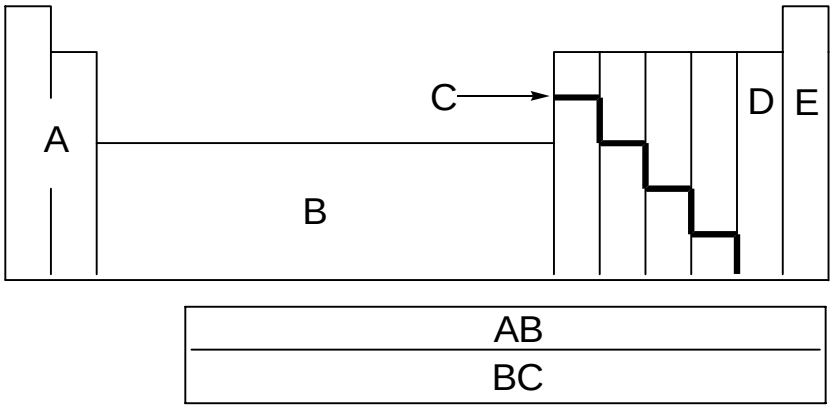
Chemistry 11 Fall 2009
Examination #1 **ANSWER KEY**

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).

For Questions 1 – 6, use the generically labeled periodic table below to select the best answer choice for each of the listed descriptions:



1. These group of elements are difficult to extract from their natural sources and separate from one another. **AB**

2. Elements within this category require Roman numerals in parentheses to indicate their oxidation states. **B**

3. Elements in this group can be malleable, shiny, and simultaneously poor conductors of heat and electricity. **C**

4. This group of elements features completely filled orbitals and are very unreactive. **E**

5. Most likely to undergo reduction. **D**

6. This group of elements can be solids, liquids, and gases at room temperature. **D**

7. The average distance between nitrogen and oxygen atoms is 115 pm in the compound nitrogen monoxide. What is this distance in centimeters? (Note: 1 m = 1 x 10^{12} pm or picometers)

   A. 1.15 x 10^{-9} cm
   B. 1.15 x 10^{-8} cm
   C. 1.15 x 10^{12} cm
   D. 1.15 x 10^{14} cm
   E. 1.15 x 10^{16} cm

8. Which of the following is the LOWEST *possible* temperature?

A. 37 ºC
B. 54 ºF
C. 313 K
D. -273 K
E. All of these temperatures are equal.

9. **FIGURE IT OUT!** A mass of mercury occupies 0.750 L. Using the provided information below, determine what volume would an equal mass of ethanol occupy? The density of mercury is 13.546 g/mL, and the density of ethanol is 0.789 g/mL.

A. 0.0437 L
B. 0.0777 L
C. 0.750 L
D. 12.9 L
E. 22.9 L

10. A student measured the diameter of a sphere and determined the average value. His measurements are 5.17 cm, 5.16 cm, 5.16 cm, and 5.17 cm. If the true diameter is known to be 6.18 cm, what can be said about the student's results?

A. The results are both precise and accurate.
B. The results are accurate but not precise.
C. The results are precise but not accurate.
D. The results are neither precise nor accurate.
E. Not enough information is provided to make any assessment of the data.

11. An automobile uses gasoline at a rate of 35 miles/gallon. Express these units in meters/milliliter. (Note: 1 km = 0.6214 miles; 1 gallon = 3.78 L)

A. 5.8 m/mL
B. 15 m/mL
C. 82 m/mL
D. 130 m/mL
E. 210 m/mL

12. Determine the number of protons, neutrons, and electrons present in $^{51}Mn^{+5}$.

A. 25 protons, 26 neutrons, and 20 electrons
B. 25 protons, 30 neutrons, and 20 electrons
C. 25 protons, 26 neutrons, and 30 electrons
D. 25 protons, 51 neutrons, and 20 electrons
E. 51 protons, 26 neutrons, and 46 electrons

13. Determine the expected electronic configuration for Po^{-2}:

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

14. One of the OWL problems involved you learning about the specific gravity of a liquid, which is often defined as the ratio of the density of a liquid substance to the density of water. If the specific gravity of X relative to water is 0.800, and the specific gravity of Y relative to water is 1.50, which of the following statements is FALSE?

A. X will float on Y.
B. Water will float on Y.
C. X will float on water.
D. Y will float on X.
E. X and water will float on Y.

