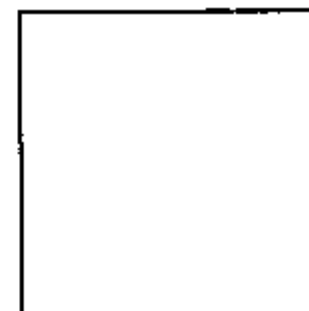


# Exam 2A

Chem 960  
Fall 2009  
Maleckar  
100 points



Initial of last name

NAME KEY

Which is Greatest? \_\_\_\_\_ (30)

Problems 2&3 \_\_\_\_\_ (29)

Problem 4 \_\_\_\_\_ (17)

Problem 5 \_\_\_\_\_ (14)

Problem 6 \_\_\_\_\_ (10)

**TOTAL** \_\_\_\_\_

# Which is Greatest?

Compare the answers for every question and circle the one that is the greatest or largest in number OR IN MAGNITUDE if a negative number.

1a. the electronegativity of

O is the furthest to the right and the highest

Si

O

S

b. the lattice energy of

Ca is +2, K is +1, so  $\text{Ca(NO}_3)_2 \rightarrow \text{KNO}_3$   
but Ca is smaller than Ba, so  $\text{Ca(NO}_3)_2 \rightarrow \text{Ba(NO}_3)_2$

Ba(NO<sub>3</sub>)<sub>2</sub>

Ca(NO<sub>3</sub>)<sub>2</sub>

KNO<sub>3</sub>

c. the IE<sub>1</sub> of

P has a half-filled p subshell

Mg

Si

P

S

d. the atomic radius of

radius decreases L → R  
Sr is furthest left

Sr

Sb

Sn

e. the polarity of

Si is the least electroneg. of Si, P, or Cl, so the bond is most polar

a Si-O bond

a P-O bond

a Cl-O bond

f. the lattice energy of

Ag is +1, Cu is +2, so Cu > Ag  
NO<sub>3</sub> is larger than Cl<sup>-</sup>, because of 4 atoms vs. 1

AgCl

CuCl<sub>2</sub>

Zn(NO<sub>3</sub>)<sub>2</sub>

g. the atomic radius of

the fewer # of p, the larger the ion

Na<sup>+</sup>

Mg<sup>2+</sup>

Al<sup>3+</sup>

11p  
10e<sup>-</sup>

12p  
10e<sup>-</sup>

13p  
10e<sup>-</sup>

h. the \_\_\_\_\_

K is s<sup>1</sup> so the IE<sub>2</sub> would be disturbing a noble gas configuration huge!

IE<sub>1</sub> of Ca

the IE<sub>1</sub> of As

the IE<sub>2</sub> of K

i. the atomic radius of

I is larger than all others; I<sup>-</sup> is larger than I

I

F

O<sup>2-</sup>

I

F

j. the attraction of \_\_\_\_\_ to a magnetic field

NO<sup>•</sup>

CO

BF<sup>•</sup>

2 unpaired e<sup>-</sup>

0 unpaired e<sup>-</sup>

1 unpaired e<sup>-</sup>

3 points each

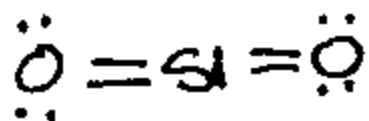
Draw each Lewis Dot structure and provide the following information for each.

