Test 1 **Chemistry 112** **Name** Key
Spring 2011
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Multiple Choice. Each question is worth four points. R = 0.0821 L atm/mol K

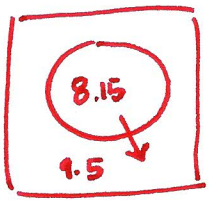
1. What is the van't Hoff factor for sodium dihydrogen phosphate?

   (a) 1
   (b) 2
   (c) 3
   (d) 4

   NaH_2PO_4

2. A cell has a normal osmotic pressure of 8.15 atm. If this cell was placed in a solution with an osmotic pressure of 9.5 atm, the cell

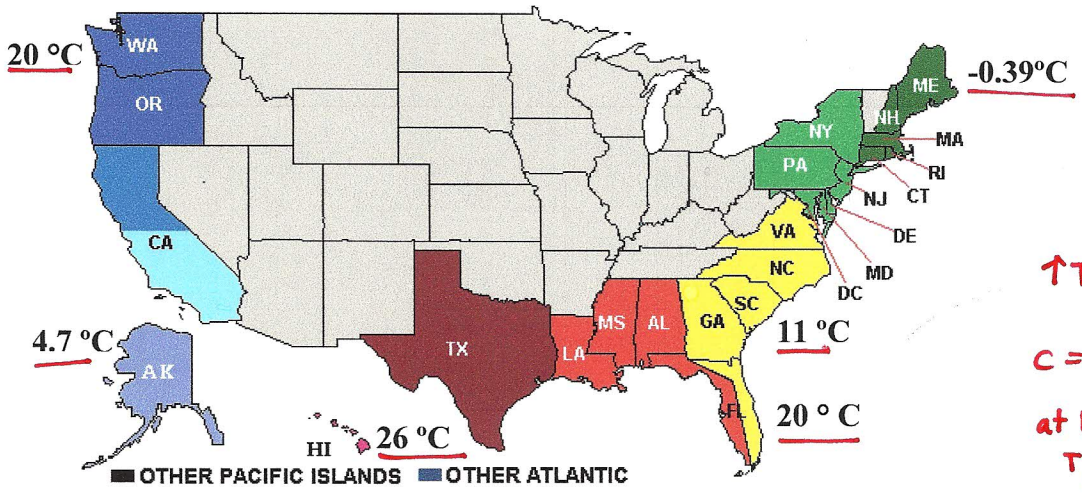
   (a) will lose water.
   (b) will gain water.
   (c) will be isotonic with the solution.
   (d) none of these

   ↑ solute ↑ π

3. Shown below is a table of Henry's Law constants for oxygen. The partial pressure of oxygen is 0.209 atm. Also shown below is map of the US labeled with water temperature at the coast for six regions. Which one of the regions would contain the least dissolved oxygen for aquatic life?

Gas	0°C	20°C	40°C	60°C
Oxygen	2.21×10^{-3}	1.43×10^{-3}	1.02×10^{-3}	8.71×10^{-4}



↑T ↓K

C = KP

at higher T, ↓S

(a) Washington
(b) Alaska
(c) Hawaii
(d) Florida
(e) South Carolina
(f) Maine

4. Which one of the following solutions has the highest freezing point? ↑solute ↓f.p. ∴ least stuff

(a) 0.10 *M* sodium phosphate Na_3PO_4 4
(b) 0.10 *M* potassium iodide x 2
(c) 0.10 *M* sodium dichromate x 3
(d) 0.10 *M* iron (III) sulfide x 5
(e) all of these would have the same freezing point

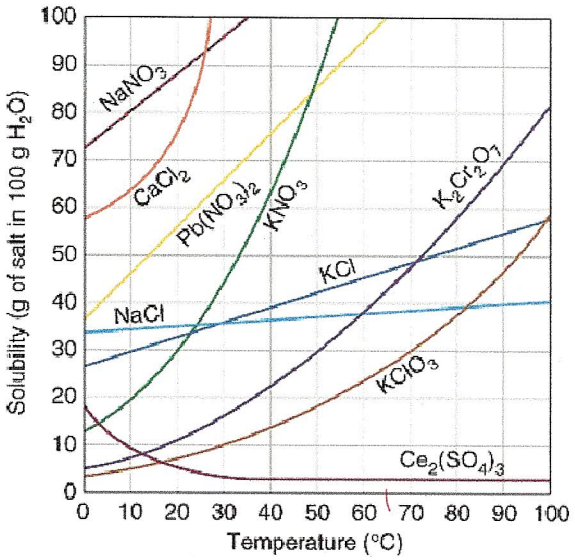
5. Which property would indicate weak intermolecular forces?

