Name: _____ date: _____ period: _____

ch. 8, 9 chemical bonds & molecular polarity and misc: mass spectra; metal / alloy /; lattice energy; PES

75 points (3 ec) test AP chemistry

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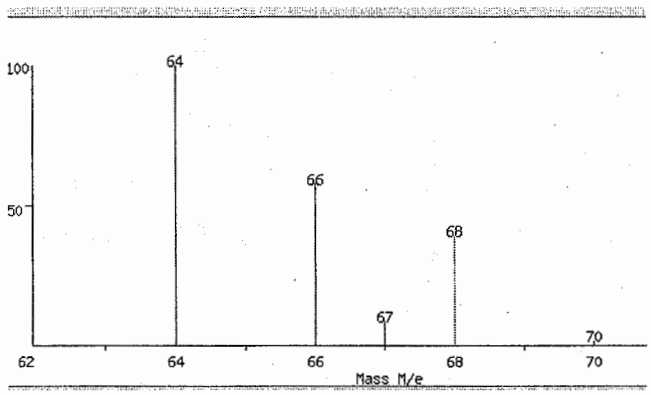
Signature: _____

In problems involving any calculation, show your work in an organized manner, include (i) any relevant equation (or formula), (ii) conversion factor(s), (iii) put the proper units in your calculations and answer, and (iv) have the proper number of significant figures in your answer.

1. Based on the below simulated mass spectrum of an atom



Data table (mass intensity)

64	100
66	57.4
67	8.4
68	38.7
70	1.2

$\Sigma = 205.7$

estimate average atomic mass of the atom. [10 points]

$\bar{x} = \sum m_i P_i$

$= 64 P_{64} + 66 P_{66} + 67 P_{67} + 68 P_{68} + 70 P_{70}$

$= 64 \frac{100}{205.7} + 66 \frac{57.4}{205.7} + 67 \frac{8.4}{205.7} + 68 \frac{38.7}{205.7} + 70 \frac{1.2}{205.7}$

$= 31.113 + 18.417 + 2.736 + 12.793 + 0.408$

$= 65.5$ amu

2. What is the relative size of atoms in a(n) ____ alloy ? [10 points]

a. interstitial

major atom size > minor atom size

b. substitutional

same size atoms

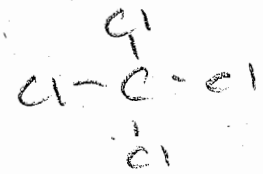
3. Describe the chemical bond in ___ and the basis of the chemical bond using the concept of electrostatic forces. [10 points]

a. sodium chloride

ionic bond

Na^+ attract Cl^-

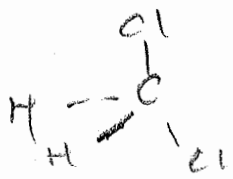
b. carbon tetrachloride



mutual attraction of shared e⁻ by C & Cl (proton in nucleus)

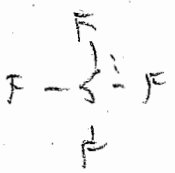
4. In regards to ___, (i) sketch the shape of the molecule, (ii) name of the shape of the molecule, (iii) bond angle(s), and (iv) molecular polarity & its basis / rationale. [15 points]

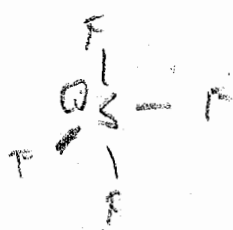
a. CH_2Cl_2



tetrahedral 109° polar ($\Sigma \neq 0$)

b. SF_4





seesaw <120° <90° polar ($\Sigma \neq 0$)

5 : 1 · 6 : 6

F : 4 · 7 = 28

24

-9

26

-24

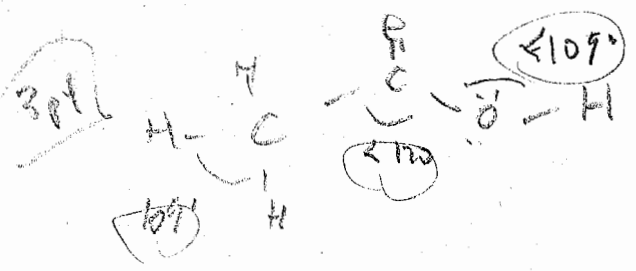
2

c. NH_3

trigonal pyramidal <109° polar ($\Sigma \neq 0$)

5. In regards to $H_3C-COOH$, a carboxylic acid with a methyl group, ___. [20 points]

a. sketch the shape of the molecule (hint: there are 3 central atoms) and what is / are the bond angle(s) in the molecule associated with each central atom ?



