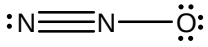
Spring 2012
CHEM 1110.20784
Test 3, Form A

Part 1. Multiple Choice: Clearly indicate the best answer on the scantron form. (50 pts)

1. Which of these elements is the *least* electronegative?
   A) S B) V C) Ni D) P E) Cs

2. The total number of lone pairs in NCl_3 is
   A) 6 B) 8 C) 9 D) 10 E) 13

3. What is the hybridization on the central nitrogen in N_2O?



   A) sp^3d B) sp^3 C) sp^2 D) sp E) none of these

4. What is the molecular shape of the IBr_3 molecule?
   A) tetrahedral B) T-shaped C) bent D) trigonal planar E) seesaw

5. Balance the following equation: _____$C_8H_{18}O_3(l)$ + _____$O_2(g)$ → _____$H_2O(g)$ + _____$CO_2(g)$
   A) $C_8H_{18}O_3(l) + 8O_2(g) \rightarrow 9H_2O(g) + 8CO_2(g)$
   B) $C_8H_{18}O_3(l) + 11O_2(g) \rightarrow 9H_2O(g) + 8CO_2(g)$
   C) $2C_8H_{18}O_3(l) + 22O_2(g) \rightarrow 9H_2O(g) + 16CO_2(g)$
   D) $C_8H_{18}O_3(l) + 13O_2(g) \rightarrow 18H_2O(g) + 8CO_2(g)$
   E) $2C_8H_{18}O_3(l) + 17O_2(g) \rightarrow 18H_2O(g) + 16CO_2(g)$

6. Which of the following statements is not true about valence electrons?
   A) They are the most accessible.
   B) They participate in bonding.
   C) They determine the chemical properties of the element.
   D) They are the closest to the nucleus.
   E) All of these are true.

7. Given the molecular geometries, which one of the molecules is nonpolar?
   A) SO_3, trigonal planar
   B) CH_2Cl_2, tetrahedral
   C) CO, linear
   D) SO_2, bent
   E) NH_3, trigonal bipyramidal

8. What is the coefficient of H_2O when the following equation is properly balanced with smallest set of whole numbers?

$$\_\_\_\ Al_4C_3 + \_\_\_\ H_2O \rightarrow \_\_\_\ Al(OH)_3 + \_\_\_\ CH_4$$

   A) 3 B) 4 C) 6 D) 12 E) 24

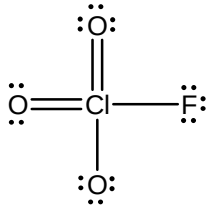
9. Which of these elements has the *greatest* electronegativity?
   A) Ca B) As C) Ga D) Cs E) Sb

10. Ammonia will react with fluorine to produce dinitrogen tetrafluoride and hydrogen fluoride (used in production of aluminum, in uranium processing, and in frosting of light bulbs). How many moles of NH_3 are needed to react completely with 13.6 mol of F_2?

$$2NH_3(g) + 5F_2(g) \rightarrow N_2F_4(g) + 6HF(g)$$

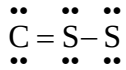
A) 34.0 mol B) 27.2 mol C) 6.80 mol D) 5.44 mol E) 2.27 mol

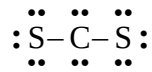
11. What is the molecular shape of ClO_3F as predicted by the VSEPR theory?

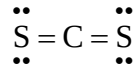


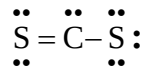
A) trigonal pyramidal B) square planar C) tetrahedral D) octahedral E) square pyramidal

12. The Lewis structure for CS_2 is:

A) 

B) 

C) 

D) 

13. Balance the following equation:

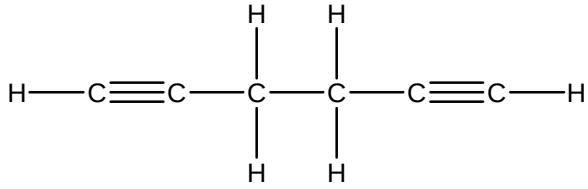
__ Ba(OH)2 (aq) + __HNO3 (aq) → __Ba(NO3)2 (aq) +__H2O (l)

