Exam Chapter 11-13 Exam C KEY

Name _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) As a gaseous element condenses, the atoms become _____ and they have _____ attraction for one another. 1) _____

A) more separated, more
B) larger, greater
C) more separated, less
D) closer together, less
E) closer together, more

2) Which one of the following should have the lowest boiling point? 2) _____

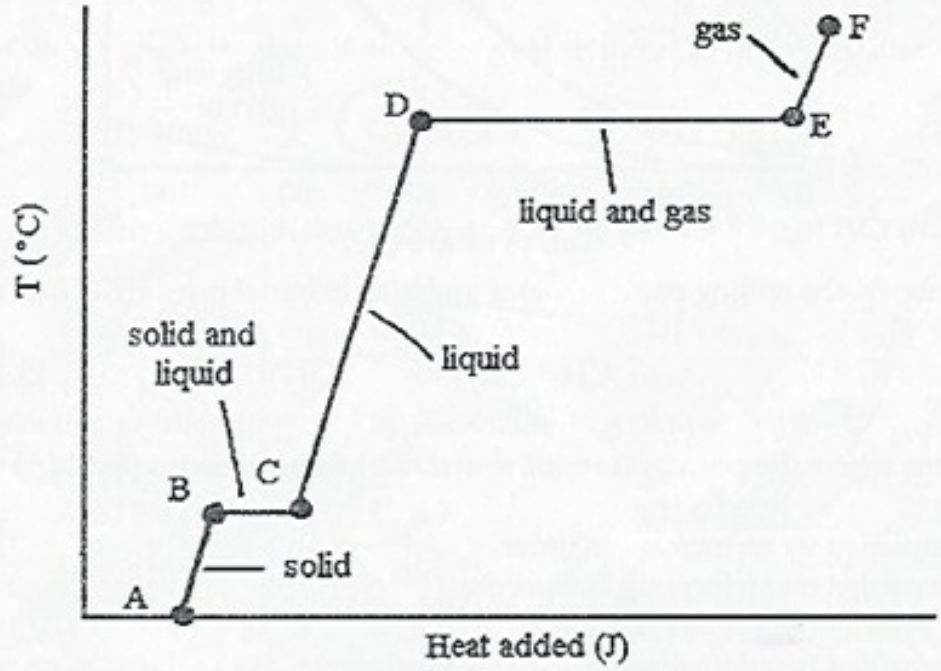
A) SiH_4 B) H_2O C) H_2S D) PH_3 E) HCl

3) In which of the following molecules is hydrogen bonding likely to be the most significant component of the total intermolecular forces? 3) _____

A) CH_4
B) CO_2
C) CH_3OH
D) $C_5H_{11}OH$
E) $C_6H_{13}NH_2$

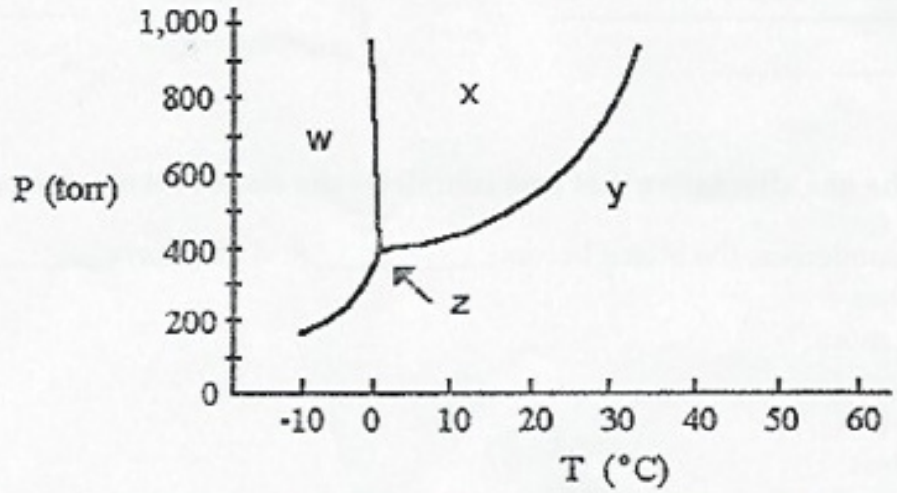
4) Which one of the following derivatives of ethane has the highest boiling point? 4) _____

