BA = bad attempt NA = not attempted

General Chemistry I Lecture Fall 2019 Test 4 12/4/19 D form A section Dr. Hahn Exam # _____

Name Key (print) Name _____ (sign)

Please show work for partial credit and full credit on the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If you run out of space, continue on the empty back pages but clearly label where the remaining answers can be found. (Please count your exam pages and make sure there are 5 pages)

MULTIPLE CHOICE. Choose the one best alternative.

1) Which of the following ionic compounds would be expected to have the highest lattice energy? 1) C

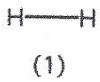
A) RbCl B) RbI C) RbF D) RbBr

2) Of the following elements, which has the **lowest** electronegativity? 2) ~~A~~ B

A) S B) Tl C) As D) Sn

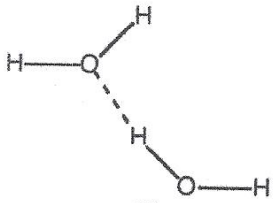
typo in test bank (A) w highest EN

3) Which drawing best represents hydrogen bonding? 3) C



(1)

(2)



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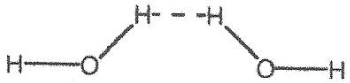


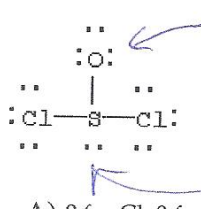
(4)

A) drawing (1) B) drawing (2) C) drawing (3) D) drawing (4)

4) Which of the following compounds exhibits hydrogen bonding? 4) C

A) $(CH_3)_3N$ B) CH_3F C) CH_3CH_2OH D) CH_3OCH_3

5) Assign formal charges to each atom in the resonance form for $SOCl_2$ given below. 5) C



$6 - \frac{2}{2} - 6 = -1$

$6 - \frac{6}{2} - 2 = +1$

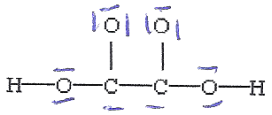
A) 0 for Cl, 0 for S, and 0 for O

C) 0 for Cl, +1 for S, and −1 for O

B) −1 for Cl, −2 for S, and −2 for O

D) −1 for Cl, +4 for S, and −2 for O

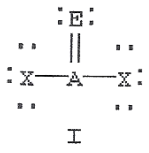
6) Consider a molecule with the following connections: 6) A



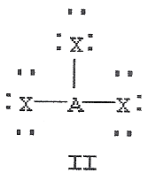
When a valid electron dot structure is written, how many double bonds will the molecule contain?

A) 2 B) 4 C) 0 D) 1

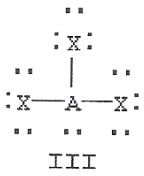
7) Which of the following should be nonplanar? 7) C



I



II



III

A) only I B) only II C) only III D) I and III

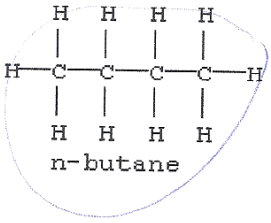
8) How many valence shell electrons does an atom of aluminum have? 8) C

A) 13 B) 2 C) 3 D) 1

9) Which substance in each of the following pairs is expected to have the larger dispersion forces? 9) B

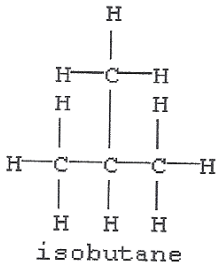
I Br_2 or I_2

II



n-butane

or

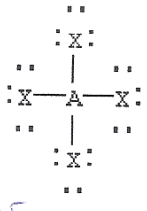


isobutane

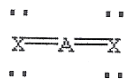
A) Br_2 in set I and n-butane in set II
B) I_2 in set I and n-butane in set II
C) Br_2 in set I and isobutane in set II
D) I_2 in set I and isobutane in set II

10) Based on VSEPR theory, which should have the **smallest** XAX bond angle? 10) C

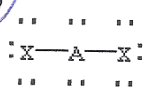
A)



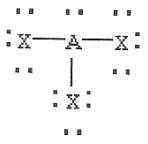
B)



C)



D)

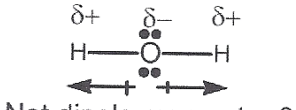


small big

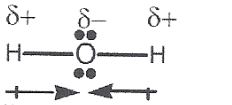
11) Which of the following most likely represent the atomic radius of a Cr atom, the ionic radius of a Cr^{2+} ion, and the ionic radius of a Cr^{3+} ion? 11) A

A) 128 pm for Cr, 89 pm for Cr^{2+}, and 63 pm for Cr^{3+}
B) 128 pm for Cr, 167 pm for Cr^{2+}, and 193 pm for Cr^{3+}
C) 128 pm for Cr, 147 pm for Cr^{2+}, and 193 pm for Cr^{3+}
D) 128 pm for Cr, 109 pm for Cr^{2+}, and 63 pm for Cr^{3+}

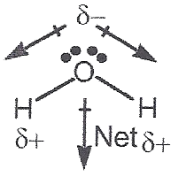
12) Which drawing best accounts for the polarity of water, H_2O, and the bond polarities that make a major contribution to the overall molecular polarity? 12) D



(1)



(2)



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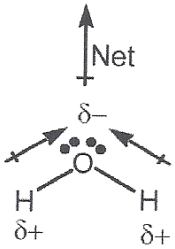


(4)

A) drawing (1) B) drawing (2) C) drawing (3) D) drawing (4)

13) Of the following, which element has the highest first ionization energy? 13) B
A) argon B) helium C) krypton D) neon
smallest

14) What is the ground-state electron configuration of the ion Hg^{2+}? 14) C
A) $[Xe]4f^{14}5d^{10}6s^2$
B) $[Xe]4f^{14}5d^{8}6s^2$
C) $[Xe]4f^{14}5d^{10}$
D) $[Xe]4f^{14}5d^{10}6s^26p^2$

15) Which element has the most favorable (most negative) electron affinity? 15) D
A) K B) Ne C) Be D) I

16) Which molecule contains the most easily broken carbon–carbon bond? 16) B
A) HC≡CH B) H_3C-CH_3 C) $F_2C=CF_2$ D) $H_2C=CH_2$

