

Chemistry 151H - Sample Exam III

Name (print legibly) _____

Student number _____

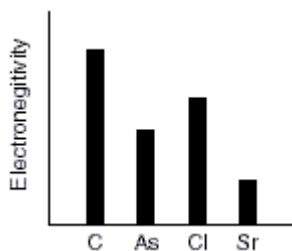
There is a periodic table and a section of miscellaneous information at the end of this exam. Circle your choices for answers on this test form as well as on the scantron sheet. **NO PROGRAMABLE CALCULATORS WILL BE ALLOWED FOR THIS EXAM.**

- (2 points) The Lewis symbol for silicon will have _____ dots around it representing valence electrons.
a) 5 b) 1 c) 2 d) 3 **e) 4**
- (2 points) The Lewis Structure for carbon monoxide will have _____ lone pairs of electrons.
a) 5 b) 1 **c) 2** d) 3 e) 4
- (2 points) The Lewis Structure for ozone will have _____ bonds located between _____ pairs of atoms.
a) 4, 2 **b) 3, 2** c) 2, 3 d) 3, 3 e) 4, 4
- (3 pts) Based upon formal charges, the Lewis structure for carbon disulfide that contributes most to the bonding in the molecule will have _____ double bond(s).
a. 1 **b. 2** c. 3 d. no
- (3 pts) Based on Molecular Orbital Theory how many electrons would be expected to be found in the π^*_{3p} orbitals for the Cl_2 molecule.
a. 4 b. 3 c. 2 d. 1
- (3 pts) Based on Molecular Orbital Theory the N_2^{2-} ion would be expected to be _____.
a. diamagnetic b. nonmagnetic **c. paramagnetic** d. antibonding
- (3 pts) Based on Molecular Orbital Theory the bond order of the Ne_2^{2+} ion would be expected to be _____.
a. 4 b. 3 c. 2 **d. 1** e. 0

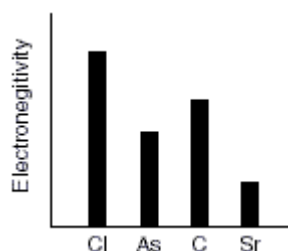
8. (3 pts) The molecular geometry of the SO_2 molecule is best described as _____.
- a. tetrahedral **b. bent** c. trigonal planar d. octahedral
9. (3 pts) The molecule XeF_4 will have _____ unshared pairs of electrons around the xenon central atom.
- a. 1 **b. 2** c. 3 d. 4
10. (2 pts) Which of the following molecules contains an exception to the octet rule?
- a. NO** b. NO_2^- c. HBr d. I_2
11. (2 pts) Based on bond length, which of the following has the strongest bond?
- a. H-Br (141 pm)
- b. H-I (161 pm)
- c. H-Cl (127 pm)
- d. H-F (92 pm)**
12. (3 pts) How many covalent bonds are there in CN^- ?
- a. 1 b. 2 **c. 3** d. 0

13. (3 pts) Which of the graphs below is correct?

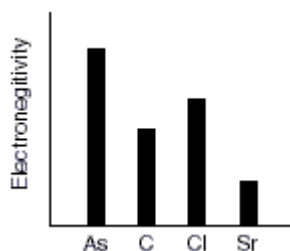
a.



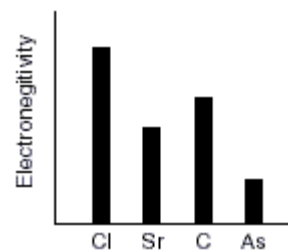
b.



c.



d.