A) C_2F_6 B) C_2H_6 C) C_2Cl_6 D) C_2I_6 E) C_2Br_6



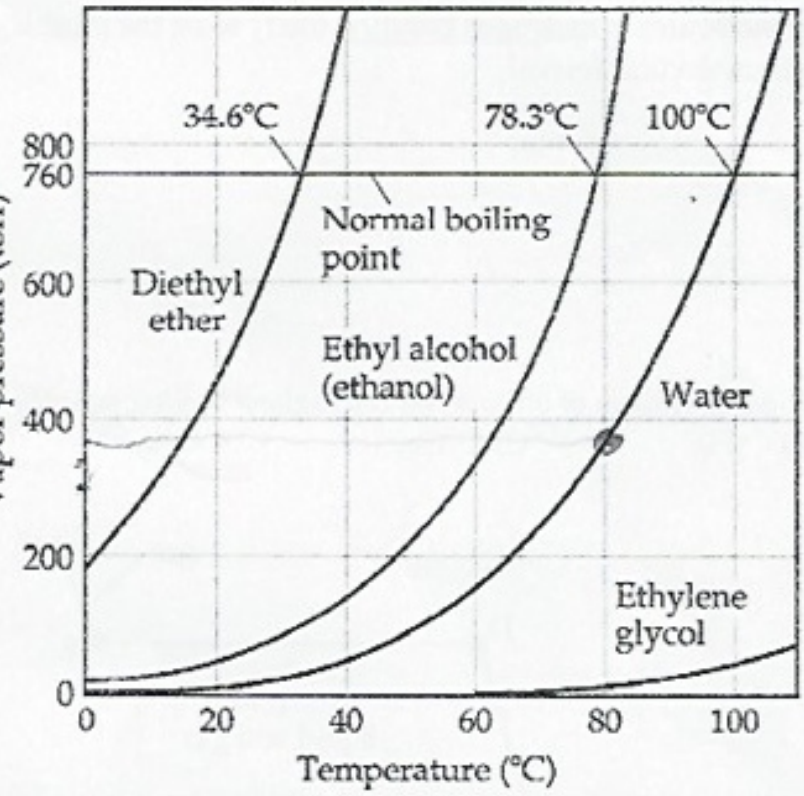
5) The heating curve shown was generated by measuring the heat flow and temperature of a solid as it was heated. The heat flow into the sample in the segment _____ will yield the value of the ΔH_{fusion} of this substance. 5) _____

A) AB B) BC C) CD D) DE E) EF



6) According to the phase diagram shown above, the normal boiling point of this substance is _____ °C. 6) _____

A) 10 B) 38 C) -3 D) 0 E) 29



.493atm × 760/1atm

7) Based on the figure above, the boiling point of water under an external pressure of 0.493 atm is _____ °C. 7) _____

A) 80 B) 90 C) 60 D) 70 E) 40

8) Formation of solutions where the process is endothermic can be spontaneous provided that _____. 8) _____

A) they are accompanied by an increase in order
B) they are accompanied by an increase in disorder
C) the solvent is a gas and the solute is a solid
D) they are accompanied by another process that is exothermic
E) the solvent is water and the solute is a gas

9) A solution with a concentration higher than the solubility is _____. 9) _____

A) is supersaturated
B) is supercritical
C) is unsaturated
D) is saturated
E) is not possible

10) The principal reason for the extremely low solubility of NaCl in benzene (C_6H_6) is the _____. 10) _____

A) hydrogen bonding in C_6H_6
B) strong solvent–solvent interactions
C) strength of the covalent bond in NaCl
D) increased disorder due to mixing of solute and solvent
E) weak solvation of Na^+ and Cl^- by C_6H_6

11) A solution contains 28% phosphoric acid by mass. This means that _____. 11) _____

