Name: ANSWERS

Date: _____

BCI SCIENCE

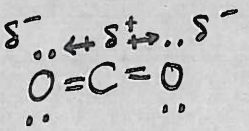
SCH 4U

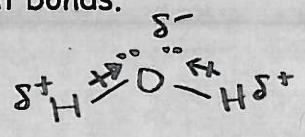
Intermolecular Forces
Reading Assignment

Read pages 238-247

1. With use of a diagram, explain why carbon dioxide is not a polar molecule but water is a polar molecule even though they both have polar covalent bonds.

ΔEN
O 3.44
C 2.55
0.89

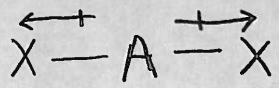
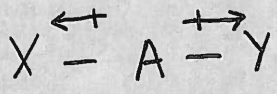
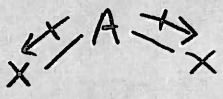
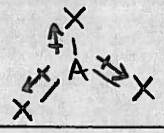
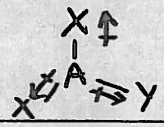
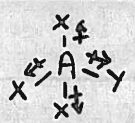




ΔEN
O 3.44
H 2.20
1.24

- dipole moments are equal but opposite in direction due to linear structure and ∴ cancel one another in CO_2 thus CO_2 is a non-polar molecule with polar bonds
- dipole moments do not cancel in H_2O due to the bent structure and thus it is a polar molecule.

2. Copy Table 4.7: Molecular Shapes and Polarities.

Molecule Shape	Polarity of Bond	Molecular Polarity
Linear		non-polar
Linear		polar
Bent		polar
Trigonal Planar		non-polar
Trigonal Planar		polar
Tetrahedral		non-polar
Tetrahedral		polar
Trigonal pyramidal		polar

3. Identify the difference between ***INTRA*MOLECULAR** and ***INTER*MOLECULAR** forces.

Intra: are bonds between atoms that form compounds/molecu

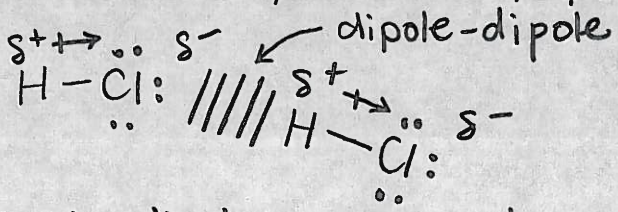
Inter: are attractive forces between compounds/molecules

4. Complete the following T-chart, by classifing the following forces as either **intramolecular** or **intermolecular**: dipole-dipole, dipole-induced dipole, dispersion, electrostatic, hydrogen bonding, ion-dipole, ion-induced dipole, metallic, non-polar covalent, polar covalent, pure covalent

INTRA	INTER
electrostatic	dipole-dipole
metallic	dipole-induced dipole
non-polar covalent	dispersion
polar covalent	hydrogen bonding
pure covalent	ion-dipole
	ion-induced dipole

5. With reference to a solution of hydrochloric acid, explain what a dipole-dipole force is.

	ΔEN
Cl	3.16
H	2.20
	0.96



dipole-dipole is an intermolecular force between two polar molecules caused by attraction of δ+ of one polar molecule and a δ− of another polar molecule

6. How is it possible that dipole forces could differ in strength?

The greater the ΔEN the greater the difference between δ+ and δ−. The greater the ΔEN the stronger the attractive forces possible.

7. Explain what hydrogen bonding is.

H-bonding is the strongest of the intermolecular dipole-dipole forces. It occurs only when there is an H-F, H-O, H-N polar covalent bonds present between both molecules.

8. H-bonds occur when one of three specific intramolecular, polar covalent bonds are present. Rank the following strengths of H-bonds from strongest to weakest and explain your ranking.

