Answer key

Laude's CH301 practice exam 2

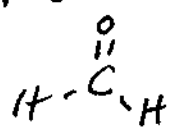
1. Which is the most polar molecule:
a. CH4
b. HBr
c. HF ← The ΔEN for H-F is 1.9 and is largest
d. HCl

2. Which of the following compounds is non-polar:
a. CH3Cl
b. XeF2 ← of form AB_2U_3 which is linear and ∴ nonpolar
c. SO2
d. NH3

3. Which of the following compounds has the largest dipole moment: look for largest ΔEN
a. H20 ← 1.4
b. CO2 ← 1.0 so O-H is largest dipole for bond
c. CH3Br ← .4 + ~.5
d. NF3 ← 1.0

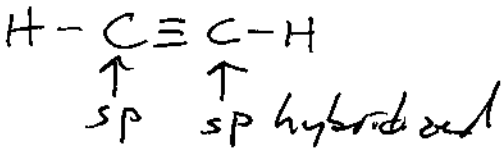
4. The bond angle in HCHO is closest to which angle:
a. 90
b. 109.5
c. 120 ←
d. 117

The Lewis structure is

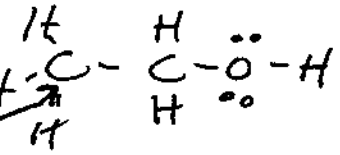


which is 120°

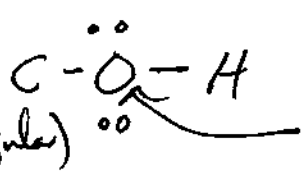
5. In the C2H2 molecule, the sigma bond between carbons is from:
a. sp and sp ←
b. sp and 1s
c. 1s and 1 s
d. sp and 2s



6. What is the electronic geometry around the most left carbon in CH3CH2OH?
a. Trigonal planar
b. Linear
c. Tetrahedral ← 4 e⁻ rich regions
d. Bent
e. T-shape



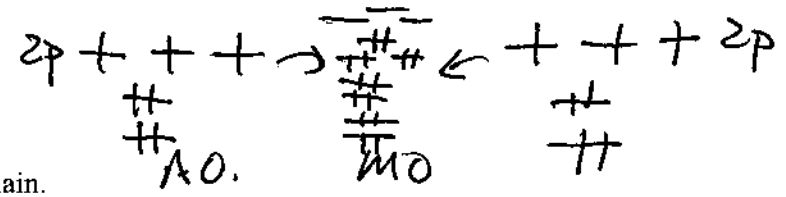
7. What is the molecular geometry of the oxygen atom in the same molecule?
a. Trigonal planar
b. Linear
c. Tetrahedral
d. Bent correct ← (angular)
e. T-shape



O has AB_2U_2 molecular formula

8. The number of sigma and pi bonds in SeO2 is:
a. 2 and 2 ←
b. 4 and 0
c. 0 and 4
d. 2 and 1

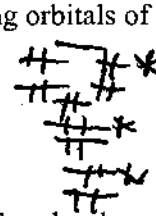
9. In N≡N, the atomic orbitals that comprise the bonding orbitals are
a. 2p orbitals ←
b.2 p and 1s orbitals
c. 2p and 2 s orbitals
d. 2 s and 2 s orbitals



10. True or false. Explain.
In molecular orbital theory, the higher energy of nonbonding electrons cancels out the bonding electrons.

It is the antibonding orbits * ← That cancel ← bonding orbit

11. Using MO, the 2p electrons in the antibonding orbitals of F2 are :
a. 4 electrons in 2 orbitals ←
b. 2 electrons, all in one orbital
c. 2 electrons, each in one orbital
d. 0 electron



12. Using MO, which of these compounds has a bond order of 2:
a. CN-
b. LiC^+
c. NeO^{+2} ← 16e⁻s has b.o. of 2 because like O_2 which has 16e⁻
d. He2

13. Using MO, which of these compounds is paramagnetic:
a. N2
b. LiH
c. NeO
d. NF ← 16e⁻ like O_2 is paramagnetic

14. From the 4 compounds above, rank their bond length accordingly to their bond order.

Shortest bond length → longest bond length

N_2 (b.o. 3) < NF (b.o. 2) < NeO (b.o. 1) < LiH (b.o. 0)

15. Which of these compounds doesn't have delocalized bonds:
a. CO_3^{2-}
b. SO_4^{2-} ← no resonance in simplest structure
c. SO3
d. $NO3^-$

16. Who theorized the ideal gas law that predicts volume change according to temperature change:
a. Boyle
b. Charles ←
c. Van de Waals
d. Dr. Laude when he sat down on a balloon

17. 1.2 moles of atmospheric helium at 273K is compressed into a box of 9 liters. What is the new pressure of this box?

a. .3 atm
b. .5 atm
c. 3 atm ← $P = \frac{nRT}{V} = \frac{(1.2)(.082)(273)}{9} = 3$
d. .9 atm

← This is not an exam. This should have been a changes of state calculation.