b. identify the hybrid orbital(s) in all central atoms and your basis / rationale

2 pt
2
2

109° C : sp^3

120° C : sp^2

109 O : sp^3

c. describe the formation of these hybrid orbital(s)

2 sp^3 C : [ ] ⇒ excite ⇒ hybridize ⇒ sp^3

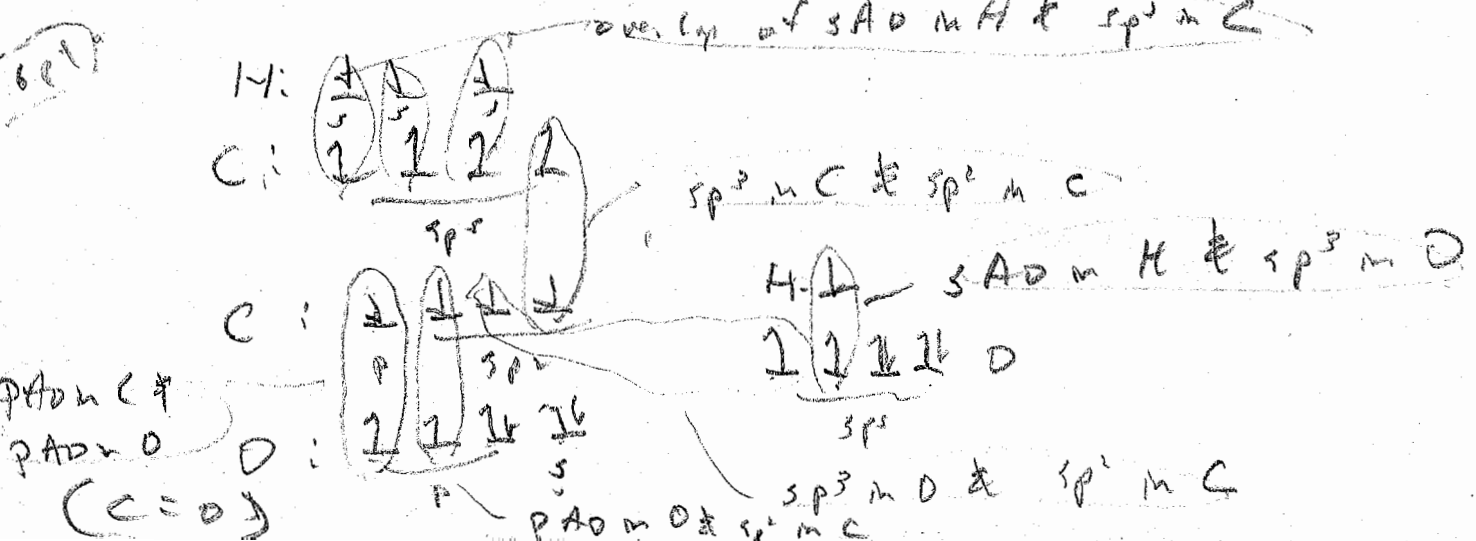
2 sp^2 C : [ ] ⇒ excite ⇒ hybridize ⇒ sp^2 p

1 sp^3 O : [ ] ⇒ hybridize ⇒ sp^3

bond with H

d. use valence bond theory to describe the bonds in the compound

6 pt



6. old topic – fill-in the table; might be hypothetical atom / ion. [13 points]

# neutrons	# protons	# electrons	charge	atomic mass	symbol
22	20	18	+2	42	$^{42}Ca^{2+}$
17	16	18	- 2	33	$^{33}S^{-2}$
24	21	18	+3	45	$^{45}Sc^{+3}$

45
- 24
21

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ch. 8, 9 chemical bonds & molecular polarity and misc: mass spectra; metal / alloy /; lattice energy; PES

75 points retest AP chemistry

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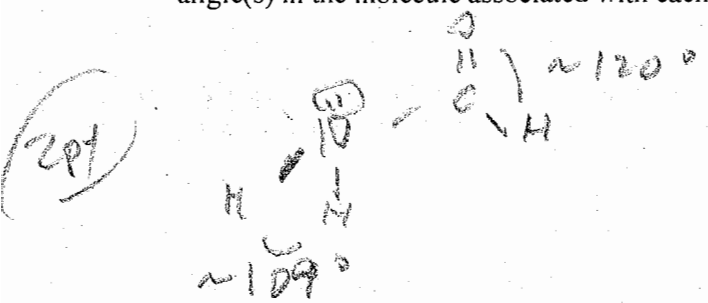
1. Sketch the PES of carbon and oxygen and show the "high" versus "low" energy level on the appropriate axis and the numeric value of the "size" of the PES signal. Also, label the source of each signal – atom and its atomic orbital. Basis / rationale of the relative energy level of the atomic orbital between carbon and oxygen. [15 points]