Structure

Hybridization

Molecular Shape

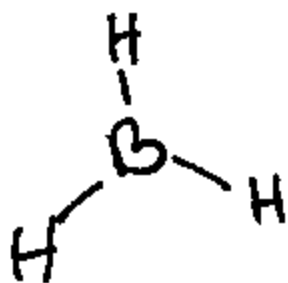
2a. SiO<sub>2</sub>



sp

linear

2b. BH<sub>3</sub>

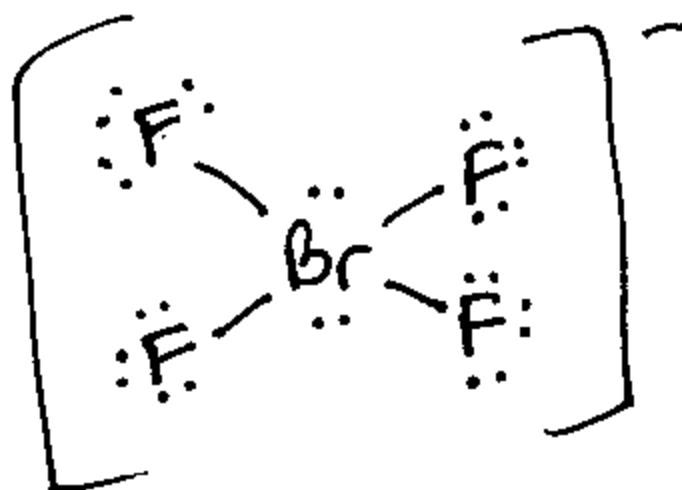


sp<sup>2</sup>

trigonal planar

2c. BrF<sub>4</sub><sup>-</sup>

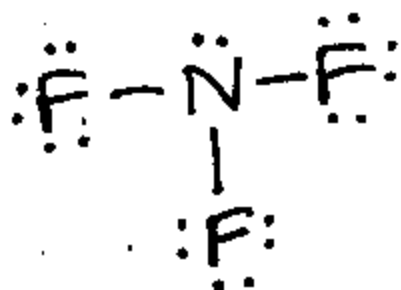
36e<sup>-</sup>



sp<sup>3</sup>d<sup>2</sup>

not required

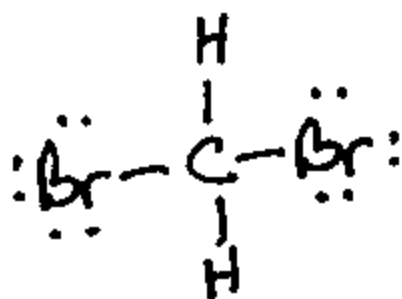
2d. NF<sub>3</sub>



sp<sup>3</sup>

trigonal pyramidal

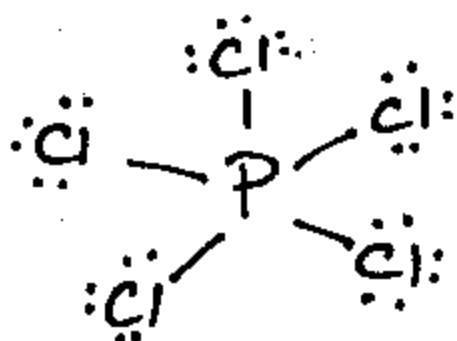
2e. CH<sub>2</sub>Br<sub>2</sub>



sp<sup>3</sup>

tetrahedral

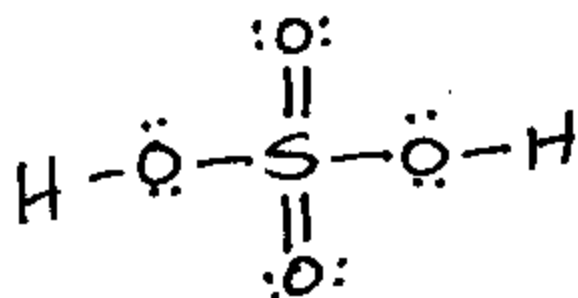
2f. PCl<sub>5</sub>



sp<sup>3</sup>d

not required

2g. H<sub>2</sub>SO<sub>4</sub>



sp<sup>3</sup>

tetrahedral

1pt each  
19 total

2h. Based on the structures from the previous page, determine to the best of your ability if the following compounds would be soluble in water or not by writing the formulas (only) in the appropriate boxes.



**Soluble in Water**

BrF<sub>4</sub><sup>-</sup> (charged, so polar)

