

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:

$SF_4$	total # of $e^-$ pairs	
	$\sigma$ bonding pairs	
	lone pairs	
	$\pi$ bonding pairs	
	base shape	
	actual shape	
oxidation state of S	approx. bond angles	

$NO_3^{1-}$	total # of $e^-$ pairs	
	$\sigma$ bonding pairs	
	lone pairs	
	$\pi$ bonding pairs	
	base shape	
	actual shape	
oxidation state of N	approx. bond angles	

$H_3O^{1+}$	total # of $e^-$ pairs	
	$\sigma$ bonding pairs	
	lone pairs	
	$\pi$ bonding pairs	
	base shape	
	actual shape	
oxidation state of O	approx. bond angles	

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)
- $K_2SO_4$  (potassium 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)

3. For each pair of compounds, circle the one with the higher melting and/or boiling point. In the space provided give the rationale 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.

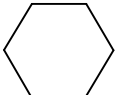

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a)  $\text{NH}_3$  vs  $\text{CH}_4$

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b) Al vs Mg

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c)  vs  (melting point only)

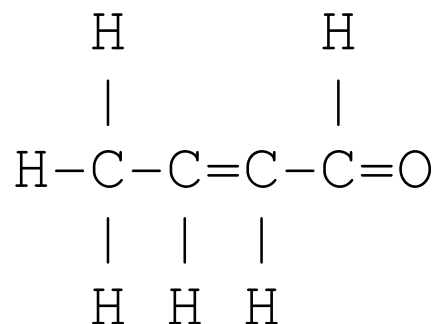
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d)  $\text{H}_5\text{C}_2\text{OC}_2\text{H}_5$  vs  $\text{C}_5\text{H}_{10}$

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

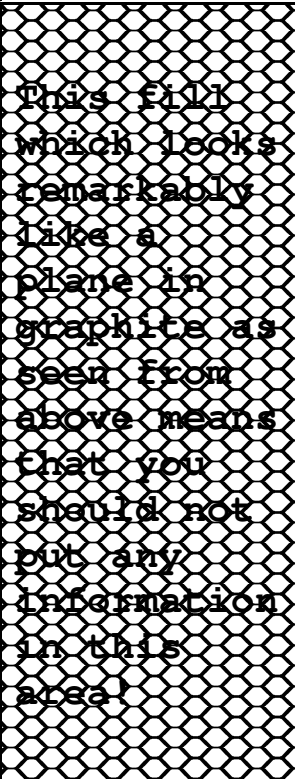
_____	always present between molecules within liquids or solids composed of discrete covalent molecules	a) ionic bonding
_____	most diverse and specific type of bonding, well studied and complex	b) dipole interactions
_____	occupies the lattice points in ammonium nitrate ( $\text{NH}_4\text{NO}_3$ )	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 (central 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

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

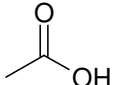


6. Why does the  $sp^3$  hybridization process always produce four  $sp^3$  hybrid orbitals. What base (or actual) shape is made possible by  $sp^3$  hybridization?
7. Describe in detail the structure of graphite (all forces and perhaps diagrams). Include information about the special type of conductivity observed in graphite. What key words can be used to help explain the conductivity in graphite.

8. Fill in the following table to show all attractive force present in the given state as well as the classification of the force (i.e intramolecular - covalent, intermolecular - v.d.w.). If the force does not classify as intra or intermolecular, describe sufficiently. Please note that the forces involved may change with state!!

	solid	liquid	gas
diamond ( $C_n$ )		 <p>This fill which looks remarkably like a plane in graphite as seen from above means that you should not put any information in this area!</p>	
$NH_4NO_3$			
quartz ( $(SiO_2)_n$ )			
carbon dioxide ( $CO_2$ )			
water ( $H_2O$ )			
methane ( $CH_4$ )			
iron (Fe)			

9. What are the charge carriers in each of the following conductive substances. Be precise! Write N.A. if conductivity would be absent.

any metal in solid state	
solution of sodium chloride (NaCl)	
solution of ammonium nitrate ( $\text{NH}_4\text{NO}_3$ )	
solution of acetic acid 	
quartz	

10. What are the smallest units of solute in each of the following solutions? Be precise! If the given combination will not form a solution, write N.A.

wax ( $\text{C}_{50}\text{H}_{102}$ ) dissolved in hexane ( $\text{C}_6\text{H}_{14}$ )	
wax ( $\text{C}_{50}\text{H}_{102}$ ) dissolved in water ( $\text{H}_2\text{O}$ )	
NaCl dissolved in hexane ( $\text{C}_6\text{H}_{14}$ )	
NaCl dissolved in water ( $\text{H}_2\text{O}$ )	
$(\text{NH}_4)_2\text{CO}_3$ dissolved in water ( $\text{H}_2\text{O}$ )	
Au dissolved in mercury (Hg)	
P(s) dissolved in carbon disulphide ( $\text{CS}_2$ )	