CHM151 Exam 4 100 Pts Fall 2014 Name:(1 Pt**)_____**

Tutors and Instructors, DO NOT HELP WITH THIS EXAM.

Take home exam Due Friday December 12th

1. (4 Pts) Which pair is geometrically similar? You must show the Lewis and VSEPR structures to justify your answer.

   (A) SO_2 and CO_2 (B) CO_2 and OF_2

   (C) PH_3 and BF_3 (D) SO_2 and O_3

2. (4 Pts) Explain why BCl_3 is a planar molecule while NCl_3 is pyramidal.

3. (4 Pts) NH_3 (pyramidal geometry) reacts with BF_3 (planar geometry) to form the addition compound, H_3NBF_3. What is the geometry around the nitrogen and boron centers in the addition compound? Explain in terms of the hybrid orbitals involved. (Hint: Show the Lewis structure of the new molecule. Both N and B are centers of this molecule.)

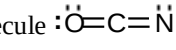
4. (3 Pts) The ammonium ion is symmetrical, with the nitrogen at the center of a tetrahedron of four equivalent hydrogens. What hybridization of nitrogen orbitals is used to represent the bonding in the ion? _____

5. (3 Pts) Which type of hybrid orbital is used by carbon in CO_2? _____

6. (3 Pts) Which compound would be expected to have the largest dipole moment? Explain why.

   (A) CO_2 (B) BF_3 (C) SO_2 (D) CF_4

   Reason:

7. (3 Pts) The molecule  has been detected in gas clouds between stars. What is the predicted C—N—H bond angle? _____

8. (4 Pts) Provide estimates of each of the following bond angles?

   (A) angle O–S–O in SO_4^{2-} _____ (B) angle Cl–C–Cl in $HCCl_3$_____

   (C) angle F–Be–F in BeF_2_____ (D) angle H–O–H in H_2O _____

9. (4 Pts) Knowing that F is more electronegative than either B or P, what conclusion can be drawn from the fact that BF_3 has no dipole moment but PF_3 does?

10. (3 Pts) A compound consisting of an element having a low ionization potential and a second element having a high electron affinity is likely to have

(A) covalent bonds. (B) metallic bonds. (C) coordinate covalent bonds,

(D) ionic bonds.

11. (3 Pts) In which pair do both compounds exhibit predominantly ionic bonding?

(A) SO_2 and HCl (B) NaF and MgO (C) KNO_3 and CH_4 (D) KCl and CO_2

12. (3 Pts) What forces hold the elements together in an ionic compound?

13. (3 Pts) Which is most likely to be formed by electron transfer and be ionic?

	Main Groups							
	I	II	III	IV	V	VI	VII	(O)
First Period								
Second Period	**X**	**Y**	**Z**	**P**		**Q**	**S**	**U**
Third Period	**W**					**R**	**T**	**M**

(A) a compound of **U** and **S** (B) a compound of **P** and **S** (C) a compound of **Z** and **P**

(D) a compound of **Y** and **T** (E) a compound of **Q** and **T**

14. (3 Pts) What is the explanation for the fact that the bonding in SnI_4 is more covalent than the bonding in SnF_4?

15. (3 Pts) Which characteristic is generally true of nonmetallic oxides?

(A) They are in general ionic compounds.

(B) They are in general covalent compounds.

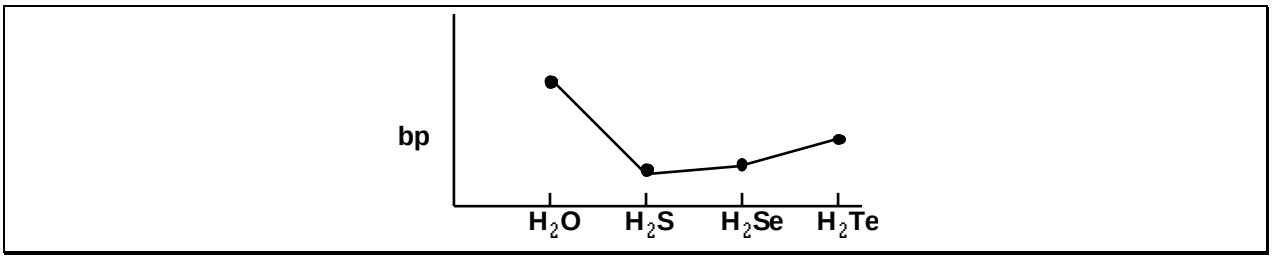
(C) They react with water to form bases.

