Multiple Choice 12 @ 4pts each

1. Which one of the following substances should exhibit hydrogen bonding in the liquid state?

A. PH_3 B. H_2 C. H_2S D. CH_4 (E) NH_3

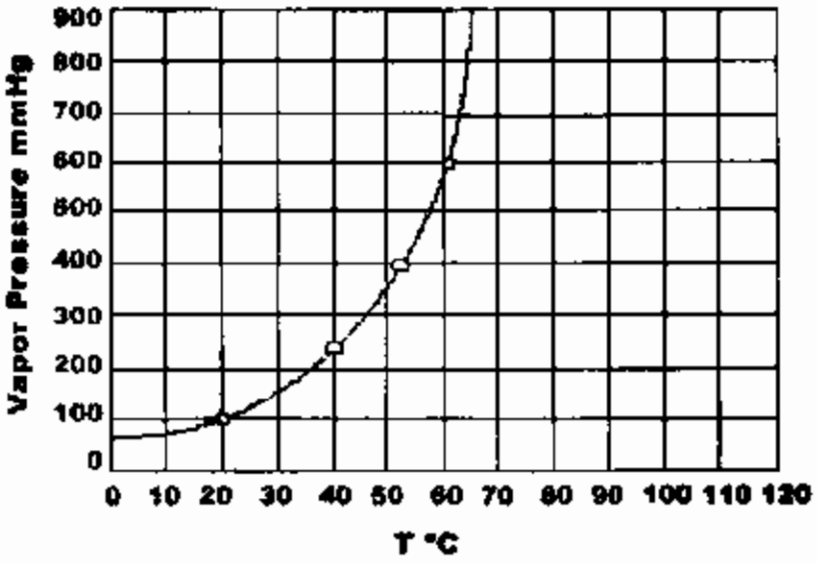
2. Which of the following properties indicates the presence of *weak* intermolecular forces in a liquid?

A. a high heat of vaporization
B. a high critical temperature
(C) a high vapor pressure
D. a high boiling point
E. None of the above.

3. A liquid boils when its

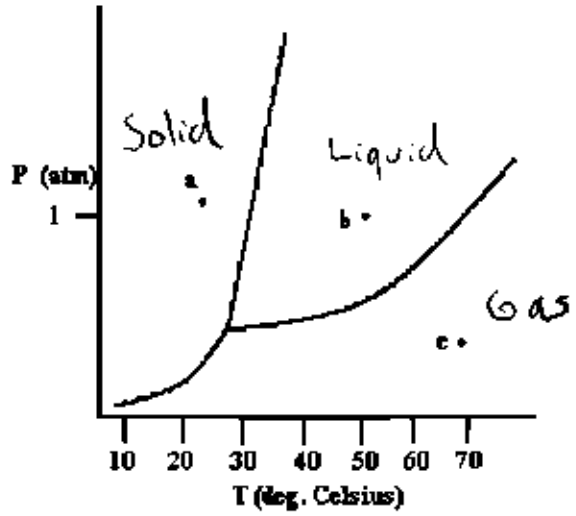
A. vapor pressure is exactly 1 atmosphere.
(B) vapor pressure is equal to, or greater than, the external pressure pushing on it.
C. temperature is equal to 273 K (standard temperature).
D. temperature is greater than room temperature.

4. Use the graph of vapor pressure to determine the normal boiling point of $CHCl_3$.



A. 19°C B. 52°C C. 60°C (D) 64°C E. 70°C

5. What phases exist at the points labeled *a*, *b*, and *c*?



6. Which of the following liquids would make a good solvent for iodine, I_2?

A. HCl B. H_2O C. CH_3OH D. NH_3 (E.) CS_2

7. The solubility of CO_2 gas in water

(A.) increases with increasing gas pressure.
B. increases with decreasing gas pressure.
C. decreases with increasing gas pressure.
D. is not dependent on pressure.

8. Dissolving a solute such as KOH in a solvent such as water results in

A. an increase in the melting point of the liquid.
B. a decrease in the boiling point of the liquid.
(C.) a decrease in the vapor pressure of the liquid.
D. no change in the boiling point of the liquid.

9. What is the approximate Na^+ ion concentration in a 0.75 M Na_2CO_3 solution?

A. 0.375 M B. 0.75 M C. 1.25 M (D.) 1.50 M E. 2.25 M

10. The units of "reaction rate" are

A. $L\ mol^{-1}\ s^{-1}$
B. $L^2\ mol^{-2}\ s^{-1}$
C. s^{-1}
D. s^{-2}
(E.) $mol\ L^{-1}\ s^{-1}$

11. For the reaction $C_6H_{14}(g) \rightarrow C_6H_6(g) + 4H_2(g)$, $\Delta P(H_2)/\Delta t$ was found to be 2.5×10^{-2} atm/s, where $\Delta P(H_2)$ is the change in pressure of hydrogen. Determine $\Delta P(C_6H_{14})/\Delta t$ for this reaction at the same time.

