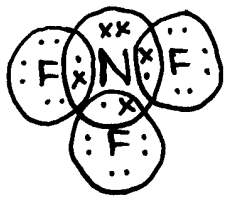
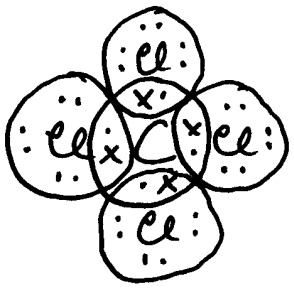
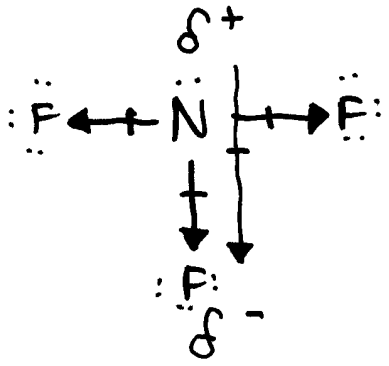
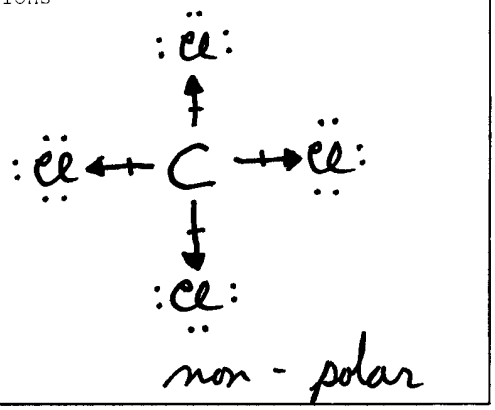
Name: _____

SCH 3U - Physical Properties Test

1. For the discrete covalent molecules: NF_3 and CCl_3 draw:
a) a good lewis dot diagram
b) a good stick structure diagram
c) add appropriate bond polarizations to the stick structure diagram
d) determine net molecular polarization

NF_3	CCl_4
lewis dot diagram 	lewis dot diagram 
stick structure with bond and molecular polarizations 	stick structure with bond and molecular polarizations 

2 For the above two discrete covalent molecules, which compound would have a higher melting or boiling point and why?

- the NH_3 would have the higher melting point because it is a polar molecule, while CCl_4 is non-polar.
- the polar molecule will have stronger intermolecular force due to interactions between region of δ^+ and δ^- charge as shown in the above diagram
- stronger forces of attraction, higher m.p. and b.p.

3. For each of the following compounds, place them in the correct location in the table provided. Some compounds may require a considerable amount of rough work to fully determine their best location in the table.

Sn	H_2O	SiF_4	KI	C_n (diamond)
$MgCl_2$	HCl	Ag	CO_2	C_5H_{12}
NCl_3	N_2	I_2	NH_3	SiO_2 (quartz)

<table>
<tr><th>Ionic</th><th colspan="3">Covalent</th><th>Metallic</th></tr>
<tr><td rowspan="3">$MgCl_2$
KI</td><td>Network</td><td colspan="2">Discrete Molecules</td><td rowspan="3">Sn
Ag</td></tr>
<tr><td rowspan="2">C_n
SiO_2</td><td>Non-polar</td><td>Polar</td></tr>
<tr><td>NCl_3
N_2
SiF_4
I_2
CO_2
C_5H_{12}</td><td>H_2O
HCl
NH_3</td></tr>
</table>

4. For the four substances listed, state the conductivity behaviour for each. If conductivity occurs include the full and correct identity of charge carriers:

(s) ➜ solid state
(l) ➜ liquid
(g) ➜ gas
(aq) ➜ aqueous solution - solution in water

NaCl(s)	non-conductive, no free moving charged particles, ions are locked in place in the lattice structure, electrons are confined to individual ions
NaCl(aq)	moderate conductivity, free moving Na^{1+} and Cl^{1-} ions conduct the charge, ions have been freed from the lattice structure through the dissolving process
Fe(s)	excellent conductivity, free moving electrons that wander through the empty valence shells of the iron atoms allow for excellent conductivity
C_n(s)	non-conductive, no free moving charge particles, carbon atoms are neutral and electrons are locked into the covalent bonding network

5. Will NaCl(s) dissolve well in hexane? Hexane has the chemical formula $C_6H_{14}(l)$. Why or why not?

NO - these two substance are not alike, hexane is a non-polar solvent and NaCl is ionic (i.e. the ultimate of polar!) - replacement forces are not sufficient