(D) They cannot be prepared directly from the elements.

(E) They react with acids to form a salt and water.

16. (4 Pts) Use structural formulas to show how hydrogen bonding occurs in liquid methanol, CH_3OH. (Use at least 2 molecules.)

17. (3 Pts) Consider the boiling point of a series of hydrogen compounds.



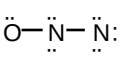
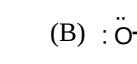
Explain the abnormally high boiling point for water.

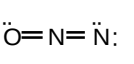
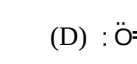
18. (3 Pts) Of these metals, interatomic forces are probably weakest in

(A) Ag (B) Au (C) Zn (D) Hg Support your answer:_____

19. (3 Pts) How many sigma (σ) and pi (π) bonds are found in the ethylene molecule $H_2C=CH_2$ according to modern bonding theory? Sigma_____ pi_____

20. (3 Pts) An acceptable Lewis dot structure for N_2O is

(A)  (B) 

(C)  (D) 

21. (4 Pts) Which has a Lewis (electron dot) structure with the greatest number of unshared pairs on the central atom?

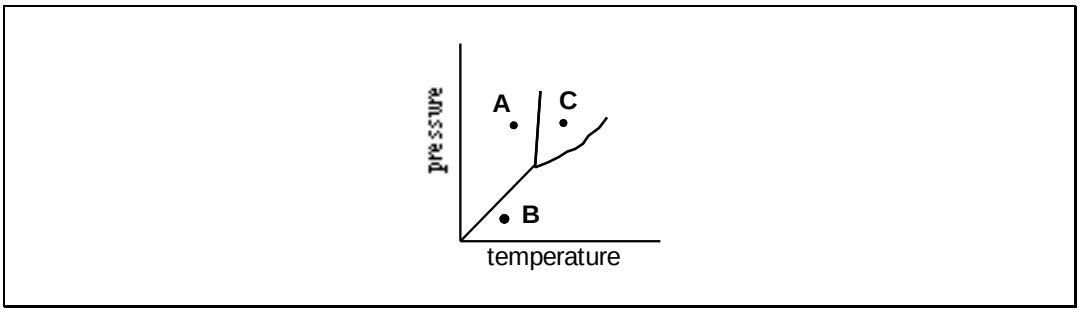
(A) NH_3 (B) IF_3 (C) $SeCl_2$ (D) ICl_2

22. (4 Pts) Draw Lewis dot representations of all reasonable contributing structures to the resonance hybrid of the nitrate ion.

23. (4 Pts) Which substance has the highest boiling point? Explain why.

(A) CH_4 (B) He (C) HF (D) Cl_2

24. (3 Pts) Consider the phase diagram of a pure compound. Which statement applies?



(A) The path **A** → **C** represents sublimation.

(B) Following the path **A** → **B** → **C** the compound would first liquefy and then vaporize.

(C) If the compound is in state **A**, continued reduction of the pressure (at constant temperature) will cause it to melt.

(D) None of these statements is correct

25. (3 Pts) A crystal of anhydrous KNO_3 is made up of

(A) molecules of KNO_3.

(B) atoms of potassium, nitrogen, and 3 atoms of oxygen alternately spaced in the crystal.

(C) a geometrical pattern of potassium ions and nitrate ions in the crystal.

(D) potassium nitrate molecules alternately spaced with water molecules.

(E) molecules of KNO_3 and water combined into larger molecules.

26. (4 Pts) Which group of substances is correctly arranged in order from the highest to the lowest melting point? Also state the primary intermolecular forces for each compound.

(A) HF>H_2>NaF (B) NaF>H_2>HF (C) HF>NaF>H_2 (D) NaF>HF>H_2

Primary forces of each:_____

Primary intermolecular forces for each:_____

27. (3 Pts) Which has the highest molar heat of vaporization?

(A) a molecular liquid, S_8 (B) a hydrogen-bonded liquid, H_2O

(C) a monatomic liquid, Ar (D) an ionic melt, BaF_2

28. (4 Pts) Which inert gas has the highest boiling point? _____ Explain why.

29. (4 Pts) Draw the structures and determine the formal charge of each atom in

(A) H_2O (B) NH_3