NF<sub>3</sub>

1 pt each

**Insoluble in Water**

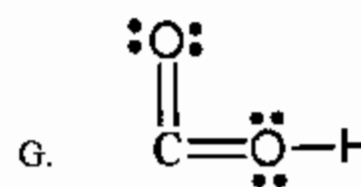
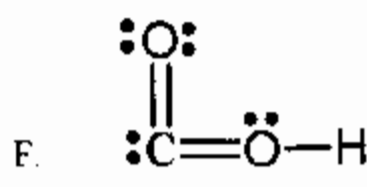
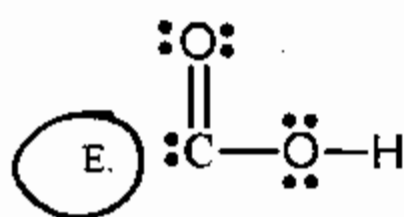
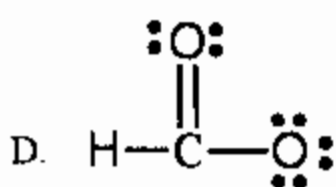
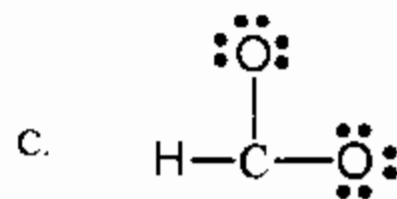
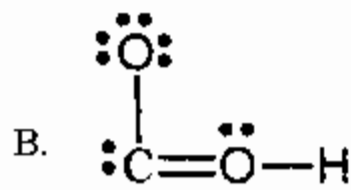
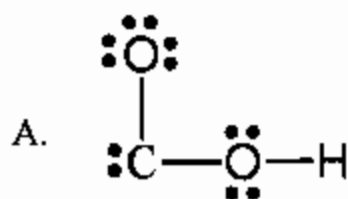
SiO<sub>2</sub>

BH<sub>3</sub>

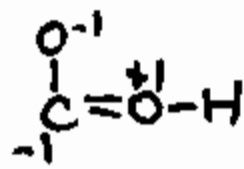
PCl<sub>5</sub>

CH<sub>2</sub>Br<sub>2</sub>

3. Circle the **BEST** possible structure for ~~CH<sub>2</sub>O<sub>2</sub>~~ <sup>CHO<sub>2</sub><sup>-</sup> 18e<sup>-</sup></sup>



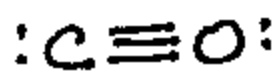
4 pts.  
A: C has 6e<sup>-</sup>  
B: bad formal charges  
C: C has 6e<sup>-</sup>  
D: H isn't acidic



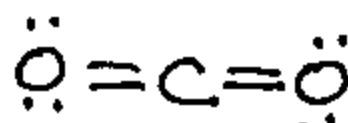
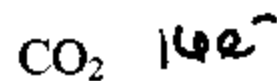
F: C has 10e<sup>-</sup> ;

G: O has 10e<sup>-</sup> ;

