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KEY

SCHM 109 Sec 003 Exam II A Fall 2009

You have 50 min for this test. *Try to be as efficient with your time as possible. See Supplemental Information at end of test. You must use the NSE calculators. Show logic and calculations for all problems. Include units and appropriate sig. fig.* ***Write your name on the back of the last page and initial the back of every other page.***

1.(0.7 pt) Regarding the Boltzmann molecular simulator program used in lecture, would decreasing the temperature in the box increase or decrease the pressure? Explain your answer using the Kinetic Molecular Theory.

.02 Decreasing the temperature would decrease the pressure

.02 Pressure is a measure of the number and energy of collisions with the walls of the container.

.03 As temperature decreases, there is a decrease in the average kinetic energy of the atoms/molecules. This means the overall speed of the atoms/molecules would decrease, so that there would be fewer collisions with the walls of containes and with less energy. Pressure decreases

2. (1.5 pt) Predict the products of the following reactions & balance the equations.

a) $3\,Mg + N_2 \rightarrow Mg_3N_2$ (.10) (.10) ratio (.10) combination

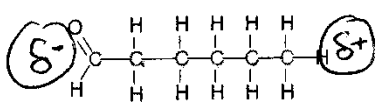
b) $Sr(OH)_2\,(aq) + 2\,HNO_3\,(aq) \rightarrow Sr(NO_3)_2 + 2H_2O$ (.06) (.06) (.06) (.06) (.06)

c) $4\,Na + SnBr_4 \rightarrow Sn + 4\,NaBr$ (.06) (.06) (.06) (.06)

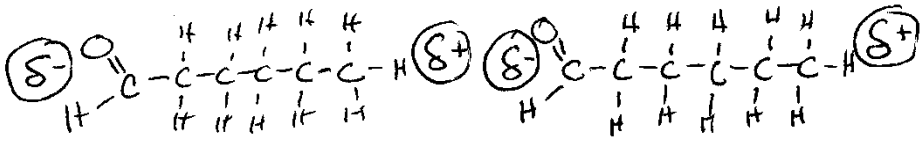
d) $2\,AlCl_3\,(aq) + 3\,Li_2S\,(aq) \rightarrow Al_2S_3 + 6\,LiCl$ (.04) (.04) (.04) (.04) (.04)

e) $C_6H_{12} + 9\,O_2 \rightarrow 6CO_2 + 6H_2O$ (.06) (.06) (.06) (.06) (.06)

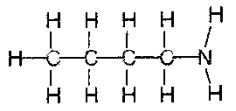
3. (0.5 pt) What kind of intermolecular forces does a sample containing the following molecule contain? Use structures to show this type of interaction.



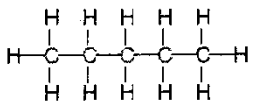
dipole - dipole



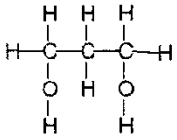
4. (1.2 pt) Which of the following compounds would have the highest, intermediate, and lowest boiling point? Explain your answer, using structures where appropriate.



a



b



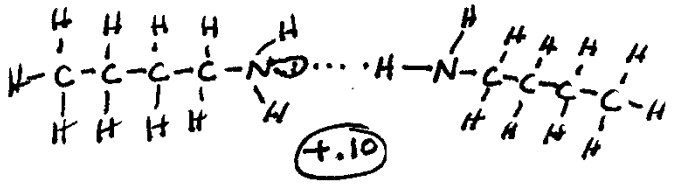
c

intermediate bp (.20)
(.10) hydrogen bonding
strongest IMF
fewer acceptor sites (.05) than c

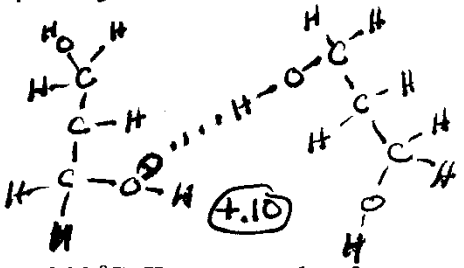
lowest bp (.25)
(.10) non-polar.
London forces
weakest IMF (.10)

highest bp (.20)
hydrogen bonding (.10)
(.10) strongest IMF
more acceptor sites than a

For molecules of similar size, the bp is directly related to the strength of IMF. (+.10)



(+.10)



(4.10)

5. (0.8 pt) A 1.675 L tank of methane gas (CH_4) is pressured to 7.81 atm at 26.2 °C. How many moles of gas are contained in the tank?

$PV = nRT$ (.15)

$n = \frac{PV}{RT} = \frac{(7.81)(1.675)}{(.08205)(299.35)}$ (.28)

$= 0.5326$ (.12)

.533 moles (.10)

$\frac{26.2}{273.15}$ (.15)

299.35 K

6. (1.2 pt) How many moles of ethylene (C_2H_4) are present in 491.8 g of ethylene? How many ethylene molecules are present in this 491.8 g? How many H atoms are present in this sample?

