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B

KEY

SCHM 109 Sec 003 Exam II B 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 increasing the temperature in the box increase or decrease the pressure? Explain your answer using the Kinetic Molecular Theory.

Increasing the temperature would increase the pressure. (.20) An increase in temperature means, there is an increase in the average kinetic energy of the atoms/molecules. The overall speed of the atoms/molecules would increase. This means there would be more collisions with the walls, and they would collide with more energy. Because pressure is a measure of the number and energy of collisions w/ walls of container, the pressure would increase. (.30) } .20

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

0.30 /equation

a) $C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$ (.06 .06 .06 .06 .06)

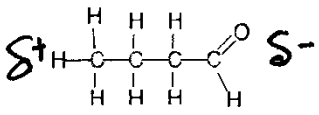
b) $2\,HNO_3\,(aq) + Mg(OH)_2\,(aq) \rightarrow Mg(NO_3)_2 + 2H_2O$ (.06 .06 .06 .06 .06) combination correct ratio

c) $3\,Rb + FeCl_3 \rightarrow 3RbCl + Fe$ (.06 .06 .06 .06)

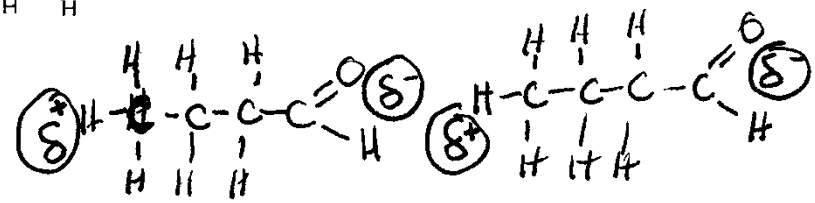
d) $2\,AlBr_3\,(aq) + 3\,Na_2S\,(s)\,aq \rightarrow Al_2S_3 + 6\,NaBr$ (.04 .04 .05 .04 .04)

e) $3\,Mg + N_2 \rightarrow Mg_3N_2$ (.10 .10 .10)

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.

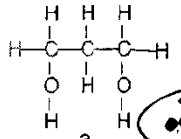


dipole-dipole



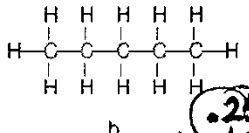
4. (1.2 pt) Which of the following compounds would have the highest, intermediate, and lowest boiling point? Explain your answer, using structures where appropriate.

Molecules have ~ same Mwt.



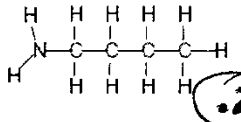
a .20

highest bp
.10 hydrogen bonding
.05 strongest IMF
more acceptor sites than c



b .25

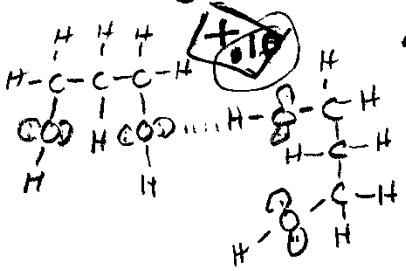
lowest bp
.10 non-polar
.10 London forces
.10 weakest IMF



c .20

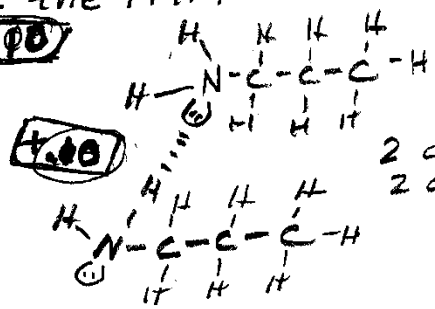
intermediate bp
.10 Hydrogen bonding
strongest IMF
.05 fewer acceptor sites

For molecules of similar size, the boiling point is directly related to the strength of the IMF. +.05



+.10

4 acceptor sites
2 donor sites per molecule



+.10

2 donor
2 acceptor

5. (0.6) What would be the % (w/v) of a solution if 35.65 g of acetic acid ($C_2H_4O_2$) were added to water to form 888.8 mL of solution?

$$\%\ w/v = \frac{g\ solute}{mL\ solution}$$ .15

$$\frac{35.65\ g}{888.8\ mL} = 4.011026$$ .15

4.011 % .20

.06 number
.04 units

6. (1.2 pt) How many moles of benzene (C_6H_6) are present in 431.2 g of benzene? How many benzene molecules are present in this 431.2 g? How many H atoms are present in this sample?