(a) high melting point strong
(b) high boiling point strong
(c) high vapor pressure weak
(d) high enthalpy of vaporization strong

6. What is the strongest intermolecular between BCl_3 and CH_3NH_2?

(a) London Dispersion
(b) Ion-dipole
(c) Dipole-dipole
(d) Hydrogen bond

7. Consider the following data. At what approximate temperature would an aqueous solution of lead nitrate be 3.00 *m*? (MW of lead nitrate is 331 g/mol; MW of water is 18.0 g/mol)



(a) 0 °C
(b) 25 °C
(c) 45 °C
(d) 55 °C
(e) 65 °C
(f) None of these

$.1\ kg \times \frac{3.00\ mol}{kg\ solvent} = 0.3\ mol \times \frac{331}{1\ mol} = 99.3\ g$

8. How many milliliters of a 0.437 *M* stock solution of glycine and how many milliliters of water are needed to make a 25 ml of a 0.36 *M* solution of glycine?

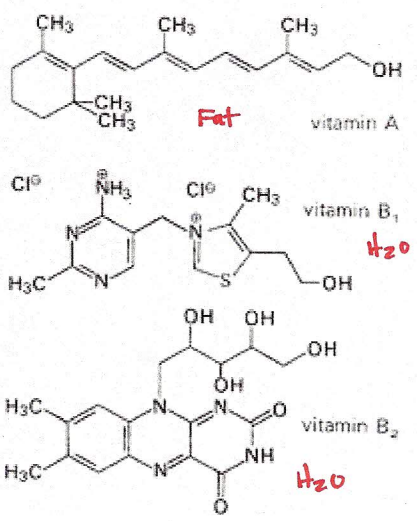
(a) 25 ml only of glycine
(b) 0.02 ml of glycine and 24.98 of water
(c) 24.98 of glycine and 0.02 ml of water
(d) 4.4 ml of water and 20.6 ml of glycine
(e) 20.6 ml of water and 4.4 ml of glycine
(f) none of these

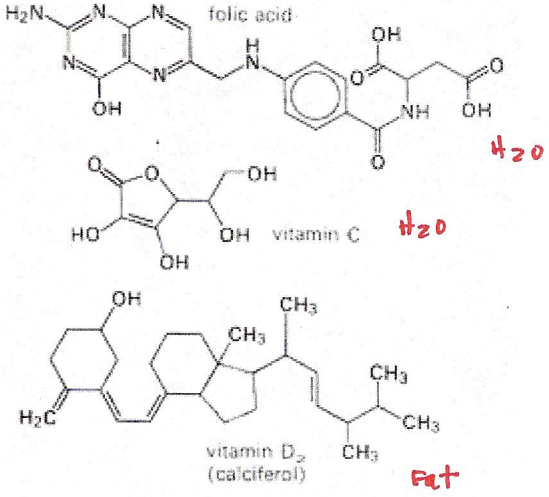
$M_1V_1 = M_2V_2$

$(.437)(mL) = (.36)(25mL)$

$mL = 20.6$ ml of glycine

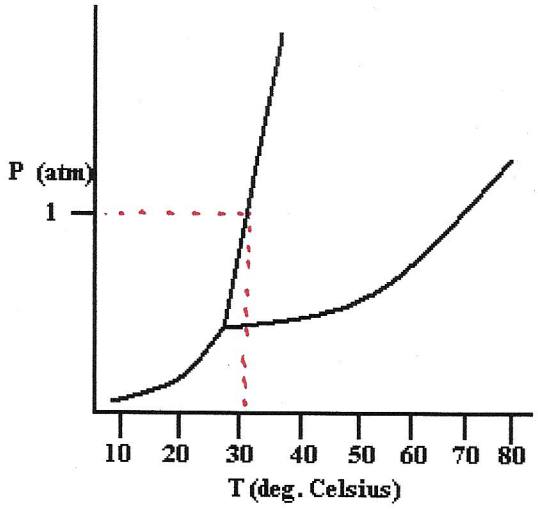
9. Vitamins are substances required in human diets to maintain normal health. Vitamins can be classified according to their solubilities. Some vitamins are soluble in water, and some vitamins are soluble in fats (which are usually made up of mostly hydrocarbons). Given below are the structures of six common vitamins. Which vitamin(s) are fat soluble?