A) 1, 1, 1, 1 B) 1, 2, 1, 2 C) 2, 1, 2, 1 D) 1, 2, 2, 1 E) 2, 1, 1, 2

14. How many electrons are in a double bond?

A) 1 B) 2 C) 3 D) 4 E) 6

15. The number of pi bonds in the molecule is

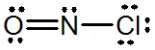


A) 2 B) 4 C) 6 D) 11 E) 15

16. What types of elements undergo covalent bonding?

A) an actinide
B) Group IA metals
C) two nonmetals
D) a nonmetal and a metal
E) a metal and a noble gas

17. What is the molecular shape of NOCl as predicted by the VSEPR theory?



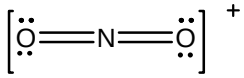
A) bent B) trigonal planar C) linear D) tetrahedral E) trigonal pyramidal

18. Given the geometries, which is a polar molecule?
    A) XeF_2, linear
    B) BrF_5, square pyramidal
    C) XeF_4, square planar
    D) CCl_4, tetrahedral
    E) PBr_5, trigonal bipyramidal

19. Molecules or ions with the same number of valence electrons are called
    A) electronegative. B) resonant. C) repelled. D) octet. E) isoelectronic.

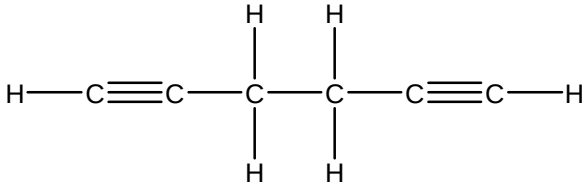
20. Which of the following contains ionic bonding?
    A) CO B) SrF_2 C) Al D) OCl_2 E) CCl_4

21. The formal charge on the nitrogen atom in the resonance structure of NO_2^+ seen below is:



    A) +1 B) -1 C) 0 D) +2 E) -2

22. The number of sigma bonds in the molecule below is



    A) 2 B) 4 C) 6 D) 11 E) 15

23. Which of these molecules has an atom with an expanded octet?
    A) HCl B) $AsCl_5$ C) ICl D) NCl_3 E) Cl_2

24. How many pure atomic orbitals of each type must be hybridized to form a set of sp^3d orbitals?
    A) One s and one p and one d
    B) Two s and three p and one d
    C) One s and three p and one d
    D) Two s and three p and one d
    E) One s and three p and two d

25. Sulfur dioxide reacts with chlorine to produce thionyl chloride (used as a drying agent for inorganic halides) and dichlorine oxide (used as a bleach for wood, pulp and textiles). If 0.400 mol of Cl_2 reacts with excess SO_2, how many moles of Cl_2O are formed?

$$SO_2(g) + 2Cl_2(g) \rightarrow SOCl_2(g) + Cl_2O(g)$$

    A) 0.0500 mol
    B) 0.100 mol
    C) 0.200 mol
    D) 0.400 mol
    E) 0.800 mol

Part 2. Calculations/Short Answer: Clearly show <u>all</u> work on the <u>blank space on the scantron answer sheet</u> for full credit. (50 pts)

1. (10 pts) Write the balanced reaction for the combustion of heptane (C_7H_{16}).

2. (10 pts) Nicotine ($C_{10}H_{14}N_2$) is a stimulant that is highly addictive. What is the mass of nitrogen in 20.0g of nicotine? (MM of $C_{10}H_{14}N_2$ = 162.1 g/mol)

3. (30 pts) Potassium chloride is used as a substitute for sodium chloride for individuals with high blood pressure. A chemist reacts 7.00 g of chlorine gas reacts 5.00 g of potassium to form potassium chloride. (MM of Cl_2 = 70.90 g/mol, MM of KCl = 74.60 g/mol)

$$2\ K\ (s) + Cl_2\ (g) \rightarrow 2\ KCl$$

   a. What is the limiting reactant? (You must PROVE this through calculations)

   b. What is the mass (g) of the excess reagent left over when the reaction is complete?

   c. What is the theoretical mass of KCl formed (in g)?

