/130 = %

Name:_____

SCH 4U Unit Test
Forces and Molecular Properties

1. Fill in each table as done on the assignment. Including the oxidation state of the central atom:

XeF_2	total # of e^- pairs	
	σ bonding pairs	
	lone pairs	
	π bonding pairs	
	base shape	
	actual shape	
oxidation state of Xe	approx. bond angles	

/8

NO_3^{1-}	total # of e^- pairs	
	σ bonding pairs	
	lone pairs	
	π bonding pairs	
	base shape	
	actual shape	
oxidation state of N	approx. bond angles	

/8

PO_4^{3-}	total # of e^- pairs	
	σ bonding pairs	
	lone pairs	
	π bonding pairs	
	base shape	
	actual shape	
oxidation state of P	approx. bond angles	

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2. Classify each of the following formula according to type of forces by placing each formula in the correct place in the table:

- C_n (diamond)
- Fe (iron)
- LiF (lithium fluoride)
- K_2SO_4 (potassiu sulphate)
- CO_2 (carbon dioxide)
- C_3H_8 (propane)
- CH_3COCH_3 (acetone)
- H_2O (water)
- $Fe_{0.95}Ni_{0.05}$
- Br_2
- $C_2H_5OC_2H_5$ (ether)
- C_3H_7OH (isopropyl alcohol)
- NH_3 (ammonia)
- NH_4NO_3 (ammonium nitrate)
- CH_3COOH (acetic acid)
- Si (silicon) (b.p. = 3538 K)
- PH_3 (phosphorus trihydride)
- SiO_2 (quartz)
- C_6H_6 (benzene)
- O_2 (oxygen)

Ionic Crystals (including crystals containing polyatomic ions)	Covalently Bonded Compounds				Metallic Crystals
	Covalent Network Crystals	Discrete Covalent Molecules			
		van der Waal (intermolecular force)	dipole inter-action (intermolecular force)	hydrogen bond (intermolecular force)	

/20

3. For each pair of compounds, circle the one with the higher melting and/or boiling point. In the space provided give the rational for your choice. Including precise reference to the attractive forces that must be overcome to melt or boil each compound as well as any other forces that may be present and why this leads to the choice you have made. Be specific as to whether the forces that must be overcome are intramolecular or intermolecular. Include any additional relevant information that has helped your choice. Use point form.

a) HF vs HCl

/4

b) SiO_2 vs SiF_4

/4

c) H_2CCl_2 vs CF_4

/4

d) Mg vs Al

/4

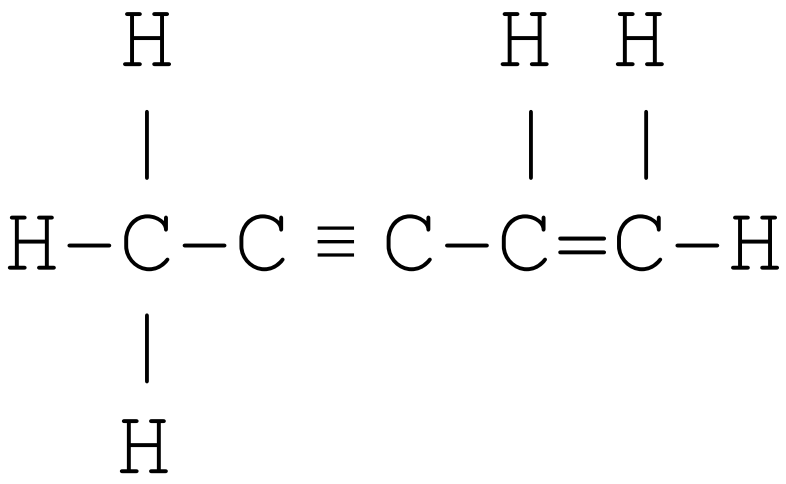
4. Match each description with the term it best describes.

/16

_____	always present between molecules within liquids or solids composed of discrete covalent molecules	a) ionic bonding
_____	most diverse and specific type of bonding, well studied and complex	b) dipole interactions
_____	occupies the lattice points in ammonium nitrate (NH_4NO_3)	c) anisotropic
_____	property that is used when determining bond type or bond polarization possibilities	d) metallic bonding
_____	requires hard charge polarization and lone pair interaction with N, O or F	e) alloy
_____	sp, sp^2, sp^3 are examples of	f) covalent network crystal
_____	a solid that has molecules as the lattice points	g) sigma
_____	an adjective that describes a physical property that has a directional characteristic	h) van der Waal force
_____	creates macromolecules that may be soluble in water	i) electronegativity
_____	type of bond that has little effect on shape	j) hydrogen bond
_____	non-conductive in any state, insoluble in all solvents	k) pi
_____	a solid that can have variable composition, a solid solution	l) covalent bonding
_____	forms the core (cental bond) of double and triple bonds	m) polyatomic ions
_____	present when bond polarizations and geometry make possible regions of partial positive and partial negative charge	n) molecular solid
_____	produces strong yet flexible bonds	o) hybridized atomic orbitals

/15

5. For the given structure identify all bonds as either sigma (σ) or pi (π).



/3

6. In the above diagram label the carbons that are sp^3, sp^2 and sp with respect to hybridization (tetrahedral, trigonal planar or linear) /3

7. Describe a two-dimensional covalent network solid of your choice (as if there is a choice). A diagram would be most helpful to fully explain all types of attractive forces present in the solid. What is special about the π electrons in your solid. Why are words such as intramolecular and intermolecular at times somewhat limited?

/9

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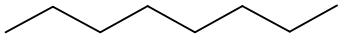
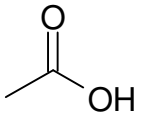
8. Given the following structures and information:

	M.P.	B.P.
	−57 °C	126 °C
	−17 °C	118 °C

a) what class of compounds (ionic, covalent network, discrete covalent molecules, or metallic) do these substance belong to?

/1

b) what are <u>ALL</u> of the intermolecular forces present in the first compound (octane) in order of decreasing strength

/1

c) what are <u>ALL</u> of the intermolecular forces present in the second compound (acetic acid) in order of decreasing strength

/2

d) offer a good explanation as to why the trend in melting point is reversed for these two compounds

/2

/6

8. Draw a good two-dimensional representation of the three-dimensional structure of diamond, label all forces and classify according intra/ inter etc. What occupies the lattice points? What type of solid is this called.

/6

9. Repeat all parts of question #8 for ice (i.e. the solid form of H_2O)

/8

10. Repeat all parts of question #8 for ammonium nitrate ($NH_4NO_3(s)$).

/8

/22

11. Explain with clear reference to charge carriers why

a) all metals conduct electricity

/1

b) all ionic solids are insulators (do not conduct)

/1

c) all aqueous solutions of made from ionic solids have some level of conductivity

/1

d) all non-polar liquids are non-conductive

/1

12. When a solution is formed, the solute is divided up into small particles that interact favourably with the solvent particles. Use the table provided to indicate the exact identity of the solute particles in each situation. Include charges if present. If the given combination is not soluble, indicate this in the instead.

SOLUTE	SOLVENT	SMALLEST UNITS OF SOLUTE
NaCl	water	
$AlBr_3$	water	
Au	water	
$(NH_4)_2SO_4$	water	
C_2H_5OH (ethyl alcohol)	water	
C_8H_{18} (octane)	water	
C_8H_{18} (octane)	hexane (C_6H_{14})	
Au	Hg	

/8

/12