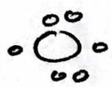
Homework 4 Answerkey

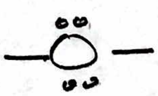
Chapter 4 - 27, 30, 31, 35, 37, 38, 42, 43, 45, 48, 53, 56, 57, 61, 70, 71, 73, 77, 81, 87, 88, 89, 90, 93, 98.

30) How many bonds & lone pairs are typically observed with each element?

a. O group 6A w/ 6 valence e^-

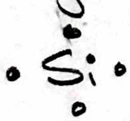


needs $2e^-$ more
each bond brings $1e^-$, thus requires 2 bonds

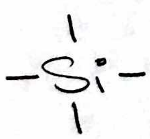


2 bonds, 2 lone pairs

b. Si group 4A w/ 4 valence e^-



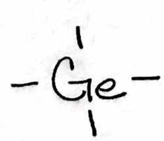
needs $4e^-$ more, thus 4 bonds



4 bonds, no lone pairs

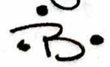
c. Ge group 4A w/ 4 valence e^-

needs $4e^-$ more, thus 4 bonds

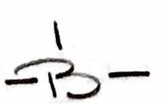


4 bonds, no lone pairs

d. B group 3A w/ 3 valence e^-



odd duck, doesn't make octet easily. usually gets $6e^-$, needing 3 more



3 bonds, no lone pairs

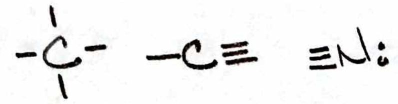
38) Draw a valid Lewis structure for each compound using the given arrangement of atoms.

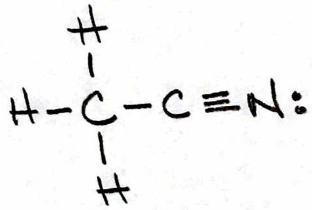
a. C_2H_3N given:

H
H C C N
H

e^- count
C 4×2 = 8
H 1×3 = 3
N 5×1 = 5
16e^-

Relavent patterns:





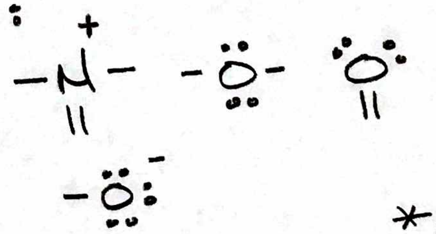
16e^- ✓
octets ✓

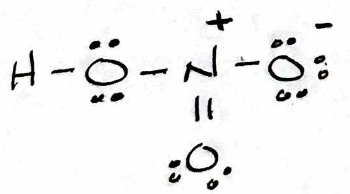
b. HNO_3 given:

H O N O
O

e^- Count
N 5×1 = 5
O 6×3 = 18
H 1×1 = 1
24e^-

Relavent patterns:





24e^- ✓
octets ✓

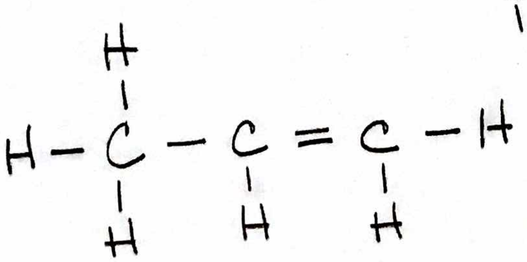
*Hard one. Nitrogen can't go over an octet which limits the possibilities.

c. C_3H_6 given:

H
H C C C H
H H H

e^- count
C 4×3 = 12
H 1×6 = 6
18e^-

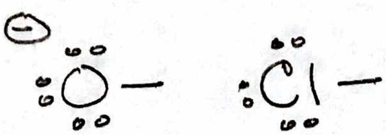
Relavent Patterns:



18e^- ✓
octets ✓

42) Draw a valid Lewis Structure for each ion:

a. OCl^-



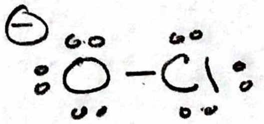
e^- count

O $6 \times 1 = 6$

Cl $7 \times 1 = 7$

(−) Charge $= +1$

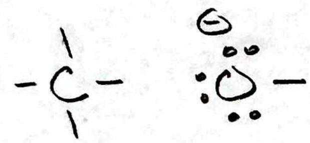
$14e^-$



$14e^-$ ✓

octets ✓

b. CH_3O^-



e^- count

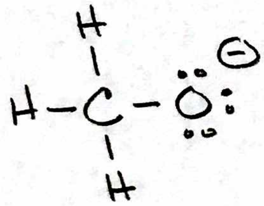
C $4 \times 1 = 4$

H $1 \times 3 = 3$

O $6 \times 1 = 6$

(−) Charge $+1$

$14e^-$

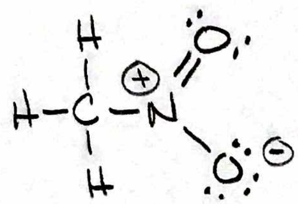


$14e^-$ ✓

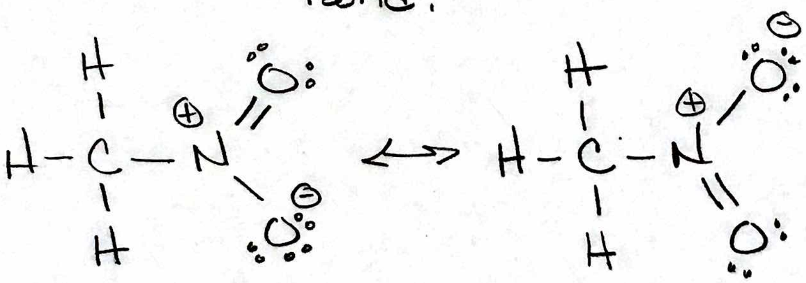
octets ✓

48) Draw a second resonance structure for nitromethane, a compound used in drag racing fuels and in the manufacture of pharmaceuticals, pesticides and fibers.

* We didn't talk about resonance. In essence a resonance structure is a structure with identical atom connectivity, but different orientation of double or tripple bonds.



This is the given structure. There is no reason for the choice of the upper oxygen to have the double bond and the lower to have the single. An equally valid structure could be drawn with the lower oxygen having the double bond.



These two are called resonance structures.

The electrons on the oxygens are said to "resonate" back and forth with the "true" structure being a blending of the two. Resonance is one of those model theories we talked about that explains the nature of matter using a simplified approach.

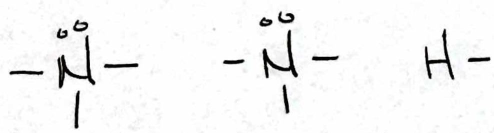
70) Draw a Lewis Structure for N_2H_4 and explain why the shape around each nitrogen atom should be described as trigonal pyramidal.

e^- count

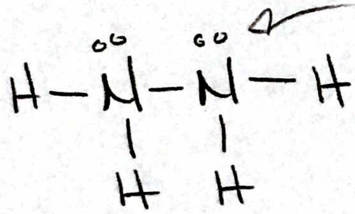
N $5 \times 2 = 10$

H $1 \times 4 = 4$

$14e^-$



Hydrogen can only make one bond, thus the two nitrogens must be bonded together.



Each N is an AX_4E which is the trigonal pyramidal geometry

$14e^-$ ✓

octet ✓

88) Answer the following questions about the molecule OCS.

a. How many valence e^- does OCS contain?

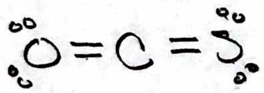
O 6 × 1 = 6
C 4 × 1 = 4
S 6 × 1 = 6

16e^-

b. Draw a valid Lewis Structure.

OCS Assumption → Carbon Central

=C= bonded to 2   O= bonded to one   S= bonded to one



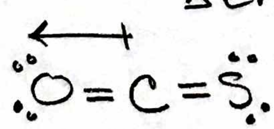
16e^- ✓
octets ✓

c. Label all polar bonds.