Part II: Short Answers

Please show work on all questions for partial credit even on questions which do not specify. (40 total pts)

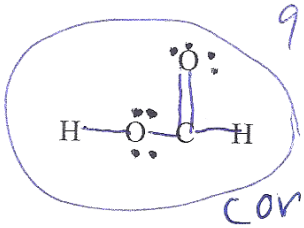
1. Electron Dot (Lewis Dot) structure: (21 pts)

a. Show your work for coming up with the valence electron count. HO C O H (10 pts)

(1)2 + (6)2 + 4 = 18 e⁻
H O C

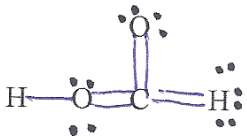
math -1
did not total -2

b. Given the two Lewis Dot structures, circle the correct Lewis Dot structure. (5 pt)



9 x 2 = 18 e⁻

correct



14 x 2 = 28

c. Explain TWO reason why the one you did NOT choose is INCORRECT. (6 pt, 3 pts each)

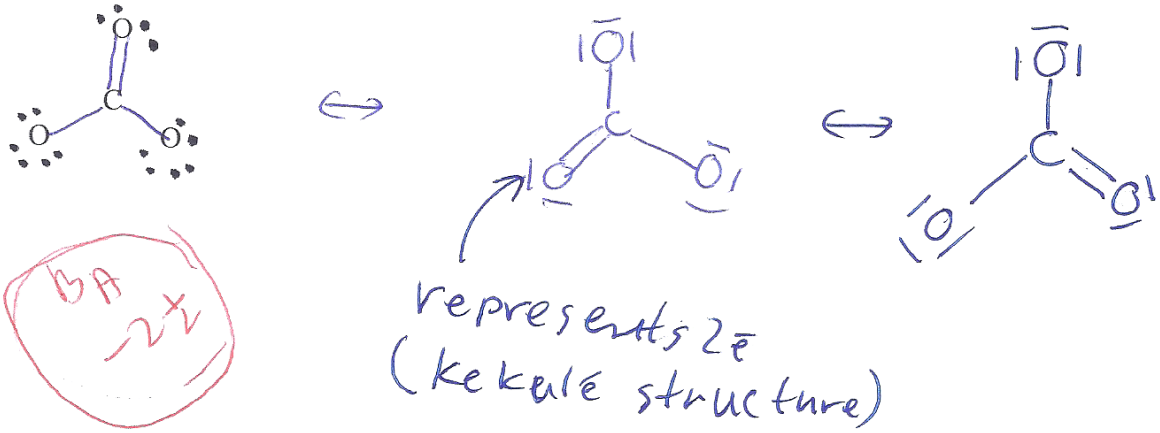
① too many e⁻

② H can only have duet (max of 2e⁻)

③ C & O – cannot expand octet because lower than period 3

BA = -1½ off each reason

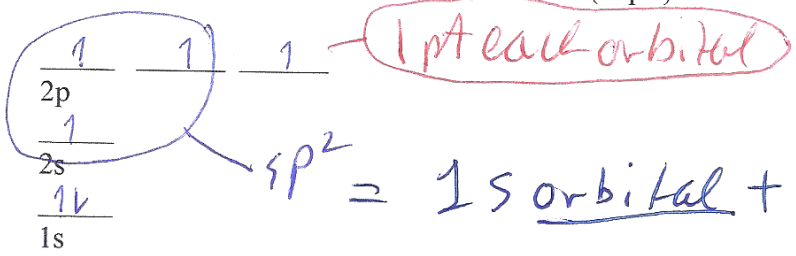
2. Draw at least one resonance structure for the given correct Lewis Dot structure. (5 pts)



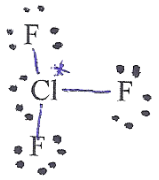
represents 2e⁻ (kekulé structure)

BA -2½

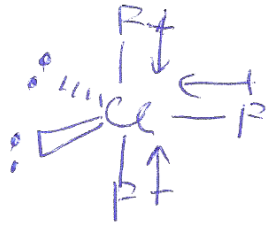
3. Given the valence orbital diagram for the element carbon (in the excited state), circle the orbitals used for the sp^2 hybridized electron orbital. (5 pts)



4. Given the following Lewis Dot structure, answer the following. (9 pts, one pt per letter)



Lewis Dot Structure



your 3D structure with dipole arrows

a. Number of charge clouds on the atom with the * 5

b. Number of lone pairs on the atom with the * 2

c. Geometry of the molecule around the atom with the * T shape

d. bond angle 120°, 90°

e. hybridization on the atom with the * sp^3d

f. Draw a 3 D structure of the molecule in the space above

g. Draw ALL non zero dipole moment arrows in the figure that you drew. -½ wrong direction arrows

h. Is the molecule [(polar) of (non polar)] (circle one parenthesis)

i. What is the predominant intermolecular force in the molecule ?

[(London forces) or (dipole-dipole) or (Hydrogen bonding)] (circle one)

BA = bad attempt NA = not attempted

General Chemistry I Lecture Fall 2019 Test 4 12/4/19 D form B section Dr. Hahn Exam # _____

Name Key (print) Name _____ (sign)

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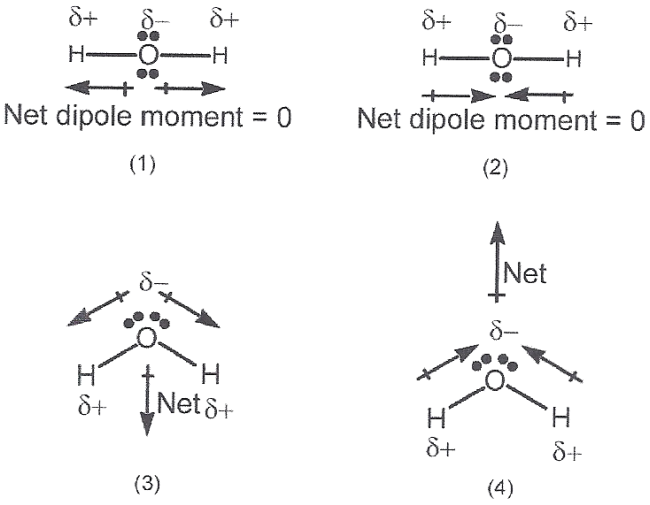
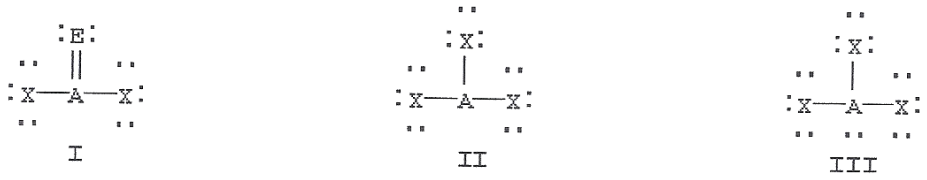
MULTIPLE CHOICE. Choose the one best alternative.

