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Name Mr. Shank Period AP 1, 2, 3

Quiz 5: *Intermolecular Forces*

Circle the appropriate intermolecular force(s) for each statement:

+1 1. Attraction between instantaneous dipoles — (LDF) DD HB

+1 2. Present in CH_2O but not in CH_4 — LDF (DD) HB

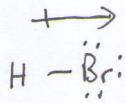
+2 3. Stronger in NH_3 than in H_2S — LDF (DD) (HB)

For each of the molecules below:

a) Draw the best possible Lewis structure
b) Draw all bond dipoles and molecular dipoles, if any
c) Give the electron configurations of the indicated atoms or ions below each molecule
d) Draw three molecules as they would likely be organized in a liquid

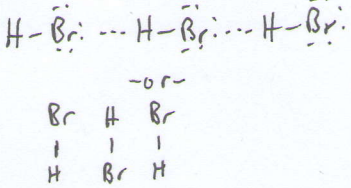
+3

4. HBr

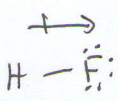


+5 H: $1s^1$

Br: $[Ar]4s^2 3d^{10} 4p^5$

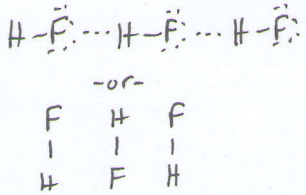


5. HF

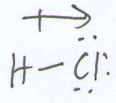


+5 F: $[He]2s^2 2p^5$

F^-: $[He]2s^2 2p^6 = [Ne]$

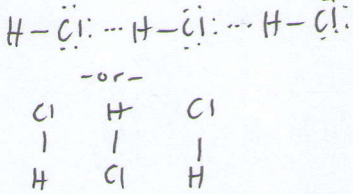


6. HCl

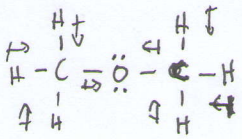


+5 Cl: $[Ne]3s^2 3p^5$

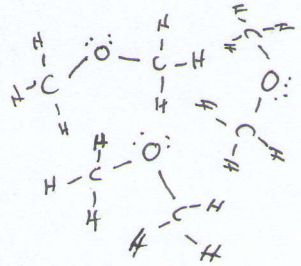
Cl^{2+}: $[Ne]3s^2 3p^3$



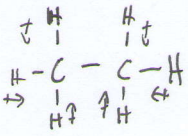
7. CH_3OCH_3



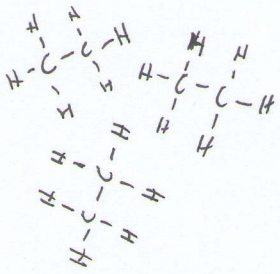
+4 O: $[He]2s^2 2p^4$



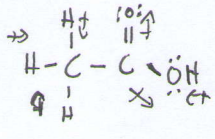
8. C_2H_6



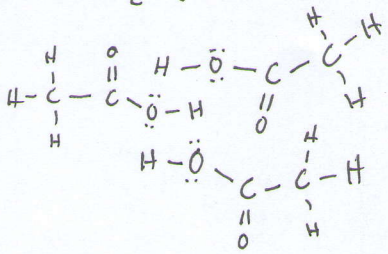
+4 C: $[He]2s^2 2p^2$



9. CH_3COOH



+4 O^{3-}: $[He]2s^2 2p^6 3s^1 = [Ne]3s^1$



List the following groups of molecules in order of **increasing** melting point:

10. HBr, HF, HCl

+3 HCl < HBr < HF

11. CH_3OCH_3, C_2H_6, CH_3COOH

+3 C_2H_6 < CH_3OCH_3 < CH_3COOH

12. HBr, HF, HCl, C_2H_6, MgO, CH_3OCH_3, CH_3COOH, KCl

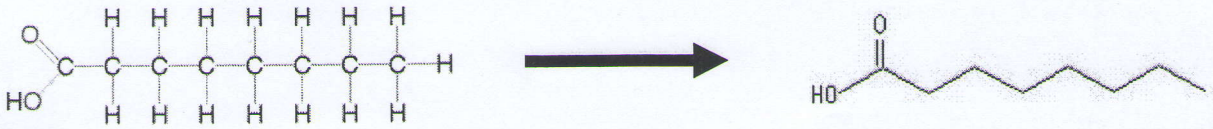
+6 C_2H_6 < CH_3OCH_3 < **HCl** < **HBr** < HF < CH_3COOH < KCl < MgO +1

13. Explain why HBr has a higher boiling point than HCl.

+2 Based on the electronegativity differences between H and Cl and H and Br, we see that $\Delta EN(H-Cl) > \Delta EN(H-Br)$, and we would expect the more polar HCl to have greater dipole-dipole interactions than HBr. Moreover, HCl has hydrogen bonding. In this case, however, we also see that HBr contains 36 total electrons and HCl contains 18 total electrons. The significantly greater number of electrons in HBr leads to much greater London dispersion forces in HBr that overwhelm the dipole-dipole interactions. Thus HBr has a higher melting point than HCl.

Extra Credit:

Fatty acids are large molecules with a non-polar aliphatic tail and a polar acidic head: R-COOH, where R contains only C and H atoms. Chemists often draw Lewis structures for fatty acids as



According to the principle that 'like attracts like', draw a likely organization of eight (8) fatty acids in water. There are two best answers.