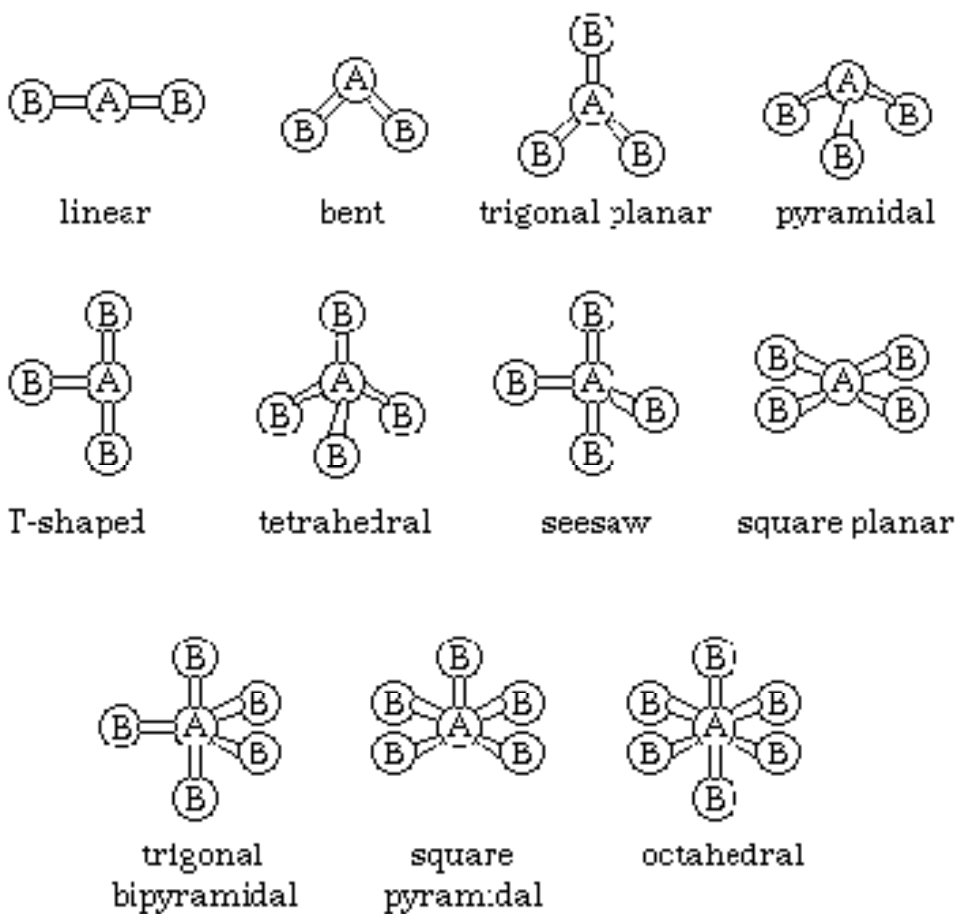
14. (2 pts) Electronegativity increases from left to right across a period due to:

- a. increased shielding of valence electrons by the core electrons.
- b. an increase in the number of protons in the nucleus.**
- c. a decrease in effective nuclear charge
- d. an increase in the shielding of core electrons by the valence electrons.

15. (2 pts) In order to be able to have more than an octet of electrons the central atom in a molecular structure must have _____.

- a. a high effective nuclear charge
- b. "p" orbitals available
- c. only 3 valence electrons
- d. "d" orbitals available**

16. (3 pts) According to VSEPR Theory four bonding and two lone pairs of electrons around a central atom will result in a _____ electron group geometry around the central atom.
a. Tetrahedral b. trigonal planar **c. octahedral** d. trigonal bipyramidal
17. (3 pts) According to VSEPR Theory a molecule of SnCl_3^- would be expected to have _____ molecular geometry.
a. Tetrahedral b. trigonal planar c. octahedral **d. trigonal pyramidal**
18. (3 pts) The groups of electrons surrounding the central atom in the molecular ion SF_5^- would be expected to have _____ geometry.
a. Tetrahedral b. trigonal planar **c. octahedral**
d. trigonal bipyramidal e. see-saw
19. (3 pts) Using Valence Bond Theory what is the expected hybrid orbital type for carbon in the carbonate ion?
a. sp **b. sp^2** c. sp^3 d. dsp^3 e. d^2sp^3
20. (3 pts) In which of the following molecules would the central atom most likely be dsp^3 hybridized?
a. XeF_4 b. CO_2 **c. I_3^-** d. SF_6 e. NH_2^-
21. (3 pts) Which of the following is/are expected to have a permanent dipole?
a. CS_2 b. CHCl_3 c. H_2S d. SO_2 **e. b, c & d**



9. What is the wavelength (λ , in m) of a radio station operating at a frequency of 99.6 MHz?

- a. 3.01×10^6 m c. 3.32×10^{-7} m
 b. 0.332 m d. 3.01 m

10. The work function of sodium is $\phi = 2.9 \times 10^{-19}$ J. What is the maximum wavelength that can cause ejection of photoelectrons from a sodium surface?