1) Which drawing best accounts for the polarity of water, H_2O, and the bond polarities that make a major contribution to the overall molecular polarity? 1) D



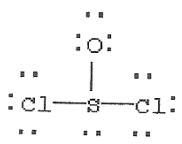
A) drawing (1) B) drawing (2) C) drawing (3) D) drawing (4)

2) Which of the following should be nonplanar? 2) C



A) only I B) only II C) only III D) I and III

3) Assign formal charges to each atom in the resonance form for $SOCl_2$ given below. 3) D

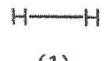


A) -1 for Cl, +4 for S, and -2 for O
B) -1 for Cl, -2 for S, and -2 for O
C) 0 for Cl, 0 for S, and 0 for O
D) 0 for Cl, +1 for S, and -1 for O

4) Which element has the most favorable (most negative) electron affinity? 4) D

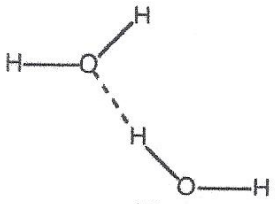
A) K B) Ne C) Be D) I

5) Which drawing best represents hydrogen bonding? 5) C

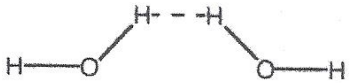


(1)

(2)



(3)



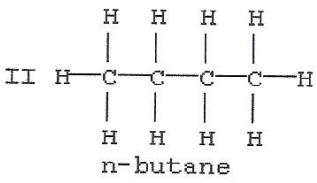
(4)

A) drawing (1) B) drawing (2) C) drawing (3) D) drawing (4)

6) Which substance in each of the following pairs is expected to have the larger dispersion forces? 6) D

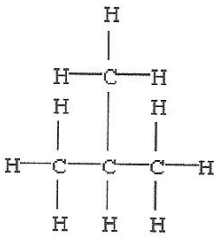
I Br_2 or I_2

II



n-butane

or



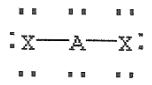
isobutane

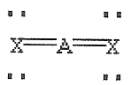
A) Br_2 in set I and isobutane in set II
B) I_2 in set I and isobutane in set II
C) Br_2 in set I and n-butane in set II
D) I_2 in set I and n-butane in set II

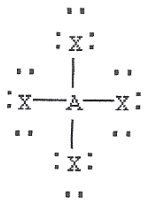
7) How many valence shell electrons does an atom of aluminum have? 7) A

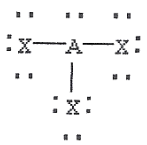
A) 3 B) 13 C) 2 D) 1

8) Based on VSEPR theory, which should have the **smallest** XAX bond angle? 8) A

A) 

B) 

C) 

D) 

9) Of the following elements, which has the **lowest** electronegativity? 9) ~~D~~

A) Sn B) As C) S D) Tl

10) What is the ground-state electron configuration of the ion Hg^{2+}? 10) D

A) $[Xe]4f^{14}5d^{8}6s^{2}$
B) $[Xe]4f^{14}5d^{10}6s^{2}$
C) $[Xe]4f^{14}5d^{10}6s^{2}6p^{2}$
D) $[Xe]4f^{14}5d^{10}$

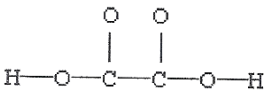
11) Which of the following compounds exhibits hydrogen bonding? 11) C

A) $(CH_3)_3N$ B) CH_3OCH_3 C) CH_3CH_2OH D) CH_3F

12) Which of the following ionic compounds would be expected to have the highest lattice energy? 12) A

A) RbF B) RbBr C) RbCl D) RbI

13) Consider a molecule with the following connections: 13) B



When a valid electron dot structure is written, how many double bonds will the molecule contain?

A) 1 B) 2 C) 0 D) 4

14) Which molecule contains the most easily broken carbon-carbon bond? 14) B

A) $H_2C{=}CH_2$ B) $H_3C{-}CH_3$ C) $F_2C{=}CF_2$ D) $HC{\equiv}CH$

15) Of the following, which element has the highest first ionization energy? 15) C

A) argon B) krypton C) helium D) neon

16) Which of the following most likely represent the atomic radius of a Cr atom, the ionic radius of a Cr^{2+} ion, and the ionic radius of a Cr^{3+} ion? 16) C

A) 128 pm for Cr, 167 pm for Cr^{2+}, and 193 pm for Cr^{3+}
B) 128 pm for Cr, 147 pm for Cr^{2+}, and 193 pm for Cr^{3+}
C) 128 pm for Cr, 89 pm for Cr^{2+}, and 63 pm for Cr^{3+}
D) 128 pm for Cr, 109 pm for Cr^{2+}, and 63 pm for Cr^{3+}

Part II: Short Answers

Please show work on all questions for partial credit even on questions which do not specify. (40 total pts)

1. Electron Dot (Lewis Dot) structure: (21 pts)

a. Show your work for coming up with the valence electron count. F N H_2 (10 pts)