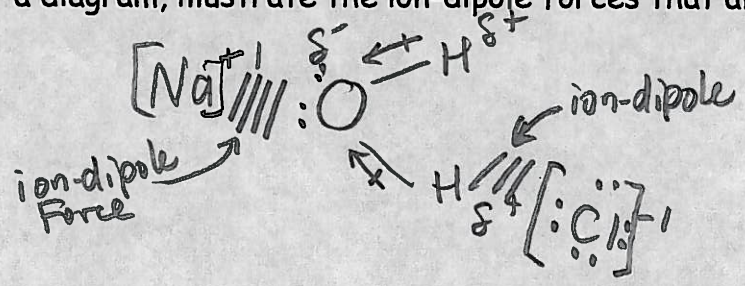
H-F > H-O > H-N

ΔEN	ΔEN	ΔEN
F 3.98	O 3.44	N 3.04
H 2.20	H 2.20	H 2.20
1.78	1.24	0.84

*H-F is strongest H-bond b/c it has largest ΔEN = most polar-covalent bond. The more polar, the stronger the attraction between H & F

*H-O is middle b/c its' ΔEN is middle value ∴ it is medium ranked polar-covalent bond. A decrease in bond polarity reduces H and O attraction. *H-N is lowest strength b/c ΔEN is lowest which leads to least amount of attractive forces.

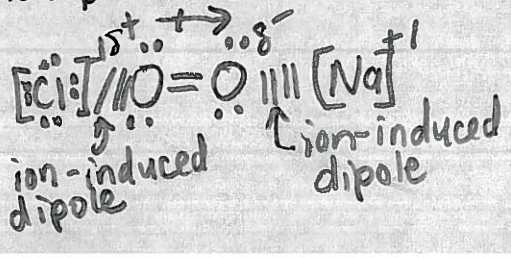
9. With use of a diagram, illustrate the ion-dipole forces that allow salt, NaCl, to dissolve in water.



10. Differentiate between dipole-induced dipole and ion-induced dipole forces and identify, with use of a diagram, which force applies when oxygen gas dissolves in a sodium chloride solution compared to a solution of hydrobromic acid.

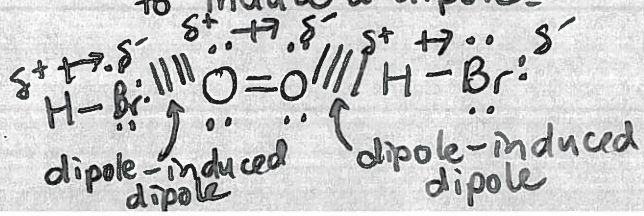
ion-induced dipole

ion causes e⁻ movement in non-polar molecule to "induce" a dipole



dipole-induced dipole

polar molecule (dipole) cause e⁻ movement in a non-polar molecule to induce a dipole.



11. What are dispersion forces?

weak intermolecular forces between <u>all</u> molecules, due to temporary dipoles resulting from the movement of e^-

12. Answer questions #8, 11, 13, 14

8. conductivity: polar molecule conducts e^- slightly
solubility: polar molecule is soluble in water
melting point: polar molecule has stronger intermolecular forces ∴ it will have ↑ melting point.

11. a) $Ne_{(g)}$ - dispersion: no polarities
b) $H_2O_{(l)}$ - H-bonding: H-O polar covalent bonds present
c) $CHCl_{3(g)}$ - dipole-dipole: $CHCl_3$ is a polar molecule
d) $BF_{3(g)}$ -

13. a) $C_{12}H_{22}O_{11}$ - H-bonding, dipole-dipole, dispersion
b) $KCl_{(s)}$ - ion-dipole, dispersion

14. *pairs of e^- in covalent bonds are in constant motion causing temporary, uneven charge (temporary dipole)

* 2 factors: ① as mass ↑, attractive forces ↑ due to greater # of e^- ∴ higher likelihood of temporary dipoles
② shape of molecule: the more linear the shape the greater the area of contact of the two molecules and ∴ the higher likelihood of temporary dipoles forming.