(a) Vitamins A and C
(b) Vitamins D_2 and B_1
(c) Vitamins D_2 and C
(d) Vitamins A and B_2
(e) Vitamins A and D_2
(f) Vitamin A only
(g) Vitamin C only
(h) Folic acid only
(i) Vitamin D_2 only

10. Consider the following phase diagram for a solvent.

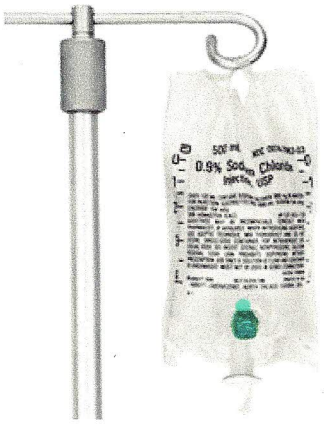


If a small amount of sodium sulfide was dissolved in 500. mL of this solvent, which of the following temperatures would be a *reasonable* freezing point?

(a) 28 °C
(b) 30 °C
(c) 38 °C
(d) 68 °C
(e) 78 °C
(f) 80 °C

Calculations. Each calculation has its own point value.

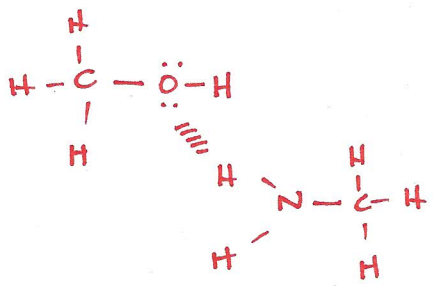
1. (10 pts) Patients who become dehydrated for various reasons need to be given water and nutrients intravenously. The intravenous solution must have the same solute concentration as the patient's blood. Typically, the saline solution is a 0.90 % (**w/v**) sodium chloride (MW = 58 g/mol) solution. The w/v unit is grams of solute per milliliters of solution. Calculate the saline solution in terms of Molarity.



assume
100 ml soln $\times \frac{0.9\text{ g NaCl}}{100\text{ ml solution}} = 0.9\text{ g NaCl} \times \frac{1\text{ mol}}{58\text{ g}} = .0155\text{ mol}$

$\frac{.0155\text{ mol}}{.1\text{ L}} = 0.16\text{ M saline solution (NaCl solution)}$

2. (10 pts) Draw a hydrogen bond between methanol (CH_3OH) and methylamine (CH_3NH_2).



3. (20 pts) Some KCl is dissolved in water at 25°C, where it completely dissociates. The vapor pressure of pure water at 25°C is 28.3 mmHg. What the mass in grams of KCl needed per liter of pure water to reduce the vapor pressure of water at 25°C by 5%. (MW of water is 18.0 g/mol and of KCl is 74.5 g/mol)

$P_1 = \chi_{solvent} P^\circ$

$26.89 = \chi \cdot 28.3$

$\chi = .95$

$1000\ ml\ H_2O \times \frac{1\ g}{ml} = 1000\ g\ H_2O \,/\, 18\ g/mol$

$55.6\ mol$

$.95 = \frac{mol\ solv}{mol\ solvent + mol\ solute}$

$.95 = \frac{55.6}{55.6 + x}$

$52.7 + .95x = 55.6$

$x = 2.97\ mol\ KCl \times \frac{74.5\ g}{1\ mol} = 221\ g\ KCl$

4. (20 pts) The boiling point of an aqueous solution of a glucose ($C_6H_{12}O_6$, MW = 180.16 g/mol) that has an osmotic pressure of 58.2 atm at 25°C is 101.77 °C? What is the density of this glucose solution? K_b of water is 0.52°C/m.

$\pi = 58.2$ atm $T_b = 101.77$ $\therefore$ $\Delta T_b = 1.77$

$\pi = MRTi$

$58.2 = M(.0821)(298)1$

$M = 2.38M$

$\Delta T_b = mK_b i$

$1.77 = m(.52)1$

$m = 3.40\,m$

Assume ↓

$1\,L \times \frac{2.38\ mol}{L\ soln} = 2.38\ mol\ glucose \times \frac{180.16\ g}{1\ mol} = 429\ g\ glucose$

$2.38\ mol\ glucose \times \frac{Kg\ solv.}{3.40\ mol\ glucose} = .700\ Kg\ solv.$

$\therefore$ 700 g solvent + 429 g solute = 1129 g solution

$d = \frac{g\ soln}{ml\ soln} = \frac{1129\ g\ solution}{1000\ mL} = 1.13\ g/mL$