2pt 2pt 2pt 2pt

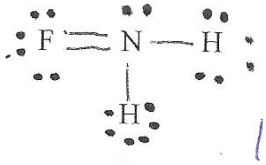
$7 + 5 + 2(1) = 14$

F N H

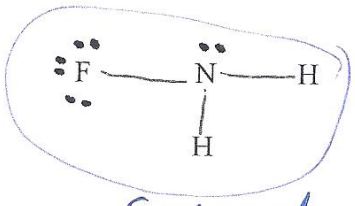
math -1

did not total -2

b. Given the two Lewis Dot structures, circle the correct Lewis Dot structure. (5 pt)



$14 \times 2 = 28$



$7 \times 2 = 14$

Correct

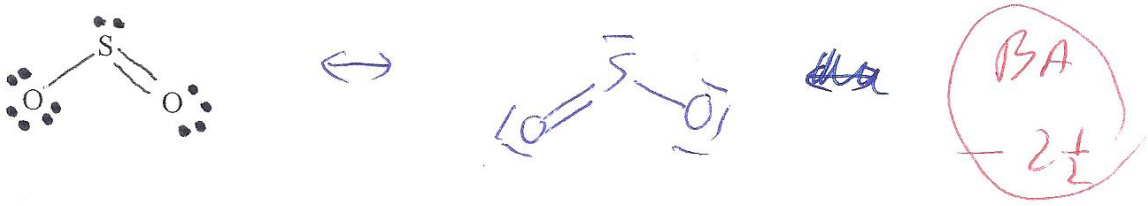
c. Explain TWO reason why the one you did NOT choose is INCORRECT. (6 pt, 3 pts each)

① too many e ② H cannot have more than duet (max of 2e)

③ N & F in period 2 cannot expand octet

BA - 1½ each reason

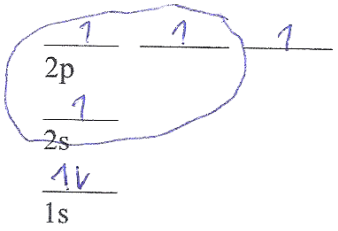
2. Draw at least one resonance structure for the given correct Lewis Dot structure. (5 pts)



BA

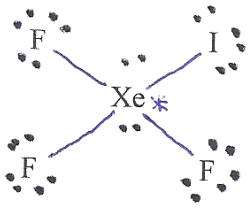
-2½

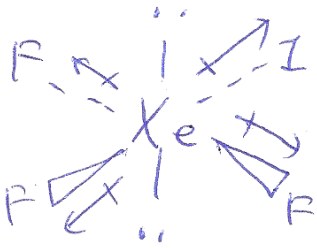
3. Given the valence orbital diagram for the element carbon (in the excited state), circle the orbitals used for the sp^2 hybridized electron orbital. (5 pts)



1pt each orbital

4. Given the following Lewis Dot structure, answer the following. (9 pts, one pt per letter)





vector sum ≠ 0 because EN I ≠ EN F

Lewis Dot Structure

your 3D structure with dipole arrows

a. Number of charge clouds on the atom with the * 6

b. Number of lone pairs on the atom with the * 2

c. Geometry of the molecule around the atom with the * square plana

d. bond angle 90

e. hybridization on the atom with the * sp^3d^2

f. Draw a 3 D structure of the molecule in the space above

g. Draw ALL non zero dipole moment arrows in the figure that you drew. -½ wrong direction arrows

h. Is the molecule [(polar) of (non polar)] (circle one parenthesis)

i. What is the predominant intermolecular force in the molecule ?

[(London forces) or (dipole-dipole) or (Hydrogen bonding)] (circle one)

BA = bad attempt NA = not attempted

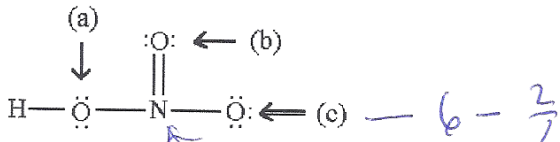
General Chemistry I Lecture Fall 2019 Test 4 12/4/19 F form A section Dr. Hahn Exam # _____

Name Key (print) Name _____ (sign)

Please show work for partial credit and full credit on the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If you run out of space, continue on the empty back pages but clearly label where the remaining answers can be found. (Please count your exam pages and make sure there are 5 pages)

MULTIPLE CHOICE. Choose the one best alternative.

1) Assign formal charges to all atoms in the following resonance form for HNO_3. 1) C



6 − 2/2 − 6 = −1

5 − 8/2 = +1

A) 0 for all atoms

B) +1 for N and H, −1 for oxygen (a) and oxygen (c), 0 for oxygen (b)

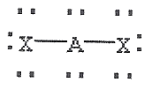
C) +1 for N, −1 for oxygen (c), 0 for all other atoms

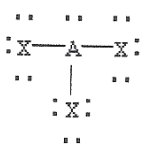
D) +1 for H, −2 for each oxygen, +5 for N

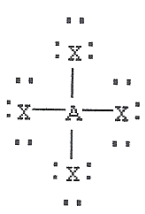
2) Which of these elements has the most favorable (most negative) electron affinity? 2) C

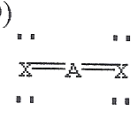
A) Ne B) N C) S D) Ca

3) Based on VSEPR theory, which should have the **smallest** XAX bond angle? 3) A

A) 

B) 

C) 

D) 

4) Which molecule contains the most easily broken carbon–carbon bond? 4) D

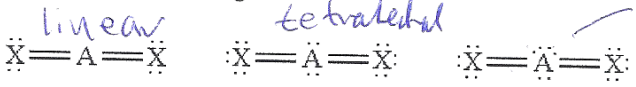
A) $F_2C{=}CF_2$ B) $HC{\equiv}CH$ C) $H_2C{=}CH_2$ D) $H_3C{-}CH_3$

5) Which is expected to have the **largest** dispersion forces? 5) C

A) NBr_3 B) C_2H_4 C) $C_{18}H_{36}$ D) Ba

6) Which of the following should be nonlinear? 6) B

linear tetrahedral 5 with lone pair



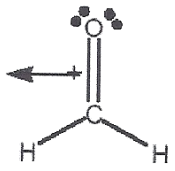
I II bent III linear

A) only I B) only II C) only III D) II and III

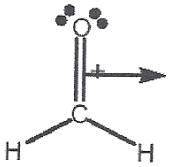
7) How many valence shell electrons does an atom of indium have? 7) C

A) 49 B) 2 C) 3 D) 1

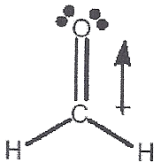
8) Which best indicates the direction of the dipole moment in formaldehyde, $H_2C{=}O$? 8) C



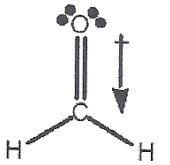
(1)



(2)



(3)



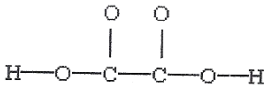
(4)

A) drawing (1) B) drawing (2) C) drawing (3) D) drawing (4)

9) Which of the following compounds exhibits hydrogen bonding? 9) B

A) CH_3OCH_3 B) CH_3NH_2 C) HI D) CH_3I

10) Consider a molecule with the following connections: 10) C



When a valid electron dot structure is written, how many double bonds will the molecule contain?