A. 2.5×10^{-2} atm/s (B.) -6.2×10^{-3} atm/s C. -2.5×10^{-2} atm/s
D. 0.10 atm/s E. 6.2×10^{-3} atm/s

12. For the overall chemical reaction shown below, which one of the following statements can be rightly assumed?

$$2H_2S(g) + O_2(g) \rightarrow 2S(s) + 2H_2O(l)$$

A. The reaction is third-order overall.
B. The reaction is second-order overall.
C. The rate law is, rate = $k[H_2S]^2[O_2]$.
D. The rate law is, rate = $k[H_2S][O_2]$.
(E.) The rate law cannot be determined from the information given.

13. (10) The osmotic pressure of seawater is 30.0 atmospheres at 25°C. How many grams of sucrose ($C_{12}H_{22}O_{11}$) is required to prepare 1 liter of an aqueous solution which is isotonic with seawater?

$\Pi = MRT$

$M = \Pi/RT = \dfrac{30\ atm}{(0.082\ L \cdot atm/mol \cdot K)(298\ K)} = 1.23\ M$

$\dfrac{1.23\ mols\ C_{12}H_{22}O_{11}}{L} \times 1\ L = 1.23\ mols\ C_{12}H_{22}O_{11}$

$1.23\ mols\ C_{12}H_{22}O_{11} \times \dfrac{342\ g\ C_{12}H_{22}O_{11}}{mole} = 422\ g\ C_{12}H_{22}O_{11}$

14.(10) Calculate the boiling point of a solution containing 600 g of ethylene glycol ($C_2H_6O_2$) in 3500 g of water.

$600\,g\ C_2H_6O_2 \times \frac{1\ mole\ C_2H_6O_2}{62.08\,g} = 9.660\ moles\ C_2H_6O_2$

$\frac{9.660\ moles}{3.5\,kg\ H_2O} = 2.76\ m$

$\Delta T_b = k_b m = (0.52^\circ C/m)(2.76\ m) = 1.43^\circ C$

Boiling pt. elevation so

B.P pure $H_2O = 100^\circ C$

This solution $100^\circ C + 1.43^\circ C = 101.43^\circ C$

15.(10) Calculate the vapor pressure of a solution of 150 g of water with 20 g of NaCl at 100°C (the normal boiling point of water).

$P_1 = X_1 P_1^\circ \qquad P_1^\circ = 1\ atm$

$150\,g\ H_2O \times \frac{1\ mole}{18.0\,g} = 8.33\ moles\ H_2O$

$20\,g\ NaCl \times \frac{1\ mole}{58.5\,g} = 0.34\ moles\ NaCl$

$NaCl \rightarrow Na^+ + Cl^-$ so 0.68 moles solute

$X_1 = \frac{8.33\ moles}{8.33\ moles + 0.68\ moles} = 0.92$

$P_1 = (0.92)(1\ atm) = 0.92\ atm$

16. Consider the gas phase reaction between nitric oxide and bromine at 273°C.

$$2NO(g) + Br_2(g) \rightarrow 2NOBr(g)$$

The following data for the initial rate of appearance of NOBR were obtained:

Experiment	[NO] (M)	[Br_2] (M)	Initial Rate (M/s)
1	0.10	0.20	24
2	0.25	0.20	150
3	0.10	0.50	60
4	0.35	0.50	735

a)(10) Determine the rate law for this reaction.

$$\frac{\text{Rate 3}}{\text{Rate 1}} = \frac{k[NO]^x[Br_2]^y}{k[NO]^x[Br_2]^y} = \frac{k(0.1)^x(0.5)^y}{k(0.1)^x(0.2)^y} = \frac{60}{24}$$

$$(0.5/0.2)^y = \frac{60}{24}; \quad 2.5^y = 2.5, \quad y = 1$$

$$\frac{\text{Rate 2}}{\text{Rate 1}} = \frac{k[NO]^x[Br_2]^y}{k[NO]^x[Br_2]^y} = \frac{k(0.25)^x(0.20)^y}{k(0.10)^x(0.20)^y} = \frac{150}{24}$$

$$\left(\frac{0.25}{0.10}\right)^x = 150/24; \quad 2.5^x = 6.25, \quad x = 2$$

$$\text{Rate} = k[NO]^2[Br_2]$$

b)(6) Determine the rate constant for this reaction. Expt. 1

$$\text{Rate} = k[NO]^2[Br_2]; \quad k = \text{Rate}/[NO]^2[Br_2]$$

$$k = 24/(0.10)^2(0.2) = 1.20 \times 10^5 \ \frac{L^2}{mol^2 s}$$

c) (6) Determine the rate of this reaction when the [NO] = 0.03 M, and [Br_2] = 0.02 M

$$\text{Rate} = (1.20 \times 10^5 \ L^2/mol^2 s)(0.03)^2(0.02) = 0.216 \ M/s$$