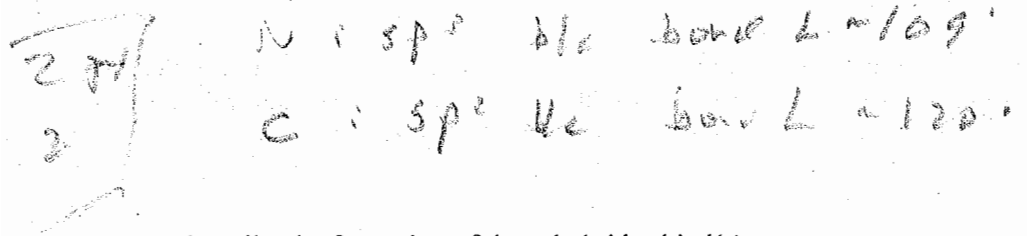
2. What is the relative size of an atom and its corresponding cation ? Basis / rationale ? [10 points]

3. In regards to $H_2N - CHO$, an amide, ___. [20 points]

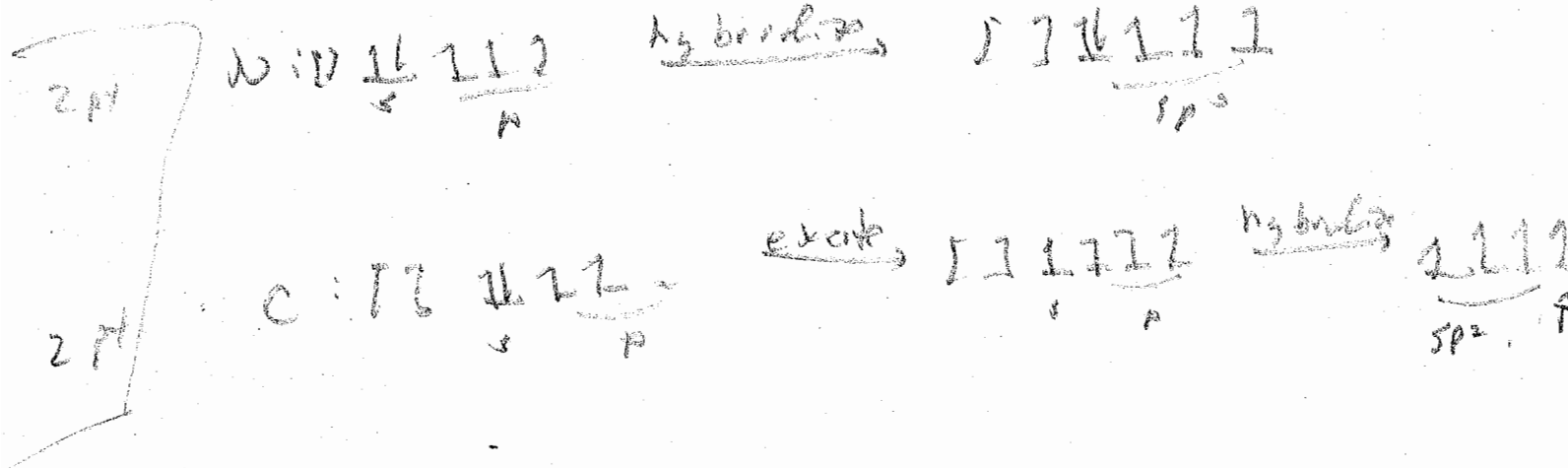
a. sketch the shape of the molecule (hint: there are 2 central atoms = carbon and nitrogen) and what is / are the bond angle(s) in the molecule associated with each central atom ?



