Test
General Chemistry CH116
UMass Boston
Summer 2013

Name_____

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

1) The pressure exerted by a column of liquid is equal to the product of the height of the column times the gravitational constant times the density of the liquid, P = *ghd*. How high a column of water (d = 1.0 g/mL) would be supported by a pressure that supports a 713 mm column of mercury (d = 13.6 g/mL)? 1) _____
   A) 14 mm
   B) 52 mm
   C) 9.7×10^3 mm
   D) 713 mm
   E) 1.2×10^4 mm

2) According to kinetic-molecular theory, in which of the following gases will the root-mean-square speed of the molecules be the highest at 200 °C? 2) _____
   A) SF_6
   B) HCl
   C) H_2O
   D) Cl_2
   E) None. The molecules of all gases have the same root-mean-square speed at any given temperature.

3) A sample of oxygen gas (O_2) was found to effuse at a rate equal to three times that of an unknown gas. The molecular weight of the unknown gas is _____ g/mol. 3) _____
   A) 10.7 B) 288 C) 96 D) 4 E) 55

4) A real gas will behave most like an ideal gas under conditions of _____. 4) _____
   A) low temperature and low pressure
   B) high temperature and low pressure
   C) STP
   D) high temperature and high pressure
   E) low temperature and high pressure

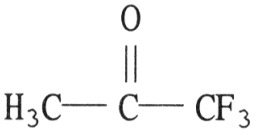
5) Which one of the following exhibits dipole-dipole attraction between molecules? Think about the shape of the molecule before answering the question. 5) _____
   A) AsH_3 B) Cl_2 C) CO_2 D) XeF_4 E) BCl_3

6) What is the predominant intermolecular force in CBr_4? 6) _____

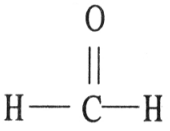
A) ionic bonding
B) dipole-dipole attraction
C) ion-dipole attraction
D) hydrogen-bonding
E) London-dispersion forces

7) Which one of the following substances will have hydrogen bonding as one of its intermolecular forces? 7) _____

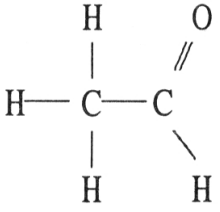
A)



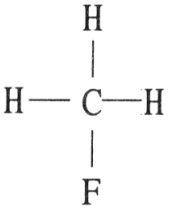
B)



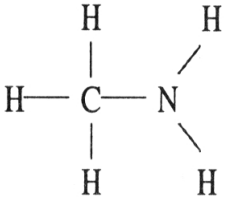
C)



D)



E)



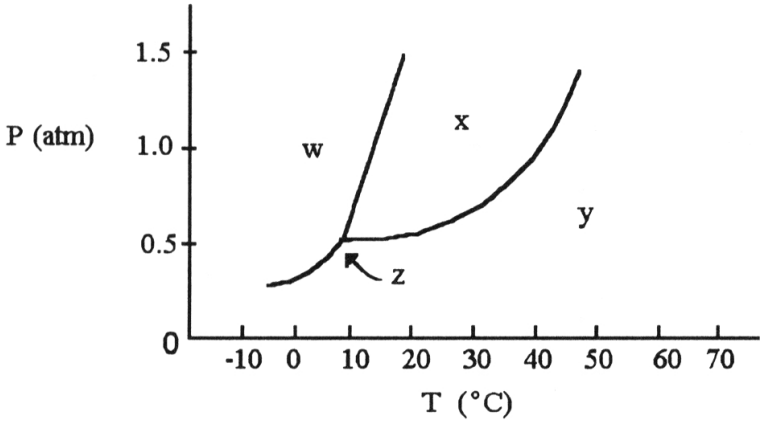
answer

8) The property responsible for the "beading up" of water is _____. 8) _____

A) viscosity
B) vapor pressure
C) hydrogen bonding
D) density
E) surface tension

9) The vapor pressure of any substance at its normal boiling point is 9) _____
A) 1 torr
B) 1 atm
C) equal to atmospheric pressure
D) 1 Pa
E) equal to the vapor pressure of water

10) Some things take longer to cook at high altitudes than at low altitudes because _____. 10) _____
A) heat isn't conducted as well in low density air
B) there is a higher moisture content in the air at high altitude
C) natural gas flames don't burn as hot at high altitudes
D) water boils at a higher temperature at high altitude than at low altitude
E) water boils at a lower temperature at high altitude than at low altitude



11) The phase diagram of a substance is given above. This substance is a _____ at 25°C and 1.0 atm. 11) _____
A) liquid
B) gas
C) crystal
D) supercritical fluid
E) solid