A) 0 B) 4 C) 2 D) 1

11) Of the following, which element has the highest first ionization energy? 11) C

A) neon B) argon C) helium D) krypton

smallest

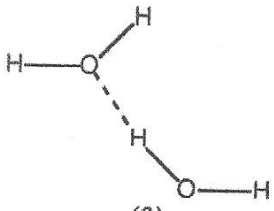
12) Of the following elements, which has the **lowest** electronegativity? 12) ~~D~~ A

A) Tl B) As C) Sn D) S

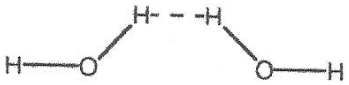
13) Which drawing best represents hydrogen bonding? 13) C

(1)

(2)



(3)



(4)

A) drawing (1) B) drawing (2) C) drawing (3) D) drawing (4)

14) What is the ground-state electron configuration of Se^{2-}? 14) A

A) $[Ar]3d^{10}4s^24p^6$ B) $[Ar]3d^{10}4s^24p^4$
C) $[Ar]3d^{10}4s^24p^2$ D) $[Ar]3d^{12}4s^24p^4$

15) Which ion has the **smallest** ionic radius? 15) C

A) K^+ B) Rb^+ C) Li^+ D) Na^+

16) Which ionic compound would be expected to have the highest lattice energy? 16) A

A) Ga_2O_3 B) Cs_2O C) CO_2 D) BaO

end chapter 6

+1 -2

covalent

+2 -2

+3 -2

small + high charge

Part II: Short Answers

Please show work on all questions for partial credit even on questions which do not specify. (40 total pts)

1. Electron Dot (Lewis Dot) structure: (21 pts)

a. Show your work for coming up with the valence electron count. Cl H N OH (10 pts)

2pt 2pt 2pt 2pt 2pt

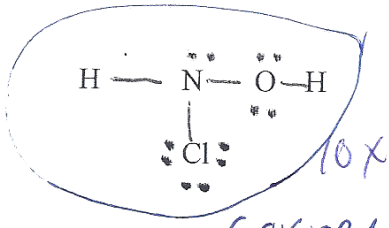
7 + 1 + 5 + 6 + 1 = 20

Cl H N O H

Math -1

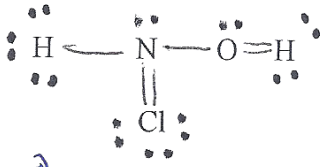
did not total -2

b. Given the two Lewis Dot structures, circle the correct Lewis Dot structure. (5 pt)



10 x 2 = 20

correct



16 x 2 = 32

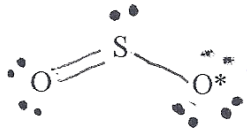
c. Explain TWO reason why the one you did NOT choose is INCORRECT. (6 pt, 3 pts each)

① too many e⁻ ② H can only have duet

③ N cannot expand octet because period = 2 (below period 3)

BA - It off each reason

2. For the molecule shown, show work for your calculation of formal charge on the atom with the * (5 pts).



-2 -1 -1 -1

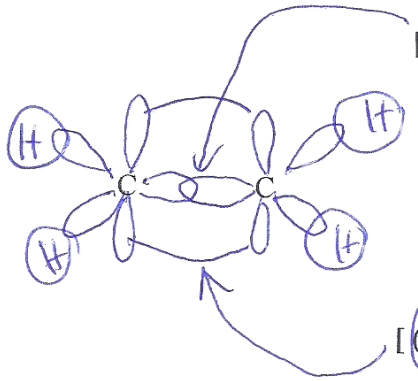
$6 - \frac{2}{2} - 6 = -1$

math -½

$$f.c. = \#\ \text{valence}\ \bar{e} - \left(\frac{\#\ \text{bonding}\ \bar{e}}{2}\right) - \left(\#\ \text{nonbonding}\ \bar{e}\right)$$

BA - 2½

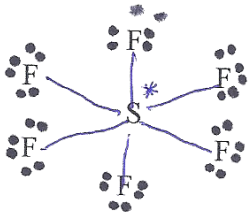
3. Given the following orbital diagram which is a π or σ bond. (5 pts, 2.5 pts each)



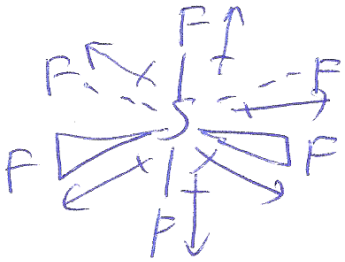
[(π) or (σ)] (circle one)

[(π) or (σ)] (circle one)

4. Given the following Lewis Dot structure, answer the following. (9 pts, one pt per letter)



Lewis Dot Structure



your 3D structure with dipole arrows

a. Number of charge clouds on the atom with the * 6

b. Number of lone pairs on the atom with the * 0

c. Geometry of the molecule around the atom with the * octahedral

d. bond angle 90

e. hybridization on the atom with the * sp^3d^2

f. Draw a 3 D structure of the molecule in the space above

g. Draw ALL non zero dipole moment arrows in the figure that you drew. — wrong direction dipole = 0

h. Is the molecule [(polar) of (non polar)] (circle one parenthesis) Vector sum = zero

i. What is the predominant intermolecular force in the molecule ?