18. A box containing 1.1 litters of a mysterious gas has a pressure of 2 atm at 273K and weighs .5 grams. What is the molecular weight of this gas:

a. 5 g/mol ← $5 = MW = \frac{gRT}{PV} = \frac{(.5)(.082)(273)}{(2\,atm)(1.1\,l)}$
b. 10 g/mol
c. 15 g/mol
d. 2.5 g/mol

19. Burning .2 mole of glucose C6H12O6 at 2.5 atm and 137 °C will create a volume of CO2 of:

a. 8 liters
b. 32 liters
c. 24 liters
d. 16 liters ← $V = \frac{nRT}{P} = \frac{(1.2)(.082)(410)}{2.5}$

$C_6H_{12}O_6 + 6\,O_2 \rightarrow 6\,CO_2 + 6\,H_2O$

⇐ solve for $n_{CO_2} = (.2\,mole)\left(\frac{6\,CO_2}{1\,glucose}\right) = 1.2$

20. What is the ratios between the speeds of CH4 and N2 at the same temperature is:

a. 3
b. .8 ←
c. 1.75
d. 1.3

$m_{CH_4} v^2_{CH_4} = m_{N_2} v^2_{N_2}$

$\frac{m_{CH_4}}{m_{N_2}} = \frac{v^2_{N_2}}{v^2_{CH_4}} = \frac{16}{24}$ take $\sqrt{\frac{16}{24}} = \frac{v_{N_2}}{v_{CH_4}} =$

21. Which of these gas are most likely to be ideal at room temperature:

a. Kr
b. H2 ←
c. Ne
d. N2

Since all are nonpolar, assume all of inst. dipole.
H_2 according to a term and b term ← size

22. True or false. Explain your answer:
Gases will not act ideally at high temperature and low pressure.

high temp makes for less sticking
low pressure make for fewer collisions

23. Which of these is not caused by intermolecular forces:

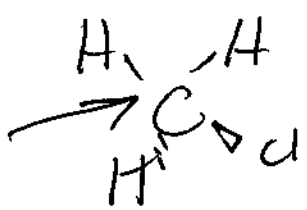
a. Freezing
b. Surface tension
c. Diffusion ← from kinetic molecular theory
d. Viscosity

24. What kind of IMF can CH3Cl molecules have:

a. Hydrogen bonding
b. Hydrogen bonding and dipole-dipole
c. Dipole-dipole and instantaneous dipoles ←
d. Ionic

all compds have inst. dipole plus CH_3Cl is polar and has dipole dipole

H-C is not H bond



25. Which IMF helps increase the boiling point of water and thus creates a friendly environment for life on earth:
a. Hydrogen bonding ←
b. Dipole- dipole
c. Ionic
d. Covalent

26. Boiling point is reached when:
a. Surface tension of the liquid is reduced to 0
b. Bubbles are formed within the liquid
c. Molecules of waters attained enough kinetic to break away from the other liquid neighbors
d. Vapor pressure equals atmospheric pressure ← by definition

27. According to their IMF strength, which one of these has the highest viscosity:
a. H2O
b. HCl
c. NaCl ←
d. Br2

$Br_2 < HCl < H_2O < NaCl$
Inst. Hbnd Hbnd ionic

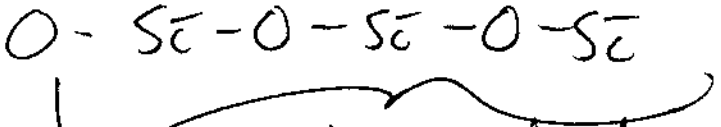
28. According to their IMF strength, which one of these has the lowest freezing point:
a. Br2
b. CO2
c. Ne ←
d. CH3OH

$Ne < CO_2 < Br_2 < CH_3OH$
Inst Inst Inst. Hbnd
Ne has fewest e⁻

29. According to their IMF strength, which one of these in their liquid states has the highest surface tension:
a. SO2
b. XeF2
c. NH3 correct ←
d. CH4

ranking IMF
$CH_4 < XeF_2 < SO_2 < NH_3$
Inst. Inst. dpole Hbnd

30. What kind of solid is SiO2: ← glass
a. Metallic
b. Molecular
c. Ionic
d. Covalent network ←



not a molecule. The intermolecular forces are covalent