6. Will NaCl(s) dissolve well in water? Why or why not?

YES the Na^{1+} and Cl^{1-} ions can interact well with the regions of δ^+ and δ^- charge on the water molecules such that the water molecules hydrate the ions in solution, the hydration is the replacement force

hydration energy > lattice energy

7. What is the underlying basis for crystallinity? Answer this question with consideration for the structure at the atomic level. What is a good example of a crystalline substance that contains only covalent bonds?

crystalline substances have ions, atoms or molecules arranged in a regularly repeating arrangement known as a crystal lattice, the arrangement at the atomic level gives the macroscopic property of crystallinity, diamond is a good example of a covalent network crystal

8. What is an empirical formula? What classification of compounds (see the headings in question #3) have only empirical formula?

empirical formula = simplest ration of atoms present in a compound

ionic, metallic and covalent network solids have only empirical formula (they are all macromolecules)

9. What is a molecular formula? Give a **clear** example. What class of compounds can have a molecular formula.

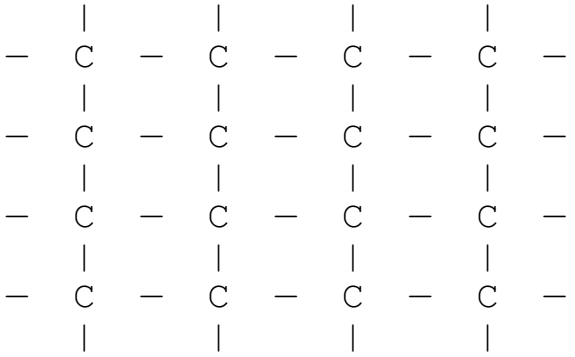
molecular formula = exact number of atoms found in a discrete covalent molecule, eg $C_6H_{12}O_6$

10. Match each definition with the word that it best defines.

g	sharing of electrons satisfies the octet rule	a)	discrete covalent molecules
f	forces that exist within a molecule	b)	difference in electronegativity
l	occurs when bond polarizations are present and molecule geometry in not symmetrical	c)	intermolecular
b	can be used to determine bond type or bond polarity	d)	macromolecule
i	electron transfer forms ions that follow the octet rule	e)	lattice energy
c	forces of attraction the exist between discrete covalent molecules	f)	intramolecular
a	molecules with a small and precise number of atoms	g)	covalent bond
e	a type of energy that is associated with an ionic crystal	h)	hyration energy
m	property of a metal that means it is bendable	i)	ionic bond
h	a type of energy that is associated with the interaction between ions and water molecules in an aqueous solution	j)	metallic bonding
d	large and unspecified number of atoms or ions form a high melting point substance	k)	cleavage
k	a property where by a substance can fracture along planes within a lattice arrangement to form flat surfaces	l)	net molecular polarization
j	makes possible free moving electrons	m)	malleable

11. With the aid of good well labeled diagrams, explain why diamond has a "melting point" near 4000 °C while water has a melting point of a mere 0 °C and yet the bonds between H and O in water are 33% stronger than the bonds between C and C in diamond. Use the terminology that has been introduced in this course where appropriate.

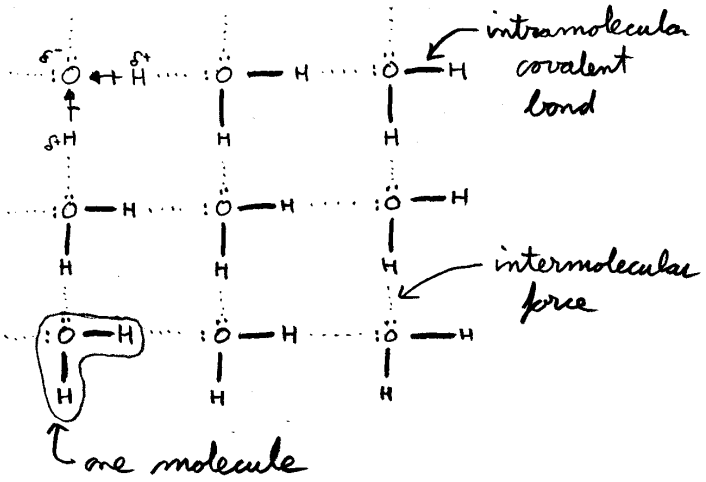
Diamond:



- all bonds are covalent intramolecular forces which must be overcome in order to melt diamond (i.e. make small enough particles to become a liquid)

- this force is very strong and therefore requires a lot of heat (i.e. high temperature)

Water:



- only the week intermolecular force between water molecules must be overcome to melt (i.e. water molecules are the small units)

- the covalent bond is not affected (and therefore being stronger than in diamond is of no consequence)