

Equations

$$= CRT \quad \ln(P_1/P_2) = \Delta H_{\text{vaporization}}/R(1/T_2 - 1/T_1)$$

$$T_b = K_b b \quad T_f = K_f b \quad P = X P^\circ$$

Fill in the correct answer on the answer sheet.

- 1) Identify which molecules have a dipole and which ones do not.



- 2) Identify which compounds have (self) hydrogen bonding.



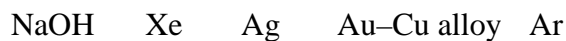
- 3) The boiling point of acetone is 56.5 °C and the $\Delta H_{\text{vaporization}}^\circ$ is 13.77 kJmol⁻¹. What is the vapor pressure at 39.9 °C?

- 4) What are the strongest forces that hold the solid together for the following compounds?



Choose from: ionic–ionic bonding, covalent bonding, hydrogen bonding, dipole–dipole attraction, or London forces.

- 5) Tell what the classification for each of the following is.



Choose from: ionic solid, covalent solid, metal, or molecular solid.

- 6) Calculate the molality of a solution created by mixing 12.3 g of CH₃OH and 163.1 g of water.
- 7) Calculate the (total or ionic) molality of a solution created by mixing 14.3 g of KBr with 150.4 g of water.
- 8) What is the mole fraction of water in a solution that has 83.60 g of CH₃OH and 559.53 g of water?
- 9) What is the osmotic pressure of a solution that has 58.70 g of ethylene glycol (HCOHCHOH) and 169.34 mL of water at 25 °C?
- 10) The vapor pressure of ethanol at 19 °C is 40.00 torr. What is the vapor pressure of ethanol for a solution that is 35.00 g ethylene glycol (HCOHCHOH) and 214.40 g of water? Give the answer to 4 significant figures.
- 11) 9.65 g of ScBr₃ is dissolved in 42.9 g of water. What is the freezing point lowering for this solution? The K_f for water is 1.86 °C kg mol⁻¹. The molar mass of ScBr₃ is 284.66 g mol⁻¹. Give your answer to **4 significant figures**.

- 12) 0.496 moles of a non-electrolyte is dissolved in 333 g of acetic acid. What is the freezing point lowering? The K_f for acetic acid is $3.90 \text{ K mol}^{-1} \text{ kg}$.
- 13) Give the van't Hoff factor for each of the following:
- | | |
|----------------------|-------------------------------------|
| A) CaS | E) Ba(OH) ₂ |
| B) MgBr ₂ | F) CH ₃ NH ₂ |
| C) HCl | G) CH ₃ CHO |
| D) HF | H) C ₆ C ₅ OH |
- 14) Place the following in the proper sequence for increasing London forces:
- | | | | | |
|-----------------------------------|-------------------------------|------------------|--------------------------------|-------------------------------|
| A) Na | Li | K | Cs | Rb |
| B) C ₅ H ₁₂ | C ₂ H ₆ | CH ₄ | C ₄ H ₁₀ | C ₃ H ₈ |
| C) NF ₃ | NBr ₃ | NCl ₃ | NI ₃ | NAt ₃ |
| D) Cl ₂ | At ₂ | F ₂ | I ₂ | Br ₂ |

For questions 15 through 20, use the CO₂ phase diagram.

- 15) On the CO₂ phase diagram, identify what region N is.
- 16) On the CO₂ phase diagram, identify what region X is.
- 17) On the CO₂ phase diagram, identify what point Q is.
- 18) On the CO₂ phase diagram, identify what line R is.
- 19) Write all the equilibria associated with line S.
- 20) Write all the equilibria associated with point Q.

ANSWER SHEET

NAME _____

- 1) CO **polar** **no dipole**
CH₂Cl₂ **polar** **no dipole**
CO₂ **polar** **no dipole**
SO₂ **polar** **no dipole**
CH₄ **polar** **no dipole**
- 2) H₂CO **has hydrogen bonding** **no hydrogen bonding**
NH₃ **has hydrogen bonding** **no hydrogen bonding**
HCN **has hydrogen bonding** **no hydrogen bonding**
HF **has hydrogen bonding** **no hydrogen bonding**
CH₃NH₂ **has hydrogen bonding** **no hydrogen bonding**
- 3) _____
- 4) NaOH _____
Xe _____
CO _____
diamond _____
CH₂F₂ _____
- 5) NaOH _____
Xe _____
Ag _____
Au-Cu alloy _____
Ar _____
- 6) _____

ANSWER SHEET

NAME _____

7) _____

8) _____

9) _____

10) _____

11) _____

12) _____

13) A) CaS i = _____

B) MgBr₂ i = _____

C) HCl i = _____

D) HF i = _____

E) Ba(OH)₂ i = _____

F) CH₃NH₂ i = _____

G) CH₃CHO i = _____

H) C₆H₅OH i = _____

14) A) smallest _____ < _____ < _____ < _____ < _____ largest

B) smallest _____ < _____ < _____ < _____ < _____ largest

C) smallest _____ < _____ < _____ < _____ < _____ largest

D) smallest _____ < _____ < _____ < _____ < _____ largest

15) _____

16) _____

17) _____

18) _____

19) _____

20) _____

KEY

- 1) CO polar
 CH₂Cl₂ polar
 CO₂ no dipole
 SO₂ polar
 CH₄ no dipole
- 2) H₂CO no hydrogen bonding
 NH₃ has hydrogen bonding
 HCN no hydrogen bonding
 HF has hydrogen bonding
 CH₃NH₂ has hydrogen bonding
- 3) 0.766 atm
- 4) NaOH ionic-ionic
 Xe London
 CO dipole-dipole
 diamond covalent
 CH₂F₂ dipole-dipole
- 5) NaOH ionic solid
 Xe molecular solid
 Ag metal
 Au-Cu alloy metal
 Ar molecular solid
- 6) 2.36 mol kg⁻¹
- 7) 1.60 × 10⁰ mol kg⁻¹
- 8) X = 0.92
- 9) P_I = 141.28 atm
- 10) X = 38.13 torr.
- 11) 5.88 K
- 12) 5.81 K
- 13) A) CaS $i = \underline{\quad 2 \quad}$
 B) MgBr₂ $i = \underline{\quad 3 \quad}$
 C) HCl $i = \underline{\quad 2 \quad}$
 D) HF $i = \underline{\quad 1 \quad}$
 E) Ba(OH)₂ $i = \underline{\quad 3 \quad}$
 F) CH₃NH₂ $i = \underline{\quad 1 \quad}$
 G) CH₃CHO $i = \underline{\quad 1 \quad}$
 H) C₆H₅OH $i = \underline{\quad 1 \quad}$
- 14) smallest Li < Na < K < Rb < Cs largest
 smallest CH₄ < C₂H₆ < C₃H₈ < C₄H₁₀ < C₅H₁₂ largest
 smallest NF₃ < NCl₃ < NBr₃ < NI₃ < NAt₃ largest
 smallest F₂ < Cl₂ < Br₂ < I₂ < At₂ largest
- 15) liquid
- 16) triple point
- 17) liquid-solid phase boundary
- 19) CO₂(g) ⇌ CO₂(l)
- 20) CO₂(g) ⇌ CO₂(s) ⇌ CO₂(l)