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:

| | | |
|---|---|---|
| $NO_2^{1-}$ | total # of $e^-$ pairs | |
| | σ bonding pairs | |
| | lone pairs | |
| | π bonding pairs | |
| | base shape | |
| | actual shape | |
| oxidation state of N | approx. bond angles | |

| | | |
|---|---|---|
| $PCl_5$ | total # of $e^-$ pairs | |
| | σ bonding pairs | |
| | lone pairs | |
| | π bonding pairs | |
| | base shape | |
| | actual shape | |
| oxidation state of P | approx. bond angles | |

| | | |
|---|---|---|
| $H_3O^{1+}$ | total # of $e^-$ pairs | |
| | σ bonding pairs | |
| | lone pairs | |
| | π 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:

- $H_2O$ (water)
- $SF_6$ (sulphur(IV) fluroide)
- Fe (silver)
- $CH_3COOH$ (acetic acid)
- LiCl (potassium iodide)
- $C_5H_{10}$ (1-pentene)
- $H_2CCl_2$ (dichloromethane)
- $C_n$ (diamond)
- $C_3H_7OH$ (isopropyl alcohol)
- $Cs_2S$ (cesium sulphide)
- $C_6H_3(CH_3)_3$ (mesitylene)
- $CO_2$ (carbon dioxide)
- $SiO_2$ (quartz)
- $NH_4Cl$ (ammonium chloride)
- HCl (hydrogen chloride)
- $Cu_{0.85}Zn_{0.10}Sn_{0.05}$ (brass)
- $Al(NO_3)_3$ (aluminum nitrate)
- $PCl_3$ (phosphorus trichloride)
- $CF_4$ (carbon tetrafluoride)
- $C_4H_8O$ (THF, an ether)

| 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 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.

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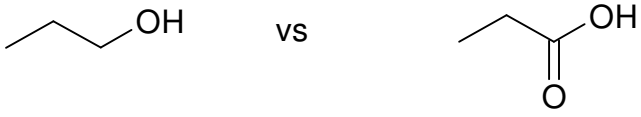
a) 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b) Ca vs K

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c) $H_2O$ vs $H_2Se$

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d) (melting point only)

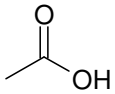
4. Both water and diamond contain covalent bonds. The covalent bond in water has an approximate bond strength of 464 kJ/mol while the single carbon carbon bonds in diamond are approximately 347 kJ/mol. Does this mean that diamond will have a lower melting point in comparison to water. Explain FULLY with reference to attractive forces, diagrams etc. By the way, this is an open ended question.

5. 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 ($C_n$) | | This cell which looks remarkably like a plane in graphite as seen from above means that you should not put any information in this area! | |
| graphite ($C_n$) | | | |
| quartz ($(SiO_2)_n$) | | | |
| carbon dioxide ($CO_2$) | | | |
| water ($H_2O$) | | | |
| methane ($CH_4$) | | | |
| iron (Fe) | | | |

6. Describe anisotropic conductivity. Give and example that you can support with diagrams.

7. What are the charge carriers in each of the following conductive substances. Be precise!

| | |
|---|---|
| any metal in solid state | |
| solution of sodium chloride ($NaCl$) | |
| solution of ammonium nitrate ($NH_4NO_3$) | |
| solution of acetic acid  | |
| quartz | |



8. What are the smallest units of solute in each of the following solutions:

| | |
|---|---|
| wax ($C_{50}H_{102}$) dissolved in hexane ($C_6H_{14}$) | |
| wax ($C_{50}H_{102}$) dissolved in water ($H_2O$) | |
| NaCl dissolved in hexane ($C_6H_{14}$) | |
| NaCl dissolved in water ($H_2O$) | |
| $(NH_4)_2CO_3$ dissolved in water ($H_2O$) | |
| Au dissolved in mercury ($Hg$) | |
| P(s) dissolved in carbon disulphide ($CS_2$) | |