[(London forces) or (dipole-dipole) or (Hydrogen bonding)] (circle one)

BA = bad attempt NA = not attempted

General Chemistry I Lecture Fall 2019 Test 4 12/4/19 F form B section Dr. Hahn Exam # _____

Name Key (print) Name _____ (sign)

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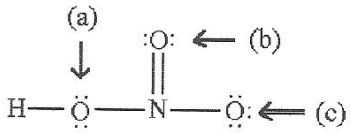
MULTIPLE CHOICE. Choose the one best alternative.

1) Assign formal charges to all atoms in the following resonance form for HNO_3. 1) C



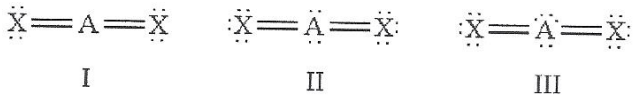
A) 0 for all atoms
B) +1 for N and H, –1 for oxygen (a) and oxygen (c), 0 for oxygen (b)
C) +1 for N, –1 for oxygen (c), 0 for all other atoms
D) +1 for H, –2 for each oxygen, +5 for N

2) Which molecule contains the most easily broken carbon–carbon bond? 2) C
A) HC≡CH B) $H_2C{=}CH_2$ C) $H_3C{-}CH_3$ D) $F_2C{=}CF_2$

3) Of the following, which element has the highest first ionization energy? 3) A
A) helium B) krypton C) neon D) argon

4) Which of the following compounds exhibits hydrogen bonding? 4) A
A) CH_3NH_2 B) CH_3OCH_3 C) HI D) CH_3I

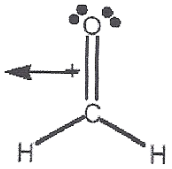
5) Which of the following should be nonlinear? 5) B



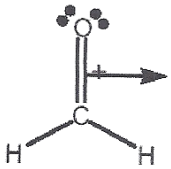
I II III

A) only I B) only II C) only III D) II and III

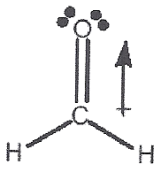
6) Which best indicates the direction of the dipole moment in formaldehyde, $H_2C{=}O$? 6) C



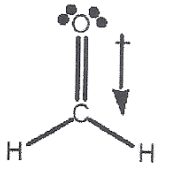
(1)



(2)



(3)



(4)

A) drawing (1) B) drawing (2) C) drawing (3) D) drawing (4)

7) Which ion has the **smallest** ionic radius? 7) D
A) Rb^+ B) K^+ C) Na^+ D) Li^+

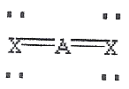
8) How many valence shell electrons does an atom of indium have? 8) D
A) 49 B) 1 C) 2 D) 3

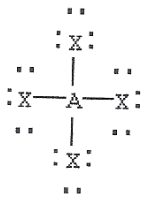
9) What is the ground-state electron configuration of Se^{2-}? 9) A
A) $[Ar]3d^{10}4s^24p^6$
B) $[Ar]3d^{10}4s^24p^4$
C) $[Ar]3d^{10}4s^24p^2$
D) $[Ar]3d^{12}4s^24p^4$

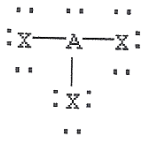
10) Which ionic compound would be expected to have the highest lattice energy? 10) A
A) Ga_2O_3 B) CO_2 C) BaO D) Cs_2O

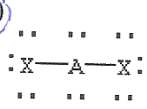
end chapter 6

11) Based on VSEPR theory, which should have the **smallest** XAX bond angle? 11) D

A)


B)


C)


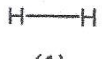
D)


12) Which of these elements has the most favorable (most negative) electron affinity? 12) B
A) N B) S C) Ne D) Ca

13) Which is expected to have the **largest** dispersion forces? 13) A

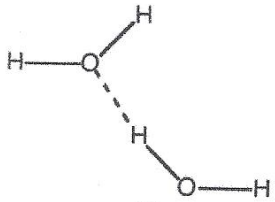
A) $C_{18}H_{36}$ B) Ba C) C_2H_4 D) NBr_3

14) Which drawing best represents hydrogen bonding? 14) C

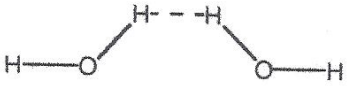


(1)

(2)



(3)



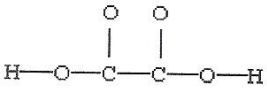
(4)

A) drawing (1) B) drawing (2) C) drawing (3) D) drawing (4)

15) Of the following elements, which has the **lowest** electronegativity? 15) ~~B~~ D

A) As B) S C) Sn D) Tl

16) Consider a molecule with the following connections: 16) A



When a valid electron dot structure is written, how many double bonds will the molecule contain?

A) 2 B) 1 C) 0 D) 4

Part II: Short Answers

Please show work on all questions for partial credit even on questions which do not specify. (40 total pts)

1. Electron Dot (Lewis Dot) structure: (21 pts)

a. Show your work for coming up with the valence electron count. H C O NH_2 (10 pts)

2pt 2pt 2pt 2pt 2pt

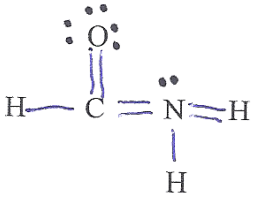
$1 + 4 + 6 + 5 + 2(1) = 18$

H C O N H

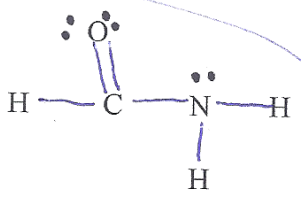
math -1

did not total -2

b. Given the two Lewis Dot structures, circle the correct Lewis Dot structure. (5 pt)



$12 \times 2 = 24\ \bar{e}$



$9 \times 2 = 18$

correct

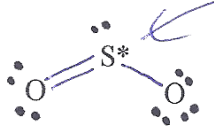
c. Explain TWO reason why the one you did NOT choose is INCORRECT. (6 pt, 3 pts each)

① too many $\bar{e}$ in structure ② C, N, O cannot expand octet all in period 2

③ H cannot have more than 2 $\bar{e}$ (duet)

