Homework - Chapter 1 Chem 2310

Name_____

I. Introduction to Organic Chemistry

1. Explain in your own words what organic chemistry is, and what it is useful for.

2. Why do you think the field of study that you are planning to go into requires organic chemistry?

II. Review of Atomic Structure

3. Fill in the following statements with names of elementary particles.

The nucleus on an atom contains ______ and _____.

Chemical reactions involve an atom's _____.

have a positive charge, _____ have a negative charge, and ______

4. How many kinds of atoms are found naturally in the universe?

5. Using a Periodic Table of Elements, give the following:

atomic number of chlorine _____

atomic number of magnesium _____

element with atomic number = 9 _____

element with atomic number = 13 _____

6. How many protons do each of the following atoms have?

nitrogen _____

bromine _____

boron_	
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sodium _____

sulfur _____

platinum _____

7. Fill in the solid blocks on the partial Periodic Table of Elements below with as many as you can **from memory**. Then fill in the rest using a Periodic Table. Work on memorizing the positions of these 16 elements!



8. Chose the elements from the list below that fit the following descriptions. Fill in all you can from memory, then look at a Periodic Table.

Al, B, Br, C, Cl, Cu, F, H, Hg, I, K, Li, Mg, Mn, N, Na, O, P, S

a) nonmetals in the second period:
b) transition metals:
c) atoms in the halogen family:
d) nonmetals in the third period:
e) atom in the same family as oxygen:
f) atom in the same family as nitrogen:
g) nonmetal in the first period:
h) alkaline earth metals:

9. Circle the atom in each pair which is more electronegative.

a) F or O	b) Br or Cl	c) C or O
d) C or Mg	e) O or N	f) S or O
g) H or O	h) C or Cl	i) C or Li

10. Answer the following questions about nitrogen and oxygen.

Which is more electronegative?

Which is larger?

Which difference is more important, size or electronegativity?

11. Answer the following questions about nitrogen and phosphorus.

Which is more electronegative?

Which is larger?

Which difference is more important, size or electronegativity?

14. Fill in the missing information for the isotopes in the chart below. (Hint: the mass will <u>not</u> be the same as the one given on the Periodic Table!)

	Protons	Neutrons	Mass (amu)	Symbol
a)	6	8		
b)	1		3	
c)				¹⁸ O
d)		17	32	

15. Using a Periodic Table of Elements, give the atomic mass of each of the following elements.

a) _____ nitrogen b) _____ iodine

c) _____ lithium d) _____ osmium

16. How is the atomic mass on the Periodic Table different from the mass of an isotope?

17. Fill in the blanks in the following statements.

- a) Protons have a _____ charge, while electrons have a _____ charge.
- b) A negative ion has more ______ than _____.
- c) A positive ion has more ______ than _____.
- d) If an atom gains three electrons, it will have a charge of _____.
- e) If an atom loses two electrons, it will have a charge of _____.

18. Fill in the following table.

	protons	electrons	charge	symbol
a)	7	8		
b)	16		-2	
c)				K+
d)		78	+2	

19. Fill in the following statements.

a) The ______ energy level is next to the nucleus.

b) The electrons in the outermost energy level of an atom are called the ______ electrons.

20. Give the number of valence electrons for each element. Then draw the dots around the symbol.

a)	С	 b)	0	 c)	Р	
d)	F	 e)	K	 f)	В	
g)	Ν	 h)	Mg	 i)	Br	

21. Why do elements in the same family have similar chemical reactivity?

III. Review of Ionic and Covalent Bonds

- 22. Are the following compounds ionic, covalent, or both?
 - a) Cl_2 d) MgF_2
 - b) CaO c) NH₂Br
 - e) NaCN e) SCl₂

23. Show how the following compounds could be formed from the original atoms using Lewis structures.

a) Cl₂
b) CaO
c) MgF₂
d) NH₃

e) NaCN

24. Circle the structure in each set which is not the same compound as the others.



25. Draw Lewis structures for the following compounds. Make sure that all atoms obey the octet rule and have the correct number of bonds and nonbonding electron pairs.

a) C ₂ H ₆	b) C ₂ H ₄	c) C ₂ H ₂
d) CH ₂ O ₂	e) C ₂ H ₇ N	f) a different compound with the formula C_2H_7N
g) C ₂ H ₅ N	h) HNO ₂	i) C ₂ H ₄ Cl ₂
j) a different compound with the formula $C_2H_4Cl_2$	k) C ₂ H ₄ O ₂	l) a different compound with the formula $C_2H_4O_2$

26. There are 4 different compounds with the formula C_4H_9Cl . Make models for each of them, then draw the Lewis structures of these compounds below.

27. Circle the compound containing the more polar bond, and give a brief explanation for your choice.



28. Draw the partial charges on the C, O, and Li atoms in the molecules below. What is the difference in the polarity between bonds in which carbon is bonded to a metal, and those in which carbon is bonded to a nonmetal?



29. Identify the polar bonds involving carbon in each of the following compounds by marking the δ + and δ - charges or drawing the correct arrow. (Disregard C-H bonds in this case.)