A) 1 L of this solution contains 28 mL of phosphoric acid
B) the density of this solution is 2.8 g/mL
C) 1 mL of this solution contains 28 g of phosphoric acid
D) 100 g of this solution contains 28 g of phosphoric acid
E) 1 L of this solution has a mass of 28 g

12) Molality is defined as the _____. 12) _____

A) moles solute/kg solution
B) moles solute/kg solvent
C) moles solute/liters solution
D) moles solute/moles solvent
E) none (dimensionless)

13) Which one of the following solutes has a limiting van't Hoff factor (i) of 3 when dissolved in water? 13) _____

A) KNO_3 B) sucrose C) Na_2SO_4 D) CH_3OH E) CCl_4

14) The concentration of HCl in a solution that is prepared by dissolving 5.5 g of HCl in 200 g of C_2H_6O is _____ molal. 14) _____

A) 27.5 B) 7.5×10^{-4} C) 0.75 D) 1.3 E) 3.3×10^{-2}

15) The molarity of urea in a solution prepared by dissolving 16 g of urea (MW = 60.0 g/mol) in 39 g of H_2O is _____ M. The density of the solution is 1.3 g/mL. 15) _____

A) 3.7 B) 6.8 C) 6.3 D) 0.16 E) 0.11

$$\frac{5.5\,g}{.2\,kg} \times \frac{1\,mol}{36.45\,g} = .75\,\frac{mol}{kg}$$

$$\frac{16\,g}{39\,g + 16\,g} \times \frac{1\,mol}{60\,g} \times \frac{1.3\,g}{1\,mL} \times \frac{1000\,mL}{1\,L} = 6.3\,\frac{mol}{L}$$

$2.41\times10^{-4}M = S = (.650)\left(3.7\times10^{-4}\frac{M}{atm}\right)$

16) The Henry's law constant for helium gas in water at 30 °C is 3.70×10^{-4} M/atm. When the partial pressure of helium above a sample of water is 0.650 atm, the concentration of helium in the water is _____ M. 16) _____

A) 5.69×10^{-4}
B) 3.70×10^{-4}
C) 2.41×10^{-4}
D) 1.76×10^{3}
E) 1.30

$21g \times \frac{1mol}{60g} = .35 \quad x = \frac{4.166}{4.166 + .35}$

$75g \times \frac{1mol}{18g} = 4.166 \quad (23.8)(.922) =$

17) The vapor pressure of pure water at 25 °C is 23.8 torr. Determine the vapor pressure (torr) of water at 25 °C above a solution prepared by dissolving 21 g of urea (a nonvolatile, non-electrolyte, MW = 60.0 g/mol) in 75 g of water. 17) _____

A) 0.92 B) 0.35 C) 27 D) 2.9 E) 22

21.9 torr

18) Calculate the freezing point of a 0.08500 m aqueous solution of $NaNO_3$. The molal freezing-point-depression constant of water is 1.86 °C/m. 18) _____

A) −0.158 B) 0.0425 C) −0.316 D) −0.0790 E) 0.0790

19) An aqueous solution of a soluble compound (a nonelectrolyte) is prepared by dissolving 33.2 g of the compound in sufficient water to form 250 mL of solution. The solution has an osmotic pressure of 1.2 atm at 25 °C. What is the molar mass (g/mole) of the compound? 19) _____

A) 2.3×10^{2} B) 1.0×10^{3} C) 2.7×10^{3} D) 6.8×10^{2} E) 28

$M = \frac{1.2atm}{\left(.0821\frac{L\,atm}{mol\,K}\right)(298K)}$

$4.9\times10^{-2}\frac{mol}{L} \times .250L = \frac{33.2g}{.0122\,mol}$

$(.085M)\left(1.86\frac{°C}{m}\right)2 = 2.700\,g/mol$

$F.P. = -0.316\,°C$

20. 1-Octanol has a higher boiling point than decane because

$CH_3(CH_2)_8CH_3$	$CH_3(CH_2)_6CH_2OH$
Decane: bp 174°C	1-Octanol: bp 195°C

A. 1-octanol is an ionic compound
B. 1-octanol has a higher molecular weight than decane
C. hydrogen bonding is possible in 1-octanol but not in decane
D. 1-octanol has more covalent bonds that must be broken in order to vaporize it than decane does
E. there are more induced dipole-induced dipole forces per mole in 1-octanol than in decane