C × 6 12.011 × 6 = 72.066
H × 6 1.00794 × 6 = 6.04764
78.11364 0.15

$$431.2\ g \left(\frac{1\ mol}{78.11364\ g}\right) = 5.520163\ mol \rightarrow 5.520\ mol$$ 0.15 .15 .05

$$5.520\ mol \left(\frac{6.022 \times 10^{23}\ molec}{1\ mol}\right) = 3.32424 \times 10^{24} \rightarrow 3.324 \times 10^{24}\ molecules$$ 0.15 .15 .05

$$3.324 \times 10^{24}\ molecules \left(\frac{6\ H}{1\ molecule}\right) = 1.994545 \times 10^{25} \rightarrow 1.995 \times 10^{25}\ H\ atoms$$ 0.15 .15 .05

-.02 units

7. (0.6) A helium balloon has a volume of 4.55 L in Spartanburg where the pressure is 742 mm Hg. It is released into the atmosphere where it rises to a height where the pressure is only 475 mm Hg. What is the new volume of the balloon? (Assume a constant temperature.)

$P_1V_1 = P_2V_2$ .15

$\frac{P_1V_1}{P_2} = V_2 = \frac{742\ mm\ Hg\ (4.55\ L)}{475\ mm\ Hg} = 7.107578\ L$ .15

.20

7.11 L .10

8. (0.8 pt) A 1.375 L tank of ethane gas (C_2H_6) is pressured to 8.89 atm at 23.2 °C. How many moles of gas are contained in the tank?

$PV = nRT$ .15 .15 $273.15 + 23.2 = 296.35$

$n = \frac{PV}{RT} = \frac{(8.89\ atm)(1.375\ L)}{(.08205\ \frac{L\ atm}{mol\ K})(296.35)} = 0.5027$ .12

.28

0.503 moles .10

9. (0.3 pt) Define oxidation .08

lose e⁻, lose H, add O .07 .15 .30

10. (0.6 pt) If 15.00 mL of a 2.550 M solution of NaOH is diluted to a final volume of 1.75 L, what will its concentration be?

$M_1V_1 = M_2V_2$ .15

$15.00\ mL\left(\frac{1\ L}{1000\ mL}\right) = 0.01500\ L$ .05

.10

$M_2 = \frac{M_1V_1}{V_2} = \frac{(2.550\ M)(0.01500)}{1.75} = 0.021857$ .20 .10

0.0219 M

11. (0.7 pt) A gas with a volume of 48.3 L and a temperature of 20 °C is cooled to -56 °C. What is the new volume?

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ 293 217 .15 calc Temp.

$\frac{V_1T_2}{T_1} = V_2 = \frac{(48.3)(217)}{293} = 35.77167$ .15 .18 .12

35.8 L .05

12. (0.8 pt) What is the concentration in molarity units of a solution that has 4.40 g of LiBr dissolved in water to give 120.6 mL of solution?

6.941
79.904
86.845 g = 1 mol .05

$4.40\ g\left(\frac{1\ mol}{86.845\ g}\right) = 0.05066\ mol$ .15 .15

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

$120.6\left(\frac{1\ L}{1000}\right) = .1206\ L$ .06

$\frac{0.05066\ mol}{.1206\ L} = 0.420066$ .15 .12

.420 M .00

B-3

13. (1.2 pt) A sample of 75.00 g of potassium 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. .05 .05 .05 .05 .05 .05 .05

$$2K + 2H_2O \rightarrow 2KOH + H_2$$

.55

K is oxidized .10 H_2O reduced .10

b) How many moles of gaseous product are produced? .20 .10

$$75.00\,g\left(\frac{1\ mol\ K}{39.098\,g}\right) = 1.918256\ mol\ K$$

.20

$$(1.918256\ mol\ K)\left(\frac{1\ mol\ H_2}{2\ mol\ K}\right) = 0.959128$$

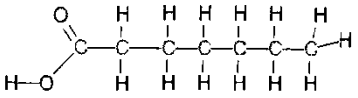
.10

.9591 mol H_2 .05

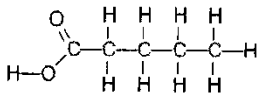
14. (0.3 pt) What would be the physical state of a compound at -59 °C that boiled at -32 °C and melted at -87 °C.?

gas
-32
liq
-59°C ← liquid
-87
solid

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



a



b ← highest solubility

One end of both molecules can hydrogen bond w/ H_2O.
(b) has a smaller non-polar region than (a)

2. Define vapor pressure.
is the pressure exerted by a gas in equilibrium with its liquid (usually).

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