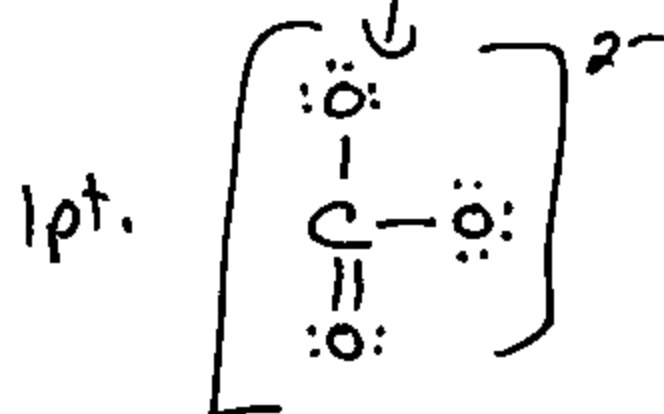
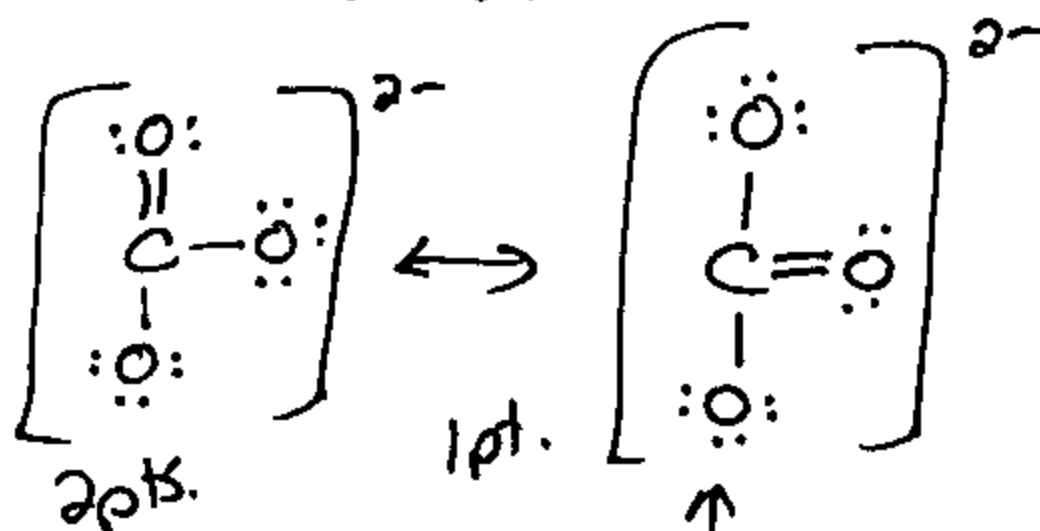
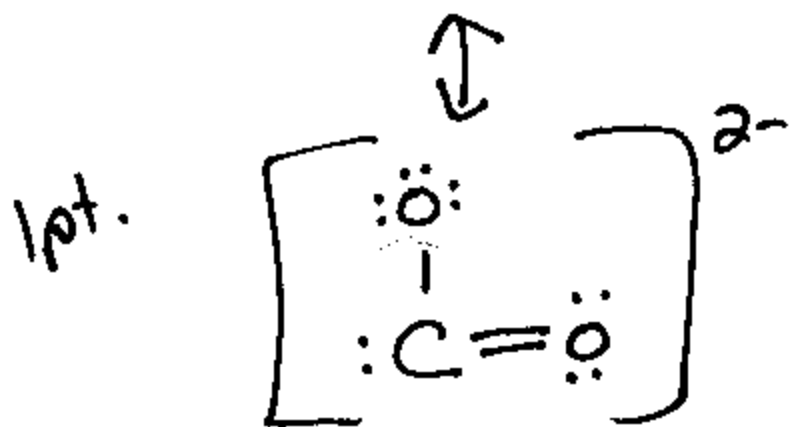
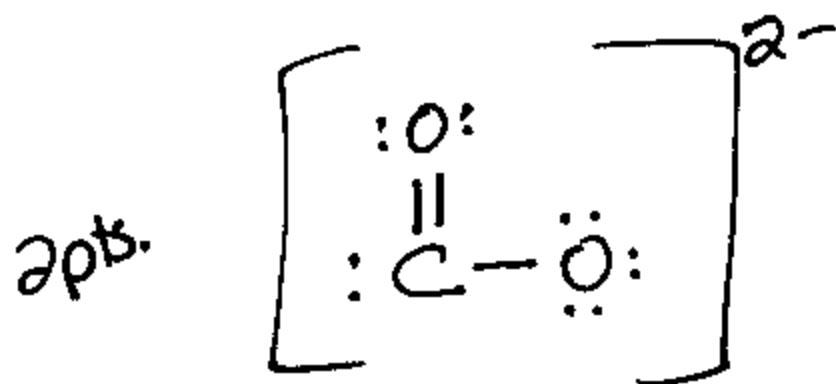
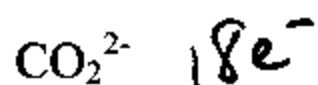
4. Draw the Lewis Dot structures for the following compounds along with ANY AND ALL equivalent resonance structures that they have. (note: not all of the compounds have equivalent resonance structures....only draw equivalent structures if there are any) Then answer the following questions about these compounds.



2pts.



2pts.



What is the C-O bond order in each structure?

$$\frac{3}{CO}$$

$$\frac{2}{CO_2}$$

$$\frac{1\frac{1}{2}}{CO_2^{2-}}$$

$$\frac{1\frac{1}{3}}{CO_3^{2-}}$$

1pt. each

Which compound has the strongest C-O bond?