30. Circle the strongest, shortest bond in each of the following pairs. Give a brief phrase explaining why in each case.

a) C-O C-S b) C-O C=O c) N-N O-O

d) C=N $C\equiv N$ e |-| C|-C| f C-N C-P

31. In each set, chose the reaction that is most likely, and give a brief explanation.



32. Using molecular models, build the following compounds. Then label each C, O, or N with the correct geometry (unless it is on the end). Redraw the structure with correct bond angles (tetrahedral angles will have to be flattened in order to draw them on a page).



33. Circle the species in each pair which you would expect to be <u>more reactive</u>. Then give a brief explanation.



34. In the molecules below, write a + or a - beside each atom which has a charge.



35. Give the geometry of the C, N and O atoms in the following molecules.

a)
$$H = H = H = H$$

 $H = H = H = H$
b) $H = C = -H = H$
 $H = H = H$
b) $H = C = -H = H$
 $H = H = H$
 $H =$

36. Indicate which of the following pairs are resonance structures and which are different molecules and why. Draw brackets and a resonance arrow for the resonance structures, and equilibrium arrows for the equilibria.





37. Draw in the other resonance structures for the following compounds. The arrows give hints as to where the electrons are spread out. Indicate whether the structures are equal resonance contributors or, if not, which is greatest contributor.



38. Give the electron configuration for the following atoms:

a) F

b) S

c) B

39. Explain the difference between the following:

a) an atomic orbital and a molecular orbital

b) an unhybridized orbital and a hybridized orbital

40. What kind of molecular orbital will be formed when the following are joined together?

- a) s + s c) $s + sp^{3}$ e) $sp + sp^{3}$
- b) p + p d) $sp^2 + sp^2$ f) sp + p

41. Label each bond in the compounds below as σ or π .



42. List the hybridized orbitals for each of the hybridization types given below. Indicate the shape made by the hybridized orbitals.



43. Will the following things require a <u>hybrid orbital</u> (sp³, sp², or sp) or an <u>unhybridized orbital</u> (p)?

a) single bond	e) 2nd bond in a double bond
b) electron pair	f) 1st bond in a triple bond
c) empty orbital	g) 2nd bond in a triple bond
d) 1st bond in a double bond	h) 3rd bond in a triple bond

44. Give the hybridization of each C, N, or O atom in the molecules below.

a)
$$H = \begin{bmatrix} H & H \\ I & I \\ -C = C - H \\ I & I \\ H & H \end{bmatrix}$$

b) $H = \begin{bmatrix} H \\ -C = & \vdots \\ -H \\ H \end{bmatrix}$

c)
$$\begin{array}{c} H & H & H \\ C = C & C - H \\ H & H \end{array}$$
 d) $\begin{array}{c} H & C = C \\ H & C \end{array}$

e)
$$H = \begin{bmatrix} 0 \\ H \\ H \\ H \\ H \end{bmatrix}$$
 $H = \begin{bmatrix} 0 \\ H \\ H \end{bmatrix}$ $H = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$ $H = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$ $H = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$ $H = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$ $H = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$ $H = \begin{bmatrix}$



45. What geometries can an atom with each of the following hybridizations have?

- a) sp³
- b) sp^2

c) sp

46. Draw a Lewis structure for each compound. Then fill in the dotted boxes with the correct names of the atomic orbitals and molecular orbitals needed.





47. Label the atomic orbitals that contributed to each bond in the compound below.



example: a) $\sigma = s + sp^3$

- b)
- c)
- d)
- e)
- f)
- g)
- h)
- i)
- j)
- k)
- 1)
- m)

48. Circle the correct word or phrase in each statement.

a) A neutral nitrogen atom has (three, four) bonds and (one, two) electron pairs.

b) A negatively charged oxygen atom has (three bonds, one electron pair / one bond, three electron pairs).

c) Charged molecules are generally (more, less) reactive than neutral molecules.

d) Compounds which have resonance structures are (more, less) stable than those that don't.

e) A resonance structure with a negative charge on an oxygen atom will contribute (more, less) to the actual structure than one with a negative charge on a nitrogen atom.

f) An atom with three sigma bonds and one lone pair has a trigonal (planar, pyramidal) shape.

g) An atom which is part of a triple bond has (sp², sp) hybridization.

h) A carbocation has (tetrahedral, trigonal planar) geometry.

i) Carbon is partially (positive, negative) when bonded to lithium.

j) A C-O bond is (more, less) polar than a C=O bond.

k) A C-Br bond is (stronger, weaker) than a C-I bond.

l) A compound with the formula C_3H_7Cl has (ionic, covalent) bonds.

m) An atom with 35 protons and 37 electrons is (positively, negatively) charged.

n) (Phosphorus, Sulfur) has six valence electrons.

o) Nitrogen is (more, less) electronegative than oxygen.

p) The mass of an atom with 8 protons, 9 neutrons, and 7 electrons is (15, 16, 17, 24).

q) An atom with two double bonds has (sp, sp^2, sp^3) hybridization.

r) An atom with tetrahedral geometry has (one, two, three, four) sigma bonds.