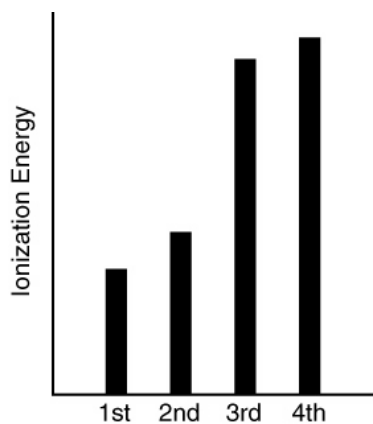
- a. 151 nm c. 45.1 nm
 b. 500 nm d. 451 nm

14. What is the speed of an argon atom (39.948 g/mol) that has a de Broglie wavelength of 5.2 pm?
- a. 0.52 m/s
 - b. 5.2×10^3 m/s
 - c. 1.9 m/s
 - d. 1.9×10^3 m/s

15. Which set of quantum numbers is for the lowest energy orbital?
- a. $n = 3, \ell = 2, m_\ell = 2$
 - b. $n = 3, \ell = 1, m_\ell = 1$
 - c. $n = 2, \ell = 1, m_\ell = 0$
 - d. $n = 2, \ell = 0, m_\ell = 0$

16. The atomic radius of germanium is smaller than the atomic radius of potassium due to
- a. a change in the n quantum number.
 - b. a decrease in the effective nuclear charge.
 - c. the fact that p and d orbitals have the same orbital penetration.
 - d. an increase in the effective nuclear charge.

17. The first four ionization energies for an element are as follows. Identify the correct element from the list.



- a. S
- b. Sr
- c. K
- d. Al

Extra Credit (5 points...Show All Work)

A flask of ammonia is connected to a flask of an unknown acid HX by a 1.00 m glass tube. As the two gases diffuse down the tube, a white ring of NH_4X forms 59.34 cm from the ammonia flask. Identify element X.

Miscellaneous Formulae and Constants

$$w = F \cdot d$$

$$KE = \frac{1}{2} m v^2$$

$$1 \text{ atm} = 760 \text{ mmHg} = 1.01325 \text{ E5 Pa}$$

$$1 \text{ bar} = 10^5 \text{ Pa}$$

$$PV = nRT$$

$$(P + n^2 a/V^2)(V - nb) = RT$$

$$d = \mathcal{M}P/RT$$

$$\mu_{\text{rms}} = [3RT/\mathcal{M}]^{1/2}$$

$$\mu_x/\mu_y = [\mathcal{M}_y/\mathcal{M}_x]^{1/2}$$

$$P_1 = \chi_1 P_{\text{total}}$$

$$c = \lambda \cdot \nu$$

$$c = 2.998 \cdot 10^8 \text{ m/s}$$

$$h = 6.626 \cdot 10^{-34} \text{ J}\cdot\text{s}$$

$$E_{\text{photon}} = h \cdot \nu$$

$$1 \text{ J} = 1 \text{ kg}\cdot\text{m}^2\cdot\text{s}^{-2}$$

$$1 \text{ nm} = 10^{-9} \text{ m}$$

$$N_A = 6.0221 \times 10^{23} \text{ mol}^{-1}$$

$$\lambda \text{ (de Broglie)} = h/(m \cdot v)$$

$$R \text{ (Rydberg const.)} = 1.0974 \cdot 10^7 \text{ m}^{-1}$$

$$\Delta E_n = -h \cdot c \cdot R \cdot Z^2 (1/n_f^2 - 1/n_i^2)$$

$$h \cdot c \cdot R = 2.18 \text{ E-18 J.}$$

$$\text{pm} = 10^{-12} \text{ m}$$

$$R \text{ (gas constant)} = 0.082053 \text{ (L} \cdot \text{atm/mol} \cdot \text{K)} = 8.3145 \text{ (J/mol} \cdot \text{K)}$$