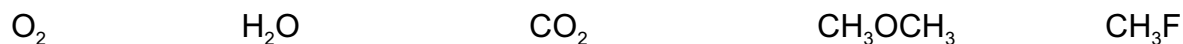


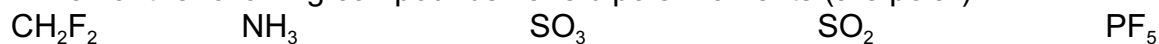
Answer the following questions on the answer sheet.

Give your answer to 3 significant figures except for question 17.

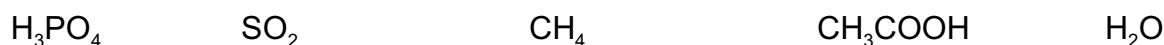
1) Which of the following compounds have dipole moments (are polar)?



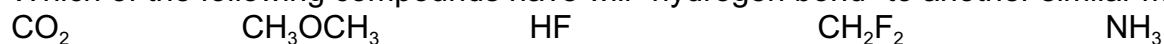
2) Which of the following compounds have dipole moments (are polar)?



3) Which of the following compounds will "hydrogen bond" to another similar molecule?



4) Which of the following compounds will "hydrogen bond" to another similar molecule?



5) Arrange the following in order of increasing London forces. SiH_4 , CH_4 , GeH_4 , SnH_4

6) Arrange the following in order of increasing London forces. $HCOOH$, C_2H_5COOH ,
 $C_6H_{13}COOH$, CH_4COOH

7) Calculate the vapor pressure of ethanol at 57.8 °C. The boiling point of ethanol is 78.3 °C and its molar enthalpy of vaporization is 39.26 kJ mol⁻¹. $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$

8–9) What is the classification of each of the following solids? (ionic solid, covalent solid, metallic solid or molecular solid)



10) – 11) What are the strongest types of forces or bonds responsible for forming the solid phase for each of the following? (ionic attractions, covalent bonds, metallic bonding, "hydrogen bonding", dipole–dipole attraction, London forces)



12) – 13) What is the van't Hoff factor for each of the following? (If it does not dissociate: $i = 1$.)



- 14) Calculate the total molality for a solution made up to be 5.77 g in NaCl in 380.7 g of water.
- 15) Calculate the freezing point depression for a solution made up to be 4.73 g in CaCl_2 in 335.2 g of water. ($K_f = 1.86 \text{ }^\circ\text{C kg mol}^{-1}$)
- 16) Calculate the osmotic pressure for a solution of water containing 37.4 g of CH_3COOH in 2.539 L of water solution at $25 \text{ }^\circ\text{C}$. $R = 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}$
- 17) What is the vapor pressure of water over a solution that contains 19.50 g of ethanol ($\text{C}_2\text{H}_5\text{OH}$) in 214.9 g of water if at the measurement temperature the vapor pressure would be 49.43 torr for pure water? Give your answer to **4 significant figures**.
- 18) What is the molar mass of a non–electrolyte compound if when 5.0333 g of it are dissolved in 66.7 g of water, it will lower the freezing point by $3.19 \text{ }^\circ\text{C}$? ($K_f = 1.86 \text{ }^\circ\text{C kg mol}^{-1}$)
- 19) What is the principal reason that the boiling point of HF is much greater than HCl
- 20) What is the principal reason that the melting point of H_2O is much greater than H_2S

NAME _____

For question 1 through 4 circle the correct answer.

- 1) O_2 polar non-polar
 H_2O polar non-polar
 CO_2 polar non-polar
 CH_3OCH_3 polar non-polar
 CH_3F polar non-polar
- 2) CH_2F_2 polar non-polar
 NH_3 polar non-polar
 SO_3 polar non-polar
 SO_2 polar non-polar
 PF_5 polar non-polar
- 3) H_3PO_4 hydrogen bonded not hydrogen bonded
 SO_2 hydrogen bonded not hydrogen bonded
 CH_4 hydrogen bonded not hydrogen bonded
 CH_3COOH hydrogen bonded not hydrogen bonded
 H_2O hydrogen bonded not hydrogen bonded
- 4) CO_2 hydrogen bonded not hydrogen bonded
 CH_3OCH_3 hydrogen bonded not hydrogen bonded
 HF hydrogen bonded not hydrogen bonded
 CH_2F_2 hydrogen bonded not hydrogen bonded
 NH_3 hydrogen bonded not hydrogen bonded
- 5) _____ < _____ < _____ < _____
- 6) _____ < _____ < _____ < _____
- 7) _____ units!
- 8-9)
- $H_2O(s)$ = _____
- $NaCl$ = _____
- gold = _____
- $CaCl_2$ = _____
- $CH_4(s)$ = _____

NAME _____

10–11)

diamond = _____

iron = _____

teflon = _____

solid Ar = _____

HCl(s) = _____

12–13)

 HNO_3 $i =$ _____ NH_3 $i =$ _____ HClO_2 $i =$ _____ Na_2SO_4 $i =$ _____ NaCl $i =$ _____

14) _____ units!

15) _____ units!

16) _____ units!

17) _____ units!

18) _____ units!

19) _____

20) _____

KEY

- 1) O_2 **non-polar**
 H_2O **polar**
 CO_2 **non-polar**
 CH_3OCH_3 **polar**
 CH_3F **polar**
- 2) CH_2F_2 **polar**
 NH_3 **polar**
 SO_3 **non-polar**
 SO_2 **polar**
 PF_5 **non-polar**
- 3) H_3PO_4 **yes**
 SO_2 **no**
 CH_4 **no**
 CH_3COOH **yes**
 H_2O **yes**
- 4) CO_2 **no**
 CH_3OCH_3 **no**
 HF **yes**
 CH_2F_2 **no**
 NH_3 **yes**
- 5) CH_4 , SiH_4 , GeH_4 , SnH_4
- 6) $HCOOH$, CH_3COOH , C_2H_5COOH , $C_6H_{13}COOH$
- 7) 0.435 atm
- 8-9)
 $H_2O(s)$ = molecular solid
 $NaCl$ = ionic solid
 gold = metal
 $CaCl_2$ = ionic solid
 $CH_4(s)$ = molecular solid

KEY

10–11)

diamond = covalent bond throughout

iron = metallic bond

teflon = covalent bond throughout

solid Ar = London forces

HCl(s) = dipole–diple forces

12–13)

 $\text{HNO}_3 = 2$ $\text{NH}_3 = 1$ $\text{HClO}_2 = 1$ $\text{Na}_2\text{SO}_4 = 3$ $\text{NaCl} = 2$ 14) 0.519mol kg^{-1} 15) $0.710\text{ }^\circ\text{C}$ (or K)16) 6.00atm 17) 47.74 torr 18) 44.0 g mol^{-1}

19) "hydrogen bonding"

20) "hydrogen bonding"