Chemistry 11 Fall 2008
Examination #1 **ANSWER KEY**

For the first portion of this exam, select the best answer choice for the questions below and mark the answers on your scantron. Then answer the free response questions that follow (100 pts. total; multiple choice 2 pts. each).

1. The total number of protons, neutrons, and electrons in $^{98}Mo^{7+}$ are:

   A. 42 protons; 56 neutrons; 35 electrons
   B. 42 protons; 98 neutrons; 35 electrons
   C. 42 protons; 56 neutrons; 49 electrons
   D. 96 protons; 2 neutrons; 89 electrons
   E. 96 protons; 2 neutrons; 103 electrons

2. A 600. mL container has what volume in fluid ounces? (1 L = 1.06 qt; 1 qt = 32 fl. oz.)

   A. 18.1 fl. oz.
   B. 1.99×10^{-2} fl. oz.
   C. 20.4 fl. oz.
   D. 1.77×10^{-2} fl. oz.
   E. 33.7 fl. oz.

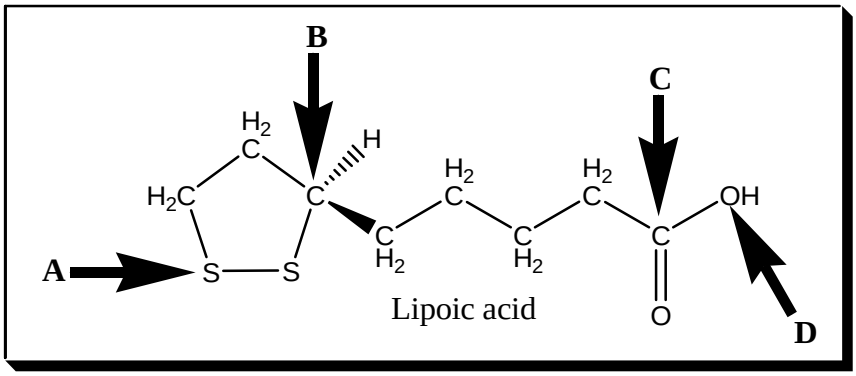
3. Convert 66 ºC to degrees Fahrenheit and Kelvin, respectively.

   A. 69 ºF and 339 K
   B. 151 ºF and 339 K
   C. 201 ºF and -207 K
   D. 87 ºF and -207 K
   E. None of the above

4. Which of the following processes does NOT represent a chemical change?

   A. the rusting of iron
   B. the reaction of sodium metal with water to form sodium hydroxide
   C. the burning of methane gas
   D. the explosion of dynamite
   E. the dissolving of sugar in water

For Questions 5 – 9, use the structure of lipoic acid shown below, a growth factor for many bacteria and protozoa that functions as an essential component of enzymes involved in human metabolism:



5. What is the geometry associated with the sulfur labeled "A"?

A. linear
B. trigonal planar
C. trigonal pyramidal
D. tetrahedral
E. bent

6. What is the relative bond angle associated with the carbon labeled "B"?

A. 90º
B. 109.5º
C. 120º
D. 180º
E. 360º

7. The component labeled "C" is known in organic chemistry as a carboxylic acid functional group. Which of the following statements concerning the carboxylic acid is NOT true?

A. The carbon labeled "C" has a trigonal planar geometry.
B. The relative bond angle for the central carbon atom is 120 degrees.
C. This portion of the molecule is considered polar.
D. The adjacent carbon to the carboxylic acid functional group is tetrahedral.
E. The carbon-oxygen dipoles are equal in magnitude.

8. What is the geometry associated with the oxygen labeled "D"?

A. linear
B. trigonal planar
C. trigonal pyramidal
D. tetrahedral
E. bent

9. Select **"A" for True** OR "**B**" for False regarding the following statement: *Lipoic acid is a polar molecule*.

10. Convert 1.39 ft/s to meters per minute. (1 m = 39.37 in)

A. 1520 m/min
B. 305 m/min
C. 2.12 m/min
D. 7.68 m/min
E. 25.4 m/min

11. Given the table of specific heat values below, what is the identity of a 26.2 g metal sample that increases by 8.5 ºC when 100.0 J of energy is absorbed?