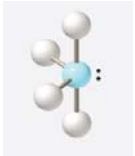
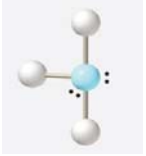
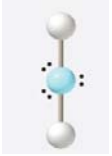
   d. What is the percent yield, if 8.96 g KCl is actually produced?

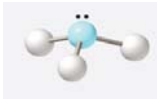
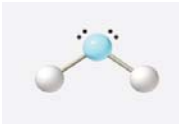
	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIIIB			IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1 **H** 1.008																	2 **He** 4.00
2	3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
3	11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
4	19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.71	29 **Cu** 63.55	30 **Zn** 65.37	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
5	37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** [98]	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.40	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.30
6	55 **Cs** 132.9	56 **Ba** 137.3	71 **Lu** 175	72 **Hf** 178.5	73 **Ta** 181	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197	80 **Hg** 200.59	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209	84 **Po** [209]	85 **At** [210]	86 **Rn** [222]
7	87 **Fr** [223]	88 **Ra** [226]	103 **Lr** [262]	104 **Rf** [267]	105 **Db** [268]	106 **Sg** [271]	107 **Bh** [272]	108 **Hs** [270]	109 **Mt** [276]	110 **Ds** [281]	111 **Rg** [280]	112 **Uub** [285]	113 **Uut** [284]	114 **Uuq** [289]	115 **Uup** [288]	116 **Uuh** [293]		118 **Uuo** [294]

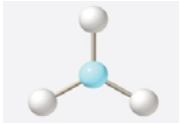
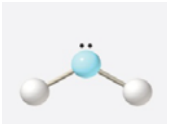
	57 **La** 138.9	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** [145]	62 **Sm** 150.4	63 **Eu** 152	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.93	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173
	89 **Ac** [227]	90 **Th** 232	91 **Pa** [231]	92 **U** 238	93 **Np** [237]	94 **Pu** [244]	95 **Am** [243]	96 **Cm** [247]	97 **Bk** [247]	98 **Cf** [251]	99 **Es** [252]	100 **Fm** [257]	101 **Md** [258]	102 **No** [259]

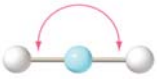
REPRESENTATIVE VSEPR STRUCTURES

			
Bonding Domains	**6**	**5**	**4**
Nonbonding Domains	**0**	**1**	**2**
Electron Geometry	**Octahedral**	**Octahedral**	**Octahedral**
Molecular Geometry	**Octahedral**	**Square pyramidal**	**Square planar**
Hybridization	**sp^3d^2**	**sp^3d^2**	**sp^3d^2**

				
Bonding Domains	**5**	**4**	**3**	**2**
Nonbonding Domains	**0**	**1**	**2**	**3**
Electron Geometry	**Trigonal bipyramidal**	**Trigonal bipyramidal**	**Trigonal bipyramidal**	**Trigonal bipyramidal**
Molecular Geometry	**Trigonal bipyramidal**	**See-saw**	**T-Shaped**	**Linear**
Hybridization	**sp^3d**	**sp^3d**	**sp^3d**	**sp^3d**

			
Bonding Domains	**4**	**3**	**2**
Nonbonding Domains	**0**	**1**	**2**
Electron Geometry	**Tetrahedral**	**Tetrahedral**	**Tetrahedral**
Molecular Geometry	**Tetrahedral**	**Trigonal pyramidal**	**Bent**
Hybridization	**sp^3**	**sp^3**	**sp^3**

		
Bonding Domains	**3**	**2**
Nonbonding Domains	**0**	**1**
Electron Geometry	**Trigonal planar**	**Trigonal planar**
Molecular Geometry	**Trigonal planar**	**Bent**
Hybridization	**sp^2**	**sp^2**

	
Total Electron Domains	**2**
Bonding Domains	**2**
Nonbonding Domains	**0**
Electron Geometry	**Linear**
Molecular Geometry	**Linear**
Hybridization	**sp**