15. The specific heat of copper metal is 0.385 J/g °C. If 34.2 g of copper, initially at 25.0 ºC, absorbs 4.689 kJ, what will be the final temperature of the copper?

A. 25.4 ºC
B. 27.8 ºC
C. 77.8 ºC
D. 356.1 ºC
E. 381.1 ºC

16. Which of the following is IMPROPERLY matched?

A. H_2; an element
B. ammonia; a compound
C. S^{-2} and Ar; isotopes
D. gasoline; a homogeneous mixture
E. crude oil; a heterogeneous mixture

17. Determine the correct formula for tin(IV) oxide below:

A. SnO
B. Sn_4O_2
C. Sn_2O_4
D. SnO_2
E. Sn_2O

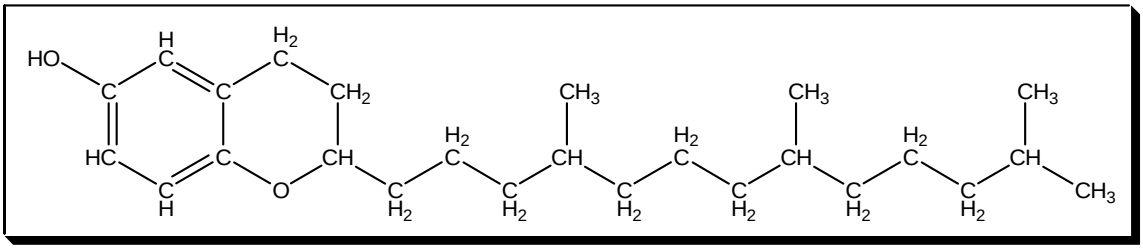
18. List the following in order of *decreasing* radius: S^{-2}, S^{-1}, S, S^{+1}, S^{+2}.

A. **$S^{-2} > S^{-1} > S > S^{+1} > S^{+2}$**
B. $S^{+2} > S^{+1} > S > S^{-1} > S^{-2}$
C. $S > S^{-1} > S^{+1} > S^{-2} > S^{+2}$
D. $S > S^{+1} > S^{-1} > S^{+2} > S^{-2}$
E. All of the above have equal radii.

19. Determine the correct listing of the listed atoms in terms of *increasing* electronegativity: Ag, Zn, C, O, Cl, and F.

A. F < Cl < O < C < Zn < Ag
B. F < O < Cl < C < Zn < Ag
C. **Ag < Zn < C < Cl < O < F**
D. Ag < Zn < C < O < Cl < F
E. Ag < Zn < Cl < C < O < F

For Questions 20 – 22, reference the structure of Vitamin E below:



20. Based on your knowledge of VSEPR, which of the following geometries is NOT present in Vitamin E?

A. trigonal planar
B. tetrahedral
C. bent
D. **trigonal pyramidal**
E. All of the above are present in Vitamin E.

21. Select "**A**" for <u>True</u> OR "**B**" for <u>False</u> regarding the following statement: *Vitamin E does not possess any resonance*.

22. Select "**A**" for <u>True</u> OR "**B**" for <u>False</u> regarding the following statement: *Vitamin E is a slightly polar molecule although predominantly nonpolar*.

23. Solve the following: $\frac{9.846 \times 10^{-1} + 3.972 \times 10^{-2}}{(4.296 \times 10^{-4})(7.391 \times 10^{8})}$

A. 1.762×10^{12}
B. 1.76×10^{12}
C. 3.226×10^{-6}
D. 3.23×10^{-6}
E. 1.232×10^{-7}

24. Which of the following contains a double bond?

A. CH_3NH_2
B. FCCF
C. CS_2
D. BF_3
E. HCN

25. A compound with generic metal M combines with oxygen to form M_2O_3. Based on the identity of the formed compound, from which group (on the periodic table) does M originate?

A. Group I
B. Group II
C. Group III
D. Group IV
E. Group V

26. (22 pts. total; 2 pts. each) Write the name/chemical formula for each of the following listed below:

A. ammonium sulfite — **$(NH_4)_2SO_3$**

B. AgCN — **silver cyanide**

C. $Ba(C_2H_3O_2)_2$ — **barium acetate**

D. tetraphosphorus heptoxide — **P_4O_7**

E. $Co(NO_2)_2$ — **cobalt(II) nitrite**

F. zinc phosphite — **$Zn_3(PO_3)_2$**

G. aluminum hydroxide — **$Al(OH)_3$**

H. CdO — **cadmium oxide**

I. SF_4 — **sulfur tetrafluoride**

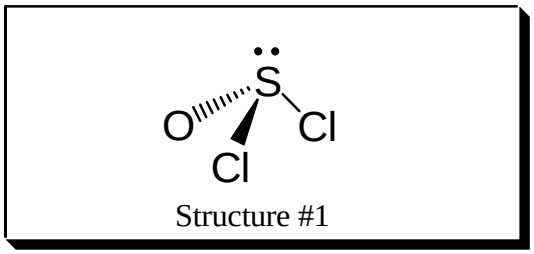
J. NH_3 — **ammonia**

K. N_2O — **dinitrogen monoxide**

27. (28 pts. total; 7 pts. each) Consider each of the following ions/molecules shown below and write your final structures in the boxes provided:

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.

Terminal atoms are assumed to have an octet of electrons (excluding hydrogen) – omitted for the sake of clarity!



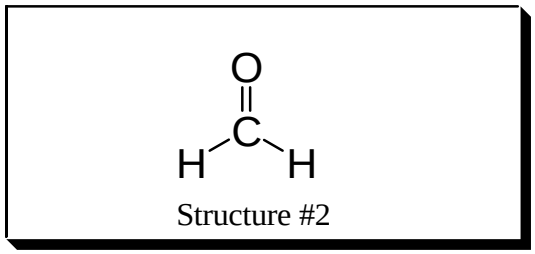
Structure #1

electronic geometry: **tetrahedral**

molecular geometry: **trigonal pyramidal**

approx. bond angle: **109.5 degrees**

polar or nonpolar? **polar**



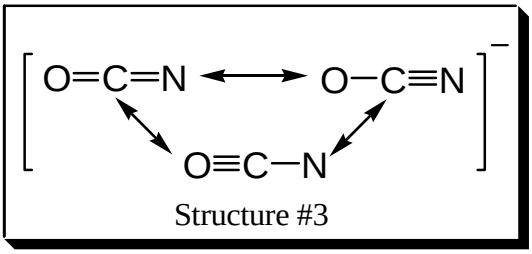
Structure #2

electronic geometry: **trigonal planar**

molecular geometry: **trigonal planar**

approx. bond angle: **120 degrees**

polar or nonpolar? **polar**



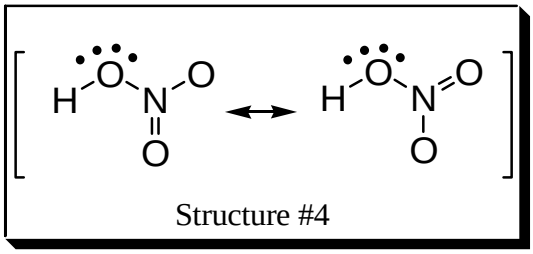
Structure #3

electronic geometry: **linear**

molecular geometry: **linear**

approx. bond angle: **180 degrees**

polar or nonpolar? **polar**



Structure #4

electronic geometry: **(O) tetrahedral; (N) trigonal planar**

molecular geometry: **(O) bent; (N) trigonal planar**

approx. bond angle: **(O) 109.5 degrees; (N) 120 degrees**

polar or nonpolar? **polar**

BONUS! (5 pts. total) A titration of 0.15 – 0.35 mg/min of Ritodrine is ordered for your patient's premature labor. The solution infusing has a strength of 150 mg/500 mL.

A. (2 pts.) Carefully manipulate the units provided in this problem to express the dosage range in mL/min.

$$? \frac{\text{mL}}{\text{min}} = \frac{0.15 \text{ mg}}{\text{min}} \times \frac{500 \text{ mL}}{150 \text{ mg}} = 0.50 \text{ mL/min}$$

$$? \frac{\text{mL}}{\text{min}} = \frac{0.35 \text{ mg}}{\text{min}} \times \frac{500 \text{ mL}}{150 \text{ mg}} = 1.2 \text{ mL/min}$$

Therefore, the acceptable dosage range is 0.50 – 1.2 mL per minute.

B. (3 pts.) The patient's contractions stop at 40 mL/hour, and you are instructed to maintain this rate. What dosage, in mg, should now be infusing per minute?

$$? \frac{\text{mg}}{\text{min}} = \frac{40 \text{ mL}}{\text{hr}} \times \frac{1 \text{ hour}}{60 \text{ min}} \times \frac{150 \text{ mg}}{500 \text{ mL}} = 0.20 \text{ mg/min}$$