Element	Specific Heat (J/g ºC)
Au	0.128
Ag	0.235
Cu	0.385
Fe	0.449
Al	0.903

A. Fe
B. Al
C. Au
D. Ag
E. Cu

12. Which comparison of atomic and/or ionic radii is correct?

A. $K^+ > K$
B. $Rb^+ > K^+$
C. S > Si
D. Kr > Xe
E. $Cl > Cl^-$

13. If matter is uniform throughout, cannot be separated into other substances by physical processes, but CAN be decomposed into other substances by ordinary chemical means, it is classified as what?

A. heterogeneous mixture
B. element
C. homogeneous mixture
D. compound
E. mixture of elements

14. The precision of a data set is considered to be poor if:

A. the data do not stray from the average value.
B. the data are a set of closely spaced numbers.
C. the data vary widely from the average value.
D. the accuracy is low.
E. the accuracy is high.

15. The content of a container filled with methanol (CH_3OH) and water (H_2O) would best be described as:

A. elements
B. a homogeneous mixture
C. a heterogeneous mixture
D. a compound
E. a pure substance

16. Carry out the following calculation: $[(2.4 \times 10^{12})\ (5.78 \times 10^{-31})] / (2.965 \times 10^{14})$

A. 1.4×10^{28}
B. 1.40×10^{28}
C. 4.7×10^{29}
D. 4.7×10^{-33}
E. 4.68×10^{-33}

17. What is the atomic symbol for plutonium?

A. P
B. Pl
C. Pu
D. Pn
E. Pm

18. Determine the correct ranking of the following species in terms of increasing electronegativities.

A. Ge < As < O < Cl < F
B. Ge < As < Cl < O < F
C. F < O < Cl < As < Ge
D. F < Cl < O < As < Ge
E. All listed species possess the same electronegativity values.

19. Which of the following statements is INCORRECT?

A. Nonmetals can be bent and are generally poor conductors of heat and electricity.
B. Metals tend to oxidize and lose electrons, while nonmetals tend to reduce and gain electrons.
C. An orbital is a region in three dimensional space where there is a probability of finding an electron.
D. The proton and the electron have identical masses.
E. Metals appear on the left side of the periodic table, while nonmetals generally occupy the right side of the periodic table.

20. A piece of dry ice left on a lab bench top at room temperature will undergo:

A. condensation
B. deposition
C. evaporation
D. sublimation
E. melting

21. Isotopes can differ in which of the following?

I. atomic number
II. mass number
III. number of protons
IV. number of neutrons
V. number of electrons

A. I only
B. I and II
C. II and III
D. II and IV
E. I and V

22. Determine the accurate electronic configuration for Dubnium, Db (Z = 105):

A. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 4d^{10}\ 4p^6\ 5s^2\ 5d^{10}\ 5p^6\ 6s^2\ 6f^{14}\ 6d^{10}\ 6p^6\ 7s^2\ 7f^{14}\ 7d^3$
B. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 5f^{14}\ 5d^{10}\ 6p^6\ 7s^2\ 6f^{14}\ 6d^3$
C. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 6f^{14}\ 5d^{10}\ 6p^6\ 7s^2\ 7f^{14}\ 6d^3$
D. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^{14}\ 5d^{10}\ 6p^6\ 7s^2\ 5f^{14}\ 6d^3$
E. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 6f^{14}\ 4d^{10}\ 6p^6\ 7s^2\ 7f^{14}\ 5d^3$

23. Manganese reacts with a certain element (X) to form a compound with the general formula Mn_3X_4. What would the most likely formula be for the compound formed between magnesium and X?

A. MgX
B. MgX_2
C. Mg_2X
D. Mg_2X_3
E. Mg_3X_2

24. **CHALLENGE!** A slab of patio brick (density = 3.4 g/cm^3) is cut into a perfect square 5.35 cm on a side and has a mass of 0.47 kg. What is the thickness of the brick?

