CHEMISTRY 102
EXAM 1   FORM D   SECTION 502

FALL 2010
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Directions: (1) Put your name on PART 1 and your name and signature on PART 2 of the exam where indicated.
  (2) Sign the Aggie Code on PART 2 of this exam.
  (3) Each multiple choice question is actually 2 questions on your scanning sheet. If you are sure of an answer, **put the same answer down for both questions** for 5 pts. If you cannot decide between two answers, put your best answer down for the first (odd) question and the other answer down for the second (even) question. If you get the first one correct you'll get 3 pts; if you get the second one correct you'll get 2 pts. If there is an ambiguous multiple choice question, use the last page to explain your answer.
  (4) Do NOT write on the envelope.
  (5) When finished, put everything in the envelope and wait to be excused. At the table, take everything out of the envelope. You can pick up the multiple choice part with the answers outside my office after 3pm.
  (6) There are a total of 36 questions (20 actual questions).

PART 1

1&2.   The units of molality are:

(a) mol solute/kg solution
(b) mole solute/kg solvent
(c) g solute/g solvent

(d) mol solute/L solution
(e) g solute/kg solvent

3&4.   Which of these aqueous solutions will freeze at the same temperature?

(1) 0.2 m $C_2H_6O_2$
(2) 0.2 m KBr
(3) 0.1 m K_3PO_4

(a) all of these
(b) none of these
(c) 1&2

(d) 1&3
(e) 2&3

5&6.   Which statement(s) is/are **TRUE**?

(1) When heat is absorbed by the system from the surroundings, the entropy of the surroundings increases.
(2) When $\Delta H > 0$, the reaction is endothermic.
(3) If $\Delta S < 0$, the reaction is becoming more disordered.

(a) 1,2,3   (b) 1,2 only   (c) 1,3 only   (d) 2 only   (e) 2,3 only

7&8.   Which of the following statements is **FALSE**?

(a) At absolute 0 K, the entropy of a pure perfect crystalline substance is zero.

(b) Endothermic processes are those that absorb heat.

(c) ΔS is a state function.

(d) The system's enthalpy alone does not determine the spontaneity of a reaction.

(e) A reaction is spontaneous if $\Delta S_{universe}$ decreases.

D1

9&10. Which of the following has a value of 0 kJ/mol for its $\Delta H^0_{f\,298}$?

(a) $I_2(g)$ (b) Ti (g)   (c) $H_2(g)$ (d) Hg(s)   (e) N(g)

11&12. Which of the following statements is **FALSE** about solubility and miscibility?

(a) Iodine, $I_2(s)$, should be more soluble in water than in carbon tetrachloride, CCl_4,

(b) Benzene, C_6H_6, is miscible in chloroform, $CHCl_3$.

(c) In the phrase "Like dissolves like," the term "like" refers to molecules with similar polarities.

(d) Water and ethanol, CH_3CH_2OH are miscible.

(e) KCl is more soluble in water than BaS.

13&14. Two liquids of equal volumes are separated by a semi-permeable membrane: 0.10 M NaCl and pure water, as shown in the diagram. Select the CORRECT answer.

(a) The net flow of water molecules will be from the pure water into the 0.10 M NaCl.

(b) The solution level of Side X will rise.

(c) This system does not exhibit a colligative property.

(d) If the concentration of NaCl is increased to 0.20 M NaCl, no effect will be seen.

(e) If Side X is initially not water, but 0.10 KBr, the outcome will be the same.

semi-permeable
membrane

X	Y
H_2O	0.10 M NaCl
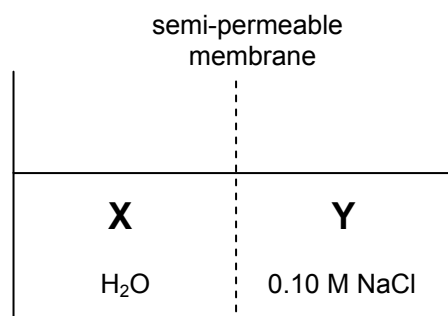
15&16. Which statement(s) list(s) the substance with the lower entropy first and the higher entropy second?

(1) $C_6H_6(\ell)$ at $40^\circ C$ < $C_6H_6(\ell)$ at $20^\circ C$

(2) CH_3CH_3 < $CH_3CH_2CH_2CH_3$

(3) 5 moles of $O_2(g)$ in 10 liters < 5 moles of $O_2(g)$ in 5 liters

(a) 1,2,3   (b) 3 only   (c) 1,3 only   (d) 2 only   (e) 2,3 only

D2

17&18. The best representation for the reaction whose heat of reaction is equal to the standard molar enthalpy of formation for $HNO_3(g)$ is:

(a) $H(g) + N(g) + 3O(g) \rightarrow HNO_3(g)$

(b) $HNO_3(g) \rightarrow ½ H_2(g) + ½ N_2(g) + 3/2 O_2(g)$

(c) $2HNO_3(g) \rightarrow H_2(g) + N_2(g) + 3 O_2(g)$

(d) $H_2(g) + N_2(g) + 3 O_2(g) \rightarrow 2HNO_3(g)$

(e) $½ H_2(g) + ½ N_2(g) + 3/2 O_2(g) \rightarrow HNO_3(g)$

19&20. Here is a listing of the molal boiling point constants (K_b values) for 3 solvents. If 0.10 mol of a soluble, nonelectrolyte were dissolved in 100 g of each solvent, what will be the order of increasing boiling point elevations of the resulting solutions?

