A. Proportional to the temperature
  - B. Proportional to the concentration of solute**
  - C. Proportional to the intermolecular force strength
  - D. Inversely proportional to molar mass of the solvent
  - E. None of the above or not enough information has been provided.
32. Which of the following atoms would be considered paramagnetic?
- I. N
  - II. Cr
  - III. Be
- A. I only
  - B. III only
  - C. I and II only**
  - D. II and III only
  - E. I, II, and III
33. The electronic configuration of the metal ion in ferric iodide is  $1s^2 2s^2 2p^6 3s^2 3p^6 \dots$
- A.  $4s^2 3d^4$
  - B.  $4s^1 3d^5$
  - C.  $3d^6$
  - D.  $3d^5$**
  - E. None of the above or not enough information has been provided.
34. Which of the following is considered a state function?
- I. Enthalpy
  - II. Pressure
  - III. Heat
- A. I only
  - B. III only
  - C. I and II only**
  - D. II and III only
  - E. I, II, and III
35. The flame test color for lithium is:
- A. Green
  - B. Lilac (violet)
  - C. Red**
  - D. Yellow
  - E. None of the above or not enough information has been provided.
36. As the molar mass of a sample of a gas decreases, its rate of effusion will:
- A. Decrease
  - B. Increase**
  - C. Remain constant
  - D. Rate of effusion is independent of temperature
  - E. None of the above or not enough information has been provided.

37. Which of the following would, when added to water, produce an acid?
- I.  $\text{H}_2$
  - II.  $\text{NO}_2$
  - III.  $\text{Na}_2\text{O}$
- A. I only
  - B. II only**
  - C. I and II only
  - D. II and III only
  - E. I, II, and III
38. Ortho-dichlorobenzene can also be named:
- A. 1,2-dichlorobenzene**
  - B. 1,3-dichlorobenzene
  - C. 1,4-dichlorobenzene
  - D. 2,3-dichlorobenzene
  - E. None of the above or not enough information has been provided.
39. The kinetic molecular theory of gases states that:
- I. The average kinetic energy of a gas is related to the Kelvin temperature.
  - II. Ideal gas particles do not attract or repel each other
  - III. Ideal gas particles have no pressure
- A. I only
  - B. II only
  - C. I and II only**
  - D. I and III only
  - E. I, II, and III
40. The net ionic equation expected when solutions of  $\text{NH}_4\text{Br}$  and  $\text{AgNO}_3$  are mixed is:
- A.  $\text{Ag}^{1+}(\text{aq}) + \text{NO}_3^{1-}(\text{aq}) \rightarrow \text{AgNO}_3(\text{s})$
  - B.  $\text{Ag}^{1+}(\text{aq}) + 2\text{NH}_4^{1+}(\text{aq}) \rightarrow \text{Ag}(\text{NH}_3)_2(\text{s}) + \text{H}_2(\text{g})$
  - C.  $\text{Ag}^{1+}(\text{aq}) + \text{Br}^{1-}(\text{aq}) \rightarrow \text{AgBr}(\text{s})$**
  - D.  $\text{NH}_4^{1+}(\text{aq}) + \text{Br}^{1-}(\text{aq}) \rightarrow \text{NH}_4\text{Br}(\text{s})$
  - E. None of the above or not enough information has been provided.
41. Which of the following is not a good measure of relative intermolecular attractive forces?
- A. Electronegativity**
  - B. Boiling points
  - C. Vapor pressures
  - D. Heat of vaporization
  - E. None of the above or not enough information has been provided.
42. Which of the following obeys the octet rule?
- A.  $\text{BeF}_2$
  - B.  $\text{H}_3\text{O}^+$**
  - C.  $\text{ArF}_4$
  - D.  $\text{SF}_6$
  - E. None of the above or not enough information has been provided.
43. If a reaction is carried out in a series of steps, the change in enthalpy of the reaction will equal the sum of the enthalpy changes for the individual steps. This statement is known as:
- A. Haber's process
  - B. Henry's law
  - C. Hess' law**
  - D. Hund's rule
  - E. None of the above or not enough information has been provided.

44. Which of the following correctly lists the individual intermolecular attractive forces in decreasing strength?
- A. **Hydrogen bonds, dipole-dipole, London dispersion**
  - B. Dipole-dipole, London dispersion, hydrogen bonds
  - C. London dispersion, hydrogen bonds, dipole-dipole
  - D. Dipole-dipole, hydrogen bonds, London dispersion
  - E. None of the above or not enough information has been provided.
45. What is the total number of isomers for  $C_3H_6$ ?
- A. 1
  - B. **2**
  - C. 3
  - D. 4
  - E. None of the above or not enough information has been provided.
46. Which series is ranked in order from smallest to largest (becoming more negative) electron affinity?
- A. **N, O, F**
  - B. N, F, O
  - C. F, O, N
  - D. O, N, F
  - E. None of the above or not enough information has been provided.
47. What is the formal charge on the iodine atom in iodic acid?
- A. -1
  - B. +1
  - C. **+2**
  - D. +3
  - E. +5
48. A solid sample of aluminum carbonate is strongly heated to drive off carbon dioxide, which is then bubbled through a solution of barium hydroxide, forming barium carbonate and water. How many moles of barium hydroxide are required to completely react with 0.60 moles of aluminum carbonate?
- A. 0.1
  - B. 0.6
  - C. **1.8**
  - D. 3.6
  - E. None of the above
49. Which of the following is insoluble in water?
- A. LiBr
  - B. **HgSO<sub>4</sub>**
  - C. FeCl<sub>2</sub>
  - D. Mg(NO<sub>3</sub>)<sub>2</sub>
  - E. None of the above or not enough information has been provided.
50. The ideal gas law represents real gases when a gas sample is experiencing which of the following conditions?
- A. Low pressure and low temperature
  - B. **Low pressure and high temperature**
  - C. High pressure and low temperature
  - D. High pressure and high temperature
  - E. None of the above or not enough information has been provided.