O	C	S
3.5	2.5	2.6

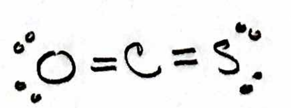
ΔEN O-C = 3.5 - 2.5 = 1.0 polar

ΔEN C-S = 2.6 - 2.5 = 0.1 non-polar



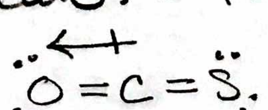
polar

d. what is the shape about the Carbon atom?

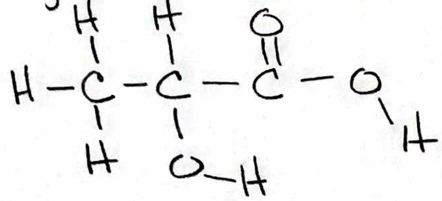


AX_2 → Linear

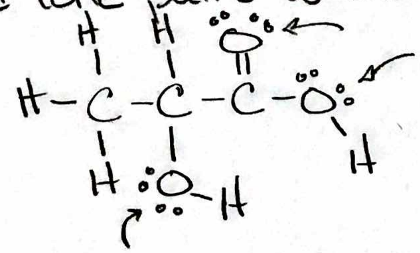
e. Is OCS a polar molecule. Explain

Yes, OCS is polar.  the OCS molecule is not symmetrical about the Carbon and has one polar bond. the molecule is therefor polar.

90) Lactic acid gives sour milk its distinctive taste. Lactic acid is also an ingredient in several skin care products that proportedly smooth fine lines and improve skin texture.

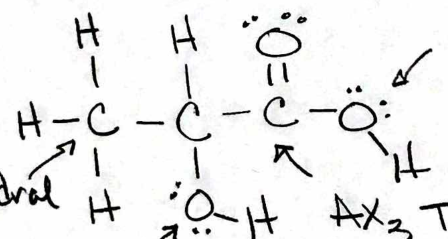


a. Add lone pairs where needed and count valence e^-



C $4 \times 3 = 12$
O $6 \times 3 = 18$
H $6 \times 1 = 6$
$36 e^-$

b. Determine the shape about the 4 indicated atoms.



AX_2E_2 bent 109.5

AX_4 Tetrahedral

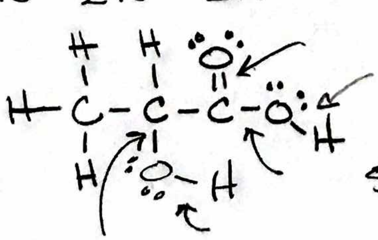
AX_3 Trigonal planar

AX_2E_2 bent 109.5

c. Label all polar bonds

O	C	H
3.5	2.5	2.1

ΔEN C-O 3.5-2.5 = 1.0 polar
C-H 2.5-2.1 = 0.4 non-polar
O-H 3.5-2.1 = 1.4 polar



5 polar bonds.

e. Is Lactic acid polar, Explain.

Yes, Lactic acid is polar. The molecule has many geometries and is not symmetrical. Dipoles do not cancel and the molecule will have a net pole.

98) Although carbon has four bonds in stable molecules, sometimes reactive carbon intermediates that contain carbon atoms without four bonds are formed for very short periods of time. Examples of these unstable intermediates include the methylcarbocation $CH_3^{\oplus}$ and methyl carbanion $CH_3^{\ominus}$. Draw Lewis structures for both unstable ions and predict the shape around carbon.

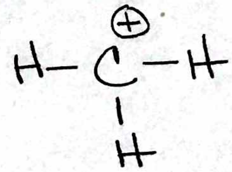
$CH_3^{\oplus}$ Treat no differently than any other polyatomic

$C \; 4 \times 1 = 4$

$H \; 3 \times 1 = 3$

$+$ Charge $\quad -1$

$6e^-$



AX_3 = Trigonal Planar

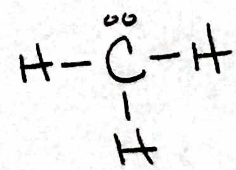
$CH_3^{\ominus}$

$C \; 4 \times 1 = 4$

$H \; 3 \times 1 = 3$

$-$ Charge $\quad 1$

$8e^-$



AX_3E = Trigonal pyramidal