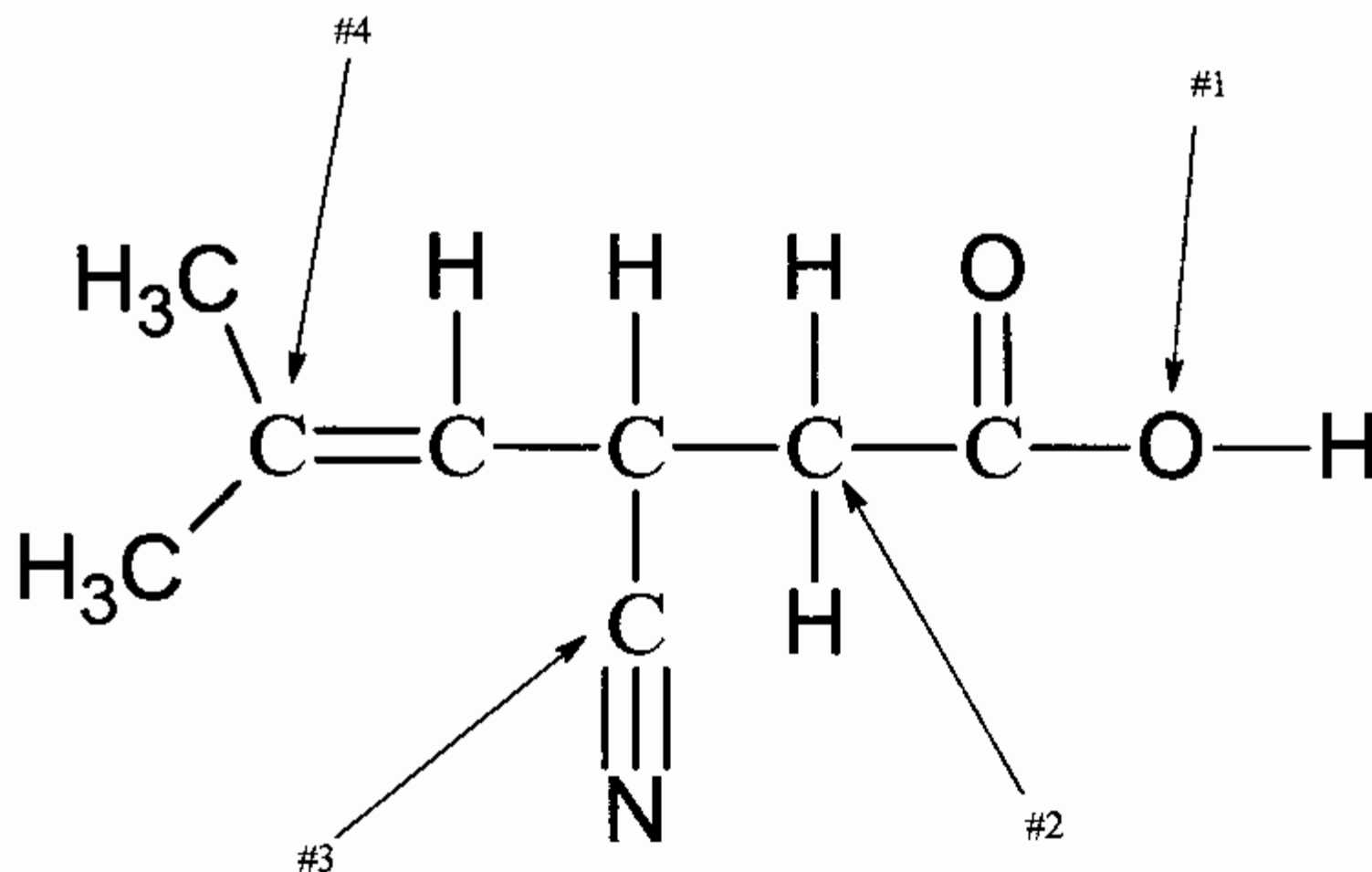


Which compound has the longest C-O bond?



1pt. each

5. For the following compound, give the hybridizations, approximate bond angles, and molecular shape for each of the numbered atoms. **CAUTION:** Not all of the bonds and lone pairs are drawn out in this structure.