(C) 2×12.011

(H) $4 \times 1.00794 = 4.03176$

$\frac{24.022}{28.05376\ g = 1\ mol}$ (0.15)

$491.8\ g \left(\frac{1\ mol}{28.05376\ g}\right) = 17.5306$ (0.15) (.15) (.05)

17.53 mol

$17.5306\ mol \left(\frac{6.022 \times 10^{23}\ molecules}{1\ mol}\right) = 1.05569 \times 10^{25}$ (0.15) (.15)

1.056×10^{25} molecules (0.05)

$1.05569 \times 10^{25}\ molecules \times \frac{4\ H}{1\ C_2H_4}$ (0.15)

4.223×10^{25} H atoms (.05)

(.15) 4.22276×10^{25}

-.02 units

A-2

7. (0.6) A helium balloon has a volume of 4.55 L in Beauford where the pressure is 760 mm Hg. It is released into the atmosphere where it rises to a height where the pressure is only 465 mm Hg. What is the new volume of the balloon? (Assume a constant temperature.)

$P_1V_1 = P_2V_2$ (.15)

$V_2 = \frac{P_1V_1}{P_2}$ $\frac{(760\ mm\ Hg)(4.55\ L)}{(465\ mm\ Hg)} =$ (0.20) 7.4365 (.15)

7.44 L (.10)

8. (0.6) What would be the % (w/v) of a solution if 75.62 g of acetic acid ($C_2H_4O_2$) were added to water to form 1111 mL of solution?

$\%\left(\frac{w}{v}\right) = \frac{g\ solute}{mL\ solution} \times 100$ (.15)

$\frac{75.62\ g}{1111\ mL} \times 100$ (.20) = 6.80648% (.15)

6.806 % (.06 number, .04 units)

9. (0.8 pt) What is the concentration in molarity units of a solution that has 7.00 g of KI dissolved in water to give 120.6 mL of solution?

$\frac{mol}{L} = M$ (.05)

K 39.0983
I 126.904
166.0023 g = 1 mol (.10)

$7.00\ g\left(\frac{1\ mol}{166.0023\ g}\right) = 0.042168\ mol$ (.15) (.12)

$120.6\ mL\left(\frac{1\ L}{1000\ mL}\right) = 0.1206\ L$ (.06)

$\frac{.042168\ mol}{0.1206\ L} =$ (.15) .3496 (.12)

0.350 M (.10)

10. (0.6 pt) If 250.0 mL of a 1.340 M solution of NaOH is diluted to a final volume of 10.7 L, what will its concentration be?

$M_1V_1 = M_2V_2$ (.15)

$M_2 = \frac{M_1V_1}{V_2} = \frac{(1.340\ M)(0.2500\ L)}{(10.7\ L)}$ (.20) = 0.031308 (.10)

0.0313 M (.10)

$250.0\ mL\left(\frac{1\ L}{1000\ mL}\right) = 0.2500\ L$ (.05)

11. (0.7 pt) A gas with a volume of 65.3 L and a temperature of 10 °C is cooled to -78 °C. What is the new volume?

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$; $V_2 = \frac{V_1T_2}{T_1}$ (.15)

$\frac{(65.3\ L)(195.15\ K)}{(283.15\ K)} = 45.005\ L$ (.18) (.12)

45.0 L (.10)

273.15 / 10 / 283.15 K (.15)

273.15 − 78 = 195.15 K

12. (0.3 pt) Define oxidation

Loss of H (.15), Loss of e^- (.08), gain of O (.07)

13. (1.2 pt) A sample of 125.0 g of sodium metal reacts completely with water to produce an explosive gas.
a) Write a balanced or net ionic chemical equation for the reaction and indicate which reactant is oxidized and which is reduced.

$2\,Na + 2\,H_2O \rightarrow 2\,NaOH + H_2$ (.05 .05 .05 .05 .05 .05 .05)

Na oxidized (.10)
H_2O reduced (.10)

.55

b) How many moles of gaseous product are produced?

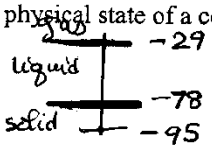
$125.0\,g\left(\frac{1\ mol}{22.98977\,g}\right) = 5.43720\ mol$ (.20) (.10)

$(5.43720\ Na)\left(\frac{1\ mol\ H_2}{2\ mol\ Na}\right) = 2.71860\ mol\ H_2$ (.20) (.10)

$2.719\ mol\ H_2$ (.05)

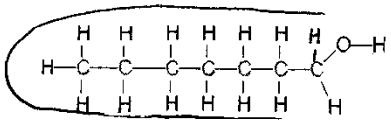
.65

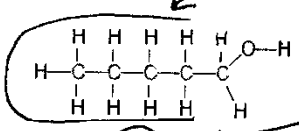
14. (0.3 pt) What would be the physical state of a compound at -95 °C that boiled at -29 °C and melted at -78 °C.?



Solid

Extra Credit: (0.8 pt)
1. For the following two structures, which would have the highest solubility in water? Explain your answer.





smaller non-polar surface
more soluble 0.1

Both a & b have the same polar (0.1) group. They differ in how long their non-polar side chain is. (b) is more soluble because it has a shorter polar side chain — less surface area to contact water (0.2)

2. Define vapor pressure.

Is the pressure exerted by the gas phase when at equilibrium with the its liquid (or solid) phase (0.4)

Supplemental Information ***(that you will be provided)***

Equations for temperature: °F = 1.8 °C + 32 K = °C + 273.15

English to metric conversions

Length: 1 m = 39.47 in; 1 in = 2.54 cm
Mass: 1 kg = 2.205 lb; 1 lb = 453.5 g
Volume 1 L = 1.057 qt
R = 0.08205 (L•atm/mol•K)
1 atm = 760. mm Hg
1 atm = 760. Torr