BA - 1/2 of each reason

2. For the molecule shown, show work for your calculation of formal charge on the atom with the * (5 pts) .



$6 - \frac{6}{2} - 2 = +1$ (1 lone pair)

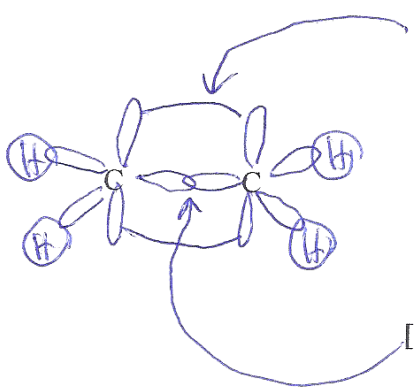
Valence $\bar{e}$ 2pt 1pt 1pt 1pt

math -1/2

BA -2 1/2

$$f.c. = \frac{\#\text{ valence } \bar{e}}{} - \frac{\#\text{ bonding } \bar{e}}{2} - \#\text{ nonbonding or lone pair } \bar{e}$$

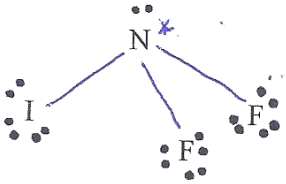
3. Given the following orbital diagram which is a π σ bond. (5 pts, 2.5 pts each)



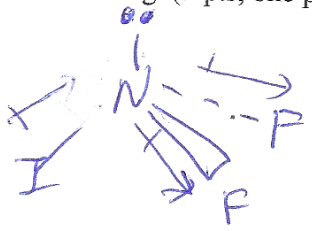
[(π) or (σ)] (circle one)

[(π) or (σ)] (circle one)

4. Given the following Lewis Dot structure, answer the following. (9 pts, one pt per letter)



Lewis Dot Structure



your 3D structure with dipole arrows

a. Number of charge clouds on the atom with the * 4

b. Number of lone pairs on the atom with the * 1

c. Geometry of the molecule around the atom with the * trigonal

d. bond angle 109.5 (slightly less) Pyramidal

e. hybridization on the atom with the * sp^3

f. Draw a 3 D structure of the molecule in the space above

g. Draw ALL non zero dipole moment arrows in the figure that you drew. wrong direction -½

h. Is the molecule [(polar) of (non polar)] (circle one parenthesis)

i. What is the predominant intermolecular force in the molecule ?

[(London forces) or (dipole-dipole) or (Hydrogen bonding)] (circle one)

BA = bad attempt NA = not attempted

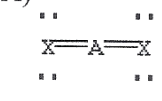
General Chemistry I Lecture Fall 2019 Test 4 12/4/19 G section Dr. Hahn Exam # _____

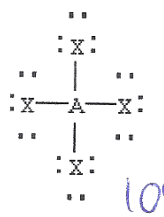
Name Key (print) Name _____ (sign)

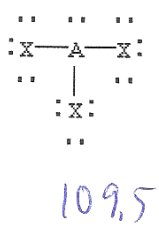
Please show work for partial credit and full credit on the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If you run out of space, continue on the empty back pages but clearly label where the remaining answers can be found. (Please count your exam pages and make sure there are 5 pages)

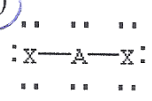
MULTIPLE CHOICE. Choose the one best alternative.

1) Based on VSEPR theory, which should have the **smallest** XAX bond angle? 1) D

A) 
180

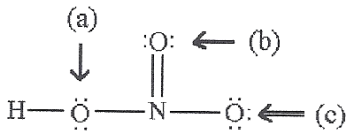
B) 
109.5

C) 
109.5

(D) 
109.5

1 lone pair use more space

2) Assign formal charges to all atoms in the following resonance form for HNO_3. 2) B



A) 0 for all atoms
B) +1 for N, −1 for oxygen (c), 0 for all other atoms
C) +1 for N and H, −1 for oxygen (a) and oxygen (c), 0 for oxygen (b)
D) +1 for H, −2 for each oxygen, +5 for N

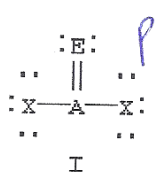
3) Which of the following ionic compounds would be expected to have the highest lattice energy? (smallest) 3) D

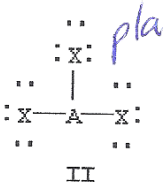
A) Rb F B) Na F C) K F (D) Li F

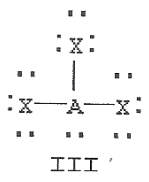
4) What is the ground-state electron configuration of Se^{2-}? 4) A

(A) $[Ar]3d^{10}4s^24p^6$
B) $[Ar]3d^{12}4s^24p^4$
C) $[Ar]3d^{10}4s^24p^2$
D) $[Ar]3d^{10}4s^24p^4$

5) Which of the following should be nonplanar? 5) C


I planar


II planar


III

A) only I B) only II (C) only III D) I and III

6) Which of these elements has the most favorable (most negative) electron affinity? 6) A

A) S B) Ca C) Ne D) N

7) How many valence shell electrons does an atom of Sn have? 7) D

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

8) Which of the following atoms with the specified electronic configurations would have the **lowest** first ionization energy? 8) D

A) [He]$2s^2 2p^3$ B) [Xe]$6s^2 4f^{14} 5d^{10} 6p^1$

C) [Ne]$3s^2 3p^4$ D) [Xe]$6s^1$ biggest & becomes noble gas

9) Which of the following most likely represent the atomic radius of a Cr atom, the ionic radius of a Cr^{2+} ion, and the ionic radius of a Cr^{3+} ion? 9) A

A) 128 pm for Cr, 89 pm for Cr^{2+}, and 63 pm for Cr^{3+}

B) 128 pm for Cr, 109 pm for Cr^{2+}, and 63 pm for Cr^{3+}

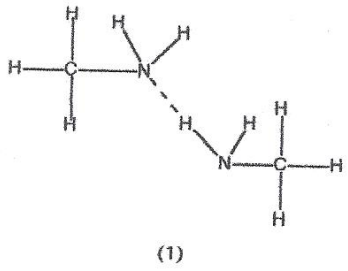
C) 128 pm for Cr, 167 pm for Cr^{2+}, and 193 pm for Cr^{3+}