	<u>Hybridization</u>	<u>App. Bond Angle</u>	<u>Molecular Shape</u>
#1	$sp^3$	$109.5^\circ$	bent
#2	$sp^3$	$109.5^\circ$	tetrahedral
#3	$sp$	$180^\circ$	linear
#4	$sp^2$	$120^\circ$	trigonal planar

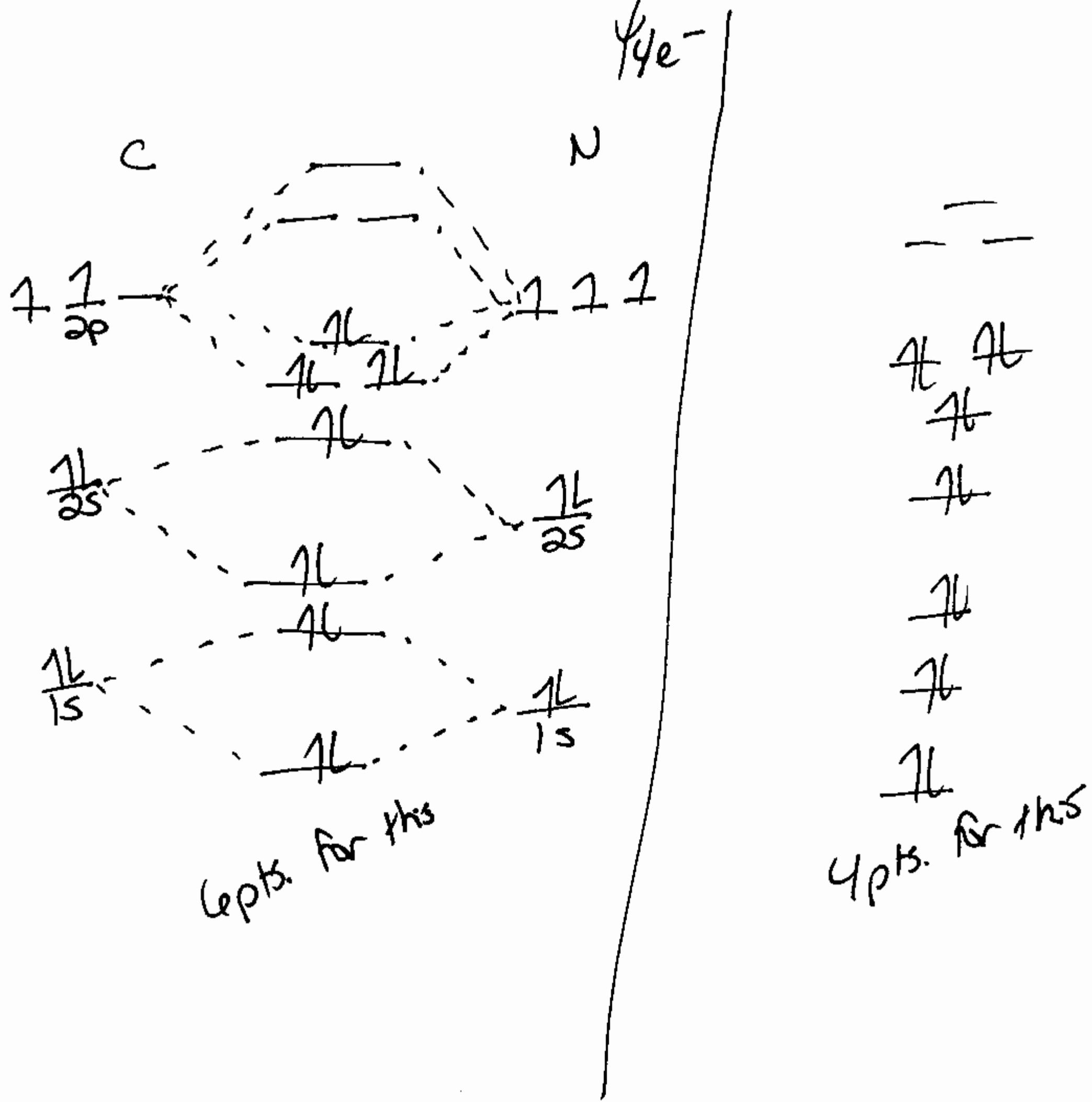
How many total  $\sigma$  bonds are in this structure? 21

How many total  $\pi$  bonds are in this structure? 4

1 pt. each

### Molecular Orbital Diagram

6. Draw the molecular orbital diagram of cyanide, CN<sup>-</sup>. Show all of the electrons, not just the valence electrons. Either p orbital splitting pattern is acceptable.



6 pts. for this

4 pts. for this

What is the bond order of CN<sup>-</sup>?

3

$bo = \frac{1}{2}(10 - 4) = 3$

Is CN<sup>-</sup> paramagnetic or diamagnetic?

diamagnetic

2 pts. each