A. 4.8 cm
B. 5.4 cm
C. 28 cm
D. 4.8 x 10^{-3} cm
E. 56 cm

25. Which of the following is correctly ranked in terms of increasing first ionization energies?

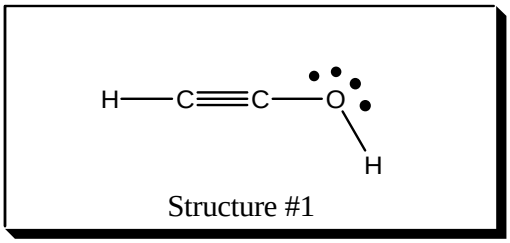
A. F < S < Al < Ca < K
B. K < Ca < Al < S < F
C. K < Al < Ca < S < F
D. F < S < Ca < Al < K
E. All listed species possess the same first ionization energies.

26. (28 pts. total; 7 pts. each) Consider each of the following ions/molecules shown below and write your final structures in the boxes provided:

******<u>NOTE</u>: Terminal atoms are assumed to have an octet of electrons (excluding hydrogen)—omitted for the sake of clarity!***

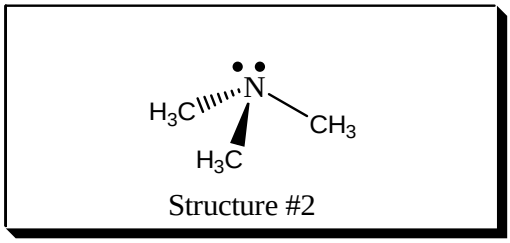
A. Beginning with the best *Lewis dot structure*, use *VSEPR* theory to draw each of the listed species, including resonance where appropriate. Don't forget to include lone pairs!

B. Describe the geometry about EACH central atom. Include <u>both</u> electronic and molecular geometries.
C. Give the approximate bond angle(s) around each central atom.
D. Determine whether the overall species is polar or nonpolar.



Structure #1

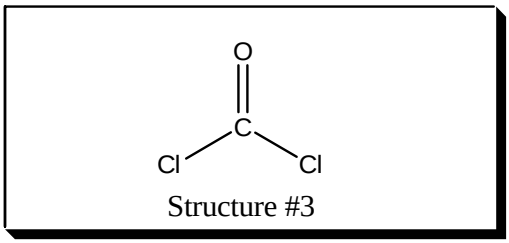
electronic geometry: **(C) linear**
(O) tetrahedral
molecular geometry: **(C) linear**
(O) bent
approx. bond angle: **(C) 180 deg**
(O) approx. 109.5 deg
polar or nonpolar? **Polar**



Structure #2

electronic geometry: **(N) Tetrahedral**
(C) Tetrahedral
molecular geometry: **(N) Trigonal Pyramidal**
(C) Tetrahedral
approx. bond angle: **approx. 109.5 deg**

polar or nonpolar? **Polar**



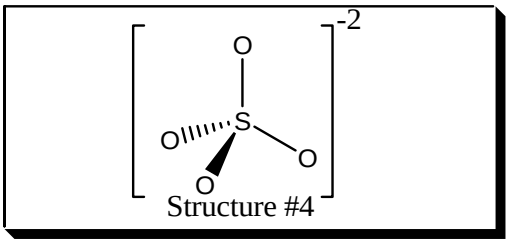
Structure #3

electronic geometry: **Trigonal Planar**

molecular geometry: **Trigonal Planar**

approx. bond angle: **approx. 120 deg**

polar or nonpolar? **Polar**



Structure #4

electronic geometry: **Tetrahedral**

molecular geometry: **Tetrahedral**

approx. bond angle: **approx. 109.5 deg**

polar or nonpolar? **Nonpolar (ionic)**

27. (22 pts. total; 2 pts. each) Write the name/chemical formula for each of the following listed below:

A.	S_4O_6	**tetrasulfur hexoxide**
B.	iron(II) phosphate	**$Fe_3(PO_4)_2$**
C.	cadmium cyanide	**$Cd(CN)_2$**
D.	zinc nitrite	**$Zn(NO_2)_2$**
E.	$PdCO_3$	**palladium(II) carbonate**
F.	diphosphorus tetroxide	**P_2O_4**

G.	ammonium acetate	**$NH_4C_2H_3O_2$ or NH_4CH_3COO**
H.	silver sulfate	**Ag_2SO_4**
I.	Cr_2O_3	**chromium(III) oxide**
J.	aluminum hydroxide	**$Al(OH)_3$**
K.	NO_2	**nitrogen dioxide (NOT NITRITE!)**