21. Which one of the following is the best conductor of electricity?

A. Diamond B. Quartz C. Silicon D. Silver E. Water

22. How much heat is required to convert 9.0 g of ice at -5 °C to water at 25 °C?

A. 4030 J C. 4880 J E. 5840 J
B. 4510 J D. 5370 J

$\Delta H°_{fusion} = 333$ J/g
$\Delta H°_{vaporization} = 2258$ J/g
Specific heats: ice = 2.10 $J \cdot g^{-1} \cdot °C^{-1}$
water = 4.18 $J \cdot g^{-1} \cdot °C^{-1}$

23

24. High surface tension is favored by:

A. weak intermolecular forces
B. strong intermolecular forces
C. high vapor pressure
D. low vapor pressure
E. high osmotic pressure

$q_1 = (9g)\left(2.1\frac{J}{g\,°C}\right)(5°C) = 94.5\,J$

$q_2 = 9g \times \frac{333\,J}{g} = 2997\,J$

$q_3 = (9g)\left(4.18\frac{J}{g\,°C}\right)(25) = 940.5\,J$

$q_1 + q_2 + q_3 = 4032$

14

$$\frac{5.5\,g\ HCl}{0.2\,kg} \times \frac{1\,mol\ HCl}{36.45\,g} = \frac{0.75\,mol}{kg}$$

15

$$\frac{16\,g\ urea}{(39\,g + 16\,g)\ solution} \times \frac{1\,mol\ urea}{60\,g}$$

$$\times \frac{1.3\,g}{1\,mL\ solution} \times \frac{1000\,mL}{1\,L} = \frac{6.3\,mol}{L}$$

16

$$S = kP$$

$$= (.650\,atm)\left(3.70\times10^{-4}\,\frac{M}{atm}\right)$$

$$= 2.41\times10^{-4}\,M$$

17

$$21\text{g urea} \times \frac{1\text{mol}}{60\text{g}} = 0.35\text{mol urea}$$

$$75\text{g } H_2O \times \frac{1\text{mol}}{18\text{g}} = 4.166\text{ mol } H_2O$$

$$P_{solv} = X_{solv} P^{\circ}$$

$$X_{solv} = \frac{4.166}{4.166 + 0.35}$$

$$= 0.922$$

$$= (0.922)(23.8\text{ torr})$$

$$= 21.9\text{ torr}$$

18

$$\Delta T = i m k_f$$

i $NaNO_3 = 2$

$$= 2(0.085\text{m})\left(1.86\frac{^{\circ}C}{m}\right)$$

$$= 0.316^{\circ}C$$

$$F.P. = -0.316^{\circ}C$$

19

$$\pi = MRT$$

$$M = \frac{\pi}{RT}$$

$$= \frac{1.2\ atm}{\left(0.0821 \frac{L\ atm}{mol\ K}\right)(298\ K)}$$

$$= 4.9 \times 10^{-2} \frac{mol}{L} \times 0.25\ L$$

$$= \frac{33.2\ g}{0.01226\ mol}$$

$$= 2700\ g/mol$$

22

q_1 q_2 q_3

$$q_1 = (9g)\left(\frac{2.1\,J}{g\,^\circ C}\right)(5\,^\circ C)$$

$$= 94.5\,J$$

$$q_2 = 9g \times \frac{333\,J}{g} = 2997\,J$$

$$q_3 = (9g)\left(\frac{4.185\,J}{g\,^\circ C}\right)(25\,^\circ C)$$

$$= 940.5\,J$$

$$\Delta H = q_1 + q_2 + q_3$$

$$= 94.5\,J + 2997\,J + 940.5\,J$$

$$= 4032\,J$$