Multiple Choice 12 @ 4pts each

1. Which one of the following substances will have both dispersion forces and dipole-dipole forces?

(A) HCl B. BCl_3 C. Br_2 D. H_2 E. CO_2

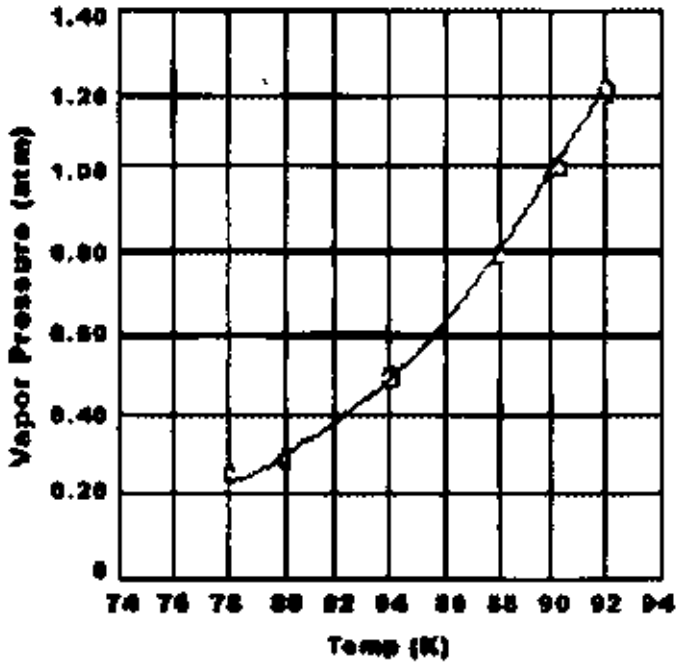
2. Which of the following substances should have the highest boiling point?

A. CH_4 B. Cl_2 C. Kr (D) CH_3Cl E. N_2

3. Which of the following characteristics indicates the presence of *weak* intermolecular forces in a liquid?

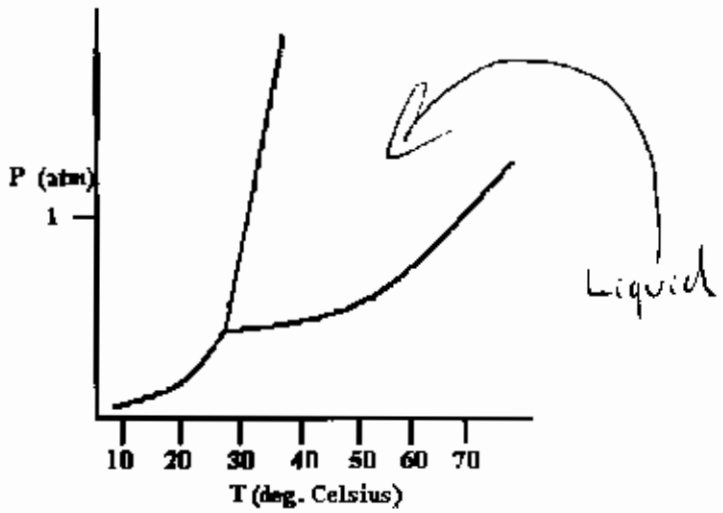
(A) a low heat of vaporization
B. a high critical temperature
C. a low vapor pressure
D. a high boiling point
E. None of the above.

4. Use the graph of vapor pressure to determine the normal boiling point of O_2.



A. 92 K (B) 90 K C. 88 K D. 84 K
E. O_2 doesn't boil because it is always a gas.

5. Using the following phase diagram of a certain substance, in what phase is the substance at 50°C and 1 atm pressure?



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 temperature.
B. decreases with decreasing temperature.
(C) decreases with increasing temperature.
D. is not dependent on temperature.