D) 128 pm for Cr, 147 pm for Cr^{2+}, and 193 pm for Cr^{3+}

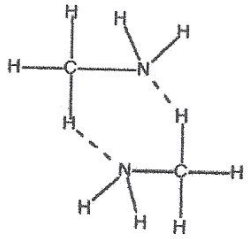
10) Which of the following compounds has the **highest** boiling point? 10) A

A) H_2O B) H_2S C) H_2Se D) H_2Te

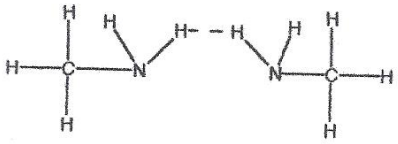
11) Which drawing best represents hydrogen bonding in methylamine, CH_3NH_2? 11) A



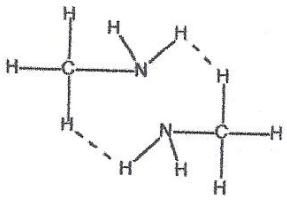
(1)



(2)



(3)



(4)

A) drawing (1) B) drawing (2) C) drawing (3) D) drawing (4)

12) Of the following elements, which has the **lowest** electronegativity? 12) ~~B~~ D

A) As B) S C) Sn D) Tl

single bond & H is smaller than N

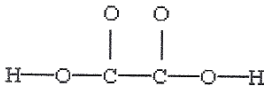
13) Which is the longest bond? 13) B

A) N–H B) N–N C) N≡N D) N=N

14) Which is expected to have the **largest** dispersion forces? 14) C

A) Ba B) C_2H_4 C) $C_{18}H_{36}$ D) NBr_3

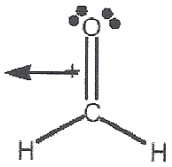
15) Consider a molecule with the following connections: 15) C



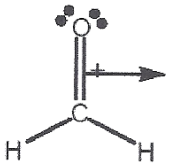
When a valid electron dot structure is written, how many double bonds will the molecule contain?

A) 1 B) 0 C) 2 D) 4

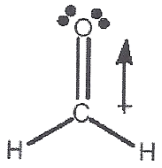
16) Which best indicates the direction of the dipole moment in formaldehyde, $H_2C{=}O$? 16) C



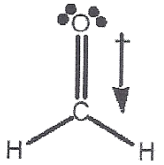
(1)



(2)



(3)



(4)

A) drawing (1) B) drawing (2) C) drawing (3) D) drawing (4)

Part II: Short Answers

Please show work on all questions for partial credit even on questions which do not specify. (40 total pts)

1. Electron Dot (Lewis Dot) structure: (21 pts)

a. Show your work for coming up with the valence electron count. Cl B H_2 (10 pts)

2pt 2pt 2pt 2pt

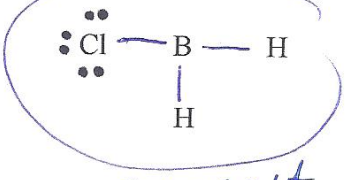
$7 + 3 + 2(1) = 12$

Cl B H

-1 math

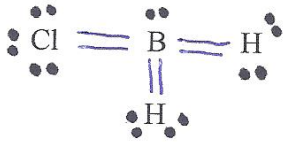
did not total -2

b. ~~Given the two~~ Lewis Dot structures, circle the correct Lewis Dot structure. (5 pt)



correct

$6 \times 2 = 12$



$14 \times 2 = 28$

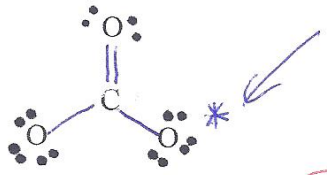
c. Explain TWO reason why the one you did NOT choose is INCORRECT. (6 pt, 3 pts each)

① too many e⁻ ② B in period 2 cannot expand octet

③ H can only have maximum of 2 e⁻

BA - 1½ off each reason

2. For the molecule shown, show work for your calculation of formal charge on the atom with the * (5 pts) .



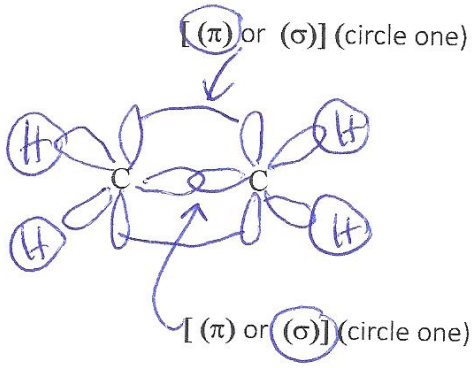
-1 0 -1 +1

$6 - \frac{2}{2} - 6 = -1$

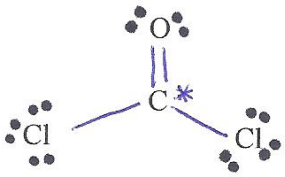
math -½

BA = -2½

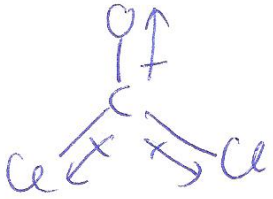
3. Given the following orbital diagram which is a π σ bond. (5 pts, 2.5 pts each)



4. Given the following Lewis Dot structure, answer the following. (9 pts, one pt per letter)



Lewis Dot Structure



your 3D structure with dipole arrows

a. Number of charge clouds on the atom with the * 3

b. Number of lone pairs on the atom with the * 0

c. Geometry of the molecule around the atom with the * trigonal planar

d. bond angle 120°

e. hybridization on the atom with the * sp^2

f. Draw a 3 D structure of the molecule in the space above – planar - does not need wedges & dashes

g. Draw ALL non zero dipole moment arrows in the figure that you drew.

h. Is the molecule [(polar) of (non polar)] (circle one parenthesis) – EN difference not same C-O vs. C-Cl

i. What is the predominant intermolecular force in the molecule ?

[(London forces) or (dipole-dipole) or (Hydrogen bonding)] (circle one)

wrong direction arrow – ½