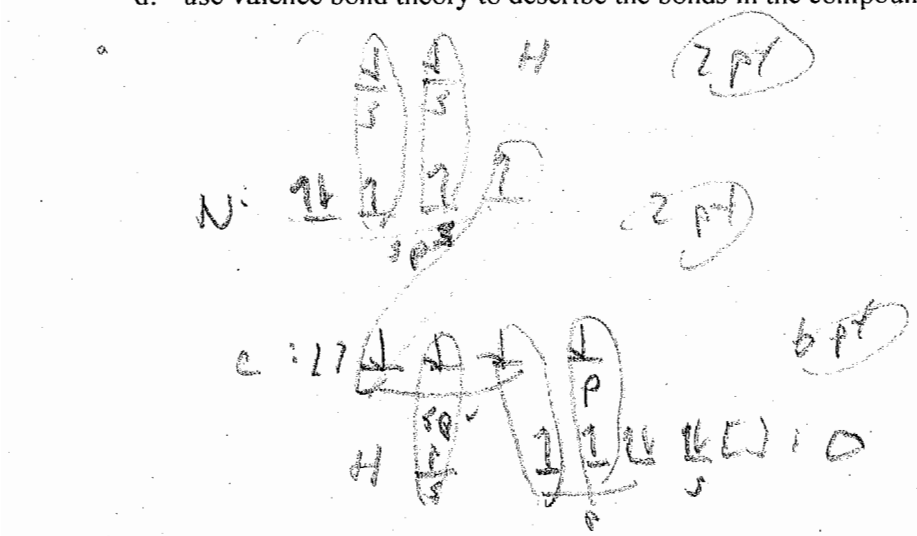
b. identify the hybrid orbital(s) in all central atoms and your basis / rationale



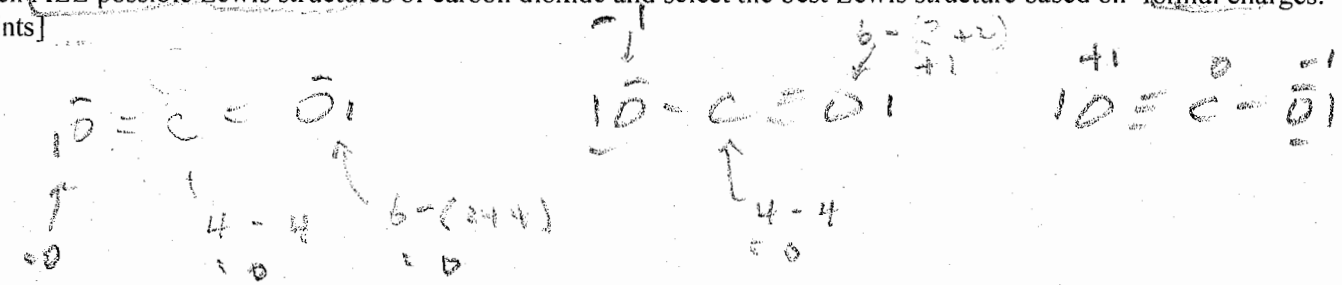
c. describe the formation of these hybrid orbital(s)



d. use valence bond theory to describe the bonds in the compound



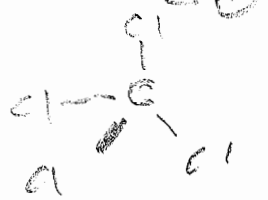
4. Sketch ALL possible Lewis structures of carbon dioxide and select the best Lewis structure based on formal charges. [10 points]



(1 pt) ↑ structure b/c minimize magnitude of formal charges

5. In regards to ___, (i) sketch the shape of the molecule, (ii) name of the shape of the molecule, (iii) bond angle(s), and (iv) molecular polarity & its basis / rationale. [15 points]

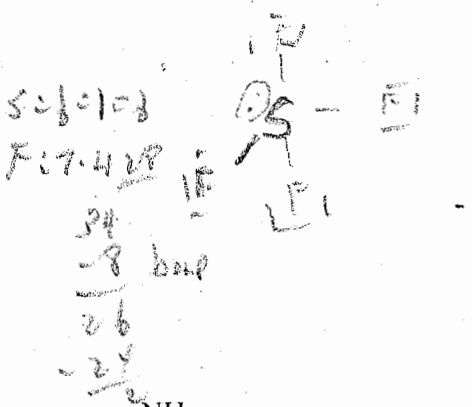
a. CH_2Cl_2



(1 pt) (1 pt) (1 pt) (1 pt) (1 pt)

tetrahedral 109° polar b/c Σ ≠ 0

b. SF_4



see saw < 120° < 90° polar Σ ≠ 0

c. NH_3

trigonal pyramidal < 109° polar Σ ≠ 0

6. old topic [5 points]: solve for k, where $\frac{75\ mmol}{minute} = k\ (5\ mole)^2$ using units of mole and minute.

3 pt

$\frac{75 \cdot 10^{-3}\ mol}{min} = k\ 25\ mol^2$

2

$k = \frac{3 \cdot 10^{-3}}{mol\ min}$