(1) 2.13 $^{\circ}$C/m   (2) 3.72 $^{\circ}$C/m   (3) 1.49 $^{\circ}$C/m

(a) (3) < (1) < (2)   (b) (2) < (1) < (3)   (c) (2) < (3) < (1)

(d) (1) < (2) < (3)   (e) (1) < (3) < (2)

21&22. Which statement is **TRUE** about aqueous solutions?

(a) As the value of the van't Hoff factor of the solute increases, the freezing point of the solution will increase.

(b) A solution can only be made by dissolving a solid into a liquid.

(c) When the molality of the solute doubles, the boiling point of the solution will double.

(d) When a solute dissolves into the solvent, the vapor pressure of the solution will be lower than the vapor pressure of the pure solvent at a particular temperature.

(e) A solution is a heterogeneous mixture in which no settling occurs.

23&24. What will be the final solution volume (in mL) when 4.00 g of $CuCl_2$ is used to prepare a 0.125 M $CuCl_2$ solution?

(a) 6.80 mL   (b) 238 mL   (c) 271 mL   (d) 146 mL   (e) 79.2 mL

25&26. Given: $4 HNO_3(\ell) \rightarrow 4NO_2(g) + 2 H_2O(\ell) + O_2(g)$ with ΔH_{rxn} = +250. kJ/mol rxn

How much heat must be absorbed to produce 20.0 g of $H_2O(\ell)$?

(a) 534 kJ   (b) 273 kJ   (c) 118 kJ   (d) 311 kJ   (e) 139 kJ

27&28. What will be the freezing point of an aqueous solution prepared by dissolving 60.0 g of ethylene glycol ($C_2H_6O_2$ – a nonelectrolyte) in 150. g of water?

(a) –14.4°C   (b) –9.80°C   (c) –12.0°C   (d) –6.93°C   (e) –4.77°C

29&30. When 30.4 g of naphthalene, $C_{10}H_8$ (128 g/mol), is dissolved in 375 g of nitrobenzene, $C_6H_5NO_2$, the solution freezes at 1.27°C. The freezing point of pure nitrobenzene is 5.70°C. Calculate the K_f for nitrobenzene.

(a) 4.11 °C/m   (b) 7.00 °C/m   (c) 6.35 °C/m   (d) 0.551 °C/m   (e) 5.29 °C/m

31&32. Calculate the % by mass of a 3.36 M KI solution. The density of the solution is 1.40 g/mL.

(a) 39.8%   (b) 1.41%   (c) 21.7%   (d) 51.6%   (e) 26.6%

PART 2

**Please read and sign: "On my honor, as an Aggie, I have neither given
nor received unauthorized aid on this exam."**   _____

(5 pts) **33.** Using the data below, calculate ΔS of the universe to determine if this reaction is spontaneous or not
at $25^{\circ}C$ and explain.

	$2\ N_2(g)$	+	$5\ O_2(g)$	$\rightarrow$	$2\ N_2O_5(s)$
S^{o} (J/mol•K)	191.5		205.0		356.0
$\Delta H_{f\ 298}^{o}$ (kJ/mol)	0		0		11.0

OVER $\Rightarrow$
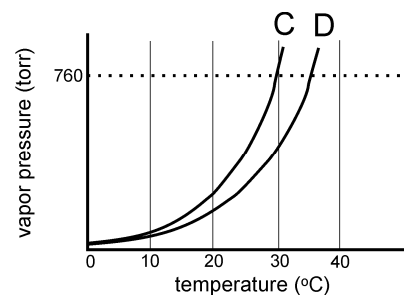
(2 pts) **34.** Consider the diagram given on the right, showing the vapor
pressure curves for a pure solvent and a solution made with that
solvent as a function of temperature.

(a) The intersection of curve C with the line, 760 torr, represents:

_____.

(b) What is the boiling point <u>elevation</u> of the solution at 1 atm? _____

(8 pts) **35.** Give the name or formula to the following compounds:

(a)   lithium bromide   _____

(b)   tin(IV) oxide   _____

(c) $(NH_4)_2SO_3$ _____

(d) $Co_2(CO_3)_3$ _____

(5 pts) **36.** In the lab, the labels fell off two bottles of sodium salts: NaCl (58.5 g/mol) and NaI (150. g/mol). A
0.511 g sample of one of the salts was dissolved in enough water to prepare 1000. mL of solution. Its
osmotic pressure was measured to be 325 torr at 25°C. Which salt was dissolved? The correct answer
without work will give you only 1 point; you must show all your calculations.

SCRAP PAPER OR COMMENTS ON EXAM