8. Consider a solution made from a nonvolatile solute and a volatile solvent. Which statement is true?

A. The vapor pressure of the solution is always greater than the vapor pressure of the pure solvent.
(B) The boiling point of the solution is always greater than the boiling point of the pure solvent.
C. The freezing point of the solution is always greater than the freezing point of the pure solvent.

9. Consider a 0.90 M $Al(NO_3)_3$ solution. This solution has a nitrate ion concentration of

A. 0.30 M B. 0.90 M C. 0.0 M D. 8.1 M (E) 2.7 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 $BrO_3^- + 5Br^- + 6H^+ \rightarrow 3Br_2 + 3H_2O$ at a particular time, $-\Delta[BrO_3^-]/\Delta t = 1.5 \times 10^{-2}$ M/s. What is $-\Delta[Br^-]/\Delta t$ at the same instant?

A. 13 M/s (B.) 7.5×10^{-2} M/s C. 1.5×10^{-2} M/s D. 3.0×10^{-3} M/s E. 330 M/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?

$\Pi = MRT$

$M = \Pi/RT = \dfrac{30\ atm}{(0.08\frac{L\ atm}{mol\ K})(298\ K)} = 1.23\ M$

$1.23\ moles/L \times 1\ L = 1.23\ moles\ C_{12}H_{22}O_{11}$

$1.23\ moles\ C_{12}H_{22}O_{11} \times 343\ g/mole = 422\ g\ C_{12}H_{22}O_{11}$

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

$600\,g\ C_2H_6O_2 \times \frac{1\ mole}{62.08\,g} = 9.66\ moles\ C_2H_6O_2$

$\frac{9.66\ moles}{3.5\ kg\ H_2O} = 2.76\ m$

$\Delta T_f = K_f m = (1.86°C/m)(2.76\,m) = 5.13°C$

Freezing pt. depression so

F.P. Pure $H_2O = 0°C$

This solution $0°C - 5.13°C = -5.1°C$

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).

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

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

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

$NaCl \rightarrow Na^+ + Cl^-$ 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. The following data were collected for the rate of disappearance of NO in the reaction

$$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$$

Experiment	[NO] (M)	$[O_2]$ (M)	Initial Rate (M/s)
1	0.01265	0.0125	1.41×10^{-2}
2	0.02510	0.0250	1.13×10^{-1}
3	0.02530	0.0125	5.64×10^{-2}

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

$$\frac{Rate\ 3}{Rate\ 1} = \frac{k[NO]^x[O_2]^y}{k[NO]^x[O_2]^y} = \frac{k(0.025)^x(0.0125)^y}{k(0.0125)^x(0.0125)^y} = \left(\frac{0.025}{0.0125}\right)^y = \frac{5.64\times10^{-2}}{1.41\times10^{-2}}$$

$$2^x = 4, \quad x = 2$$

$$\frac{Rate\ 2}{Rate\ 3} = \frac{k[NO]^x[O_2]^y}{k[NO]^x[O_2]^y} = \frac{k(0.0250)^x(0.0125)^y}{k(0.0250)^x(0.0125)^y} = \left(\frac{0.025}{0.0125}\right)^x = \frac{1.13\times10^{-1}}{5.64\times10^{-2}}$$

$$2^y = 2, \quad y = 1$$

$$Rate = k[NO]^2[O_2]$$

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

$$k = Rate / [NO]^2[O_2] \quad \text{for expt. 1}$$

$$k = 1.41\times10^{-2}\ mol/L\cdot s / (0.025\ M)^2(0.0125\ M)$$

$$k = 1.41\times10^{-2} / 1.95\times10^{-6} = 7.23\times10^{3}\ M^{-2}s^{-1}$$

c) (6) Determine the rate of this reaction when the [NO] = 0.03 M, and $[O_2]$ = 0.02 M

$$Rate = (7.23\times10^{3}\ M^{-2}s^{-1})(0.03)^2(0.02)$$

$$Rate = 0.13\ moles/L\cdot s$$