12) On a phase diagram, the critical temperature is _____. 12) _____
A) the temperature required to cause sublimation of a solid
B) the temperature below which a gas cannot be liquefied
C) the temperature at which all three states are in equilibrium
D) the temperature required to melt a solid
E) the temperature above which a gas cannot be liquefied

13) The volume of an ideal gas is zero at _____. 13) _____
A) -273 K B) -273 °C C) -363 K D) -45 °F E) 0 °C

14) The molar volume of a gas at STP is _____ L. 14) _____
A) 22..4 B) 62.36 C) 0.08206 D) 14.7 E) 1.00

15) Standard temperature and pressure (STP), in the context of gases, refers to _____. 15) _____

A) 273 K and 1 atm
B) 273 K and 1 pascal
C) 298 K and 1 torr
D) 298 K and 1 atm
E) 273 K and 1 torr

16) Of the following, _____ has the highest boiling point. 16) _____

N_2
Br_2
H_2
Cl_2
O_2

A) O_2 B) N_2 C) Br_2 D) H_2 E) Cl_2

17) In a Torricelli barometer, a pressure of one atmosphere supports a 760 mm column of mercury. If the original tube containing the mercury is replaced with a tube having twice the diameter of the original, the height of the mercury column at one atmosphere pressure is _____ mm. 17) _____

A) 380 B) 4.78×10^3 C) 760 D) 121 E) 1.52×10^3

18) A sample of a gas (5.0 mol) at 1.0 atm is expanded at constant temperature from 10 L to 15 L. The final pressure is _____ atm. 18) _____

A) 1.5 B) 15 C) 0.67 D) 7.5 E) 3.3

19) Which of the following equations shows an incorrect relationship between pressures given in terms of different units? 19) _____

A) 1.20 atm = 122 kPa
B) 1.0 torr = 2.00 mm Hg
C) 0.760 atm = 578 mm Hg
D) 152 mm Hg = 2.03×10^4 Pa
E) 1.00 atm = 760 torr

20) In a saturated solution of a salt in water, _____. 20) _____

A) seed crystal addition may cause massive crystallization
B) the rate of crystallization > the rate of dissolution
C) the rate of dissolution > the rate of crystallization
D) the rate of crystallization = the rate of dissolution
E) addition of more water causes massive crystallization

21) The van der Waals equation for real gases recognizes that _____. 21) _____

A) molar volumes of gases of different types are different
B) the non-zero volumes of gas particles effectively decrease the amount of "empty space" between them
C) the molecular attractions between particles of gas decreases the pressure exerted by the gas
D) gas particles have non-zero volumes and interact with each other
E) all of the above statements are true

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

22) FIND YOUR PROBLEM

Ammonium nitrite (NH_4NO_2) decomposes upon heating to form N_2 gas.

$NH_4NO_{2(s)}$ --> $N_{2(g)} + 2H_2O$

When a sample of NH_4NO_2 is decomposed in a test tube 511 ml N_2 is collected over water at 26°C and 745 torr total pressure. How many grams of NH_4NO_2 were decomposed?

Total pressure of gas 745 torr

Net pressure of gas = total pressure — water vapor pressure

=(745 -25) torr = 720

Pressure in atm = 720torr X $\frac{1\ atm}{760\ torr}$ = 0.9473

Temperature = 26 o C = 299.149 K

PV = nRT

n=$\frac{PV}{RT}$ = $\frac{0.9473 \times 0.511\ L}{8.2100E\text{-}2\ Latm/molKx\ 299.1498K}$ =0.0197 moles

molar mass of amm. nitrite =64.05g/mol

grams of ammonium nitrite=0.01971 mols x 64.0520g/mol = 1.26 g ANSWER

Ammonium nitrite (NH_4NO_2) decomposes upon heating to form N_2 gas.

$NH_4NO_{2(s)}$ --> $N_{2(g)} + 2H_2O$

When a sample of NH_4NO_2 is decomposed in a test tube 616 ml N_2 is collected over water at 26°C and 766 torr total pressure. How many grams of NH_4NO_2 were decomposed?

Total pressure of gas 766 torr

Net pressure of gas = total pressure — water vapor pressure

=(766 -25) torr = 741

Pressure in atm = 741torr X $\frac{1\ atm}{760\ torr}$ = 0.97499

Temperature = 26 o C = 299.149 K

PV = nRT

n=$\frac{PV}{RT}$ = $\frac{0.97499 \times 0.6159\ L}{8.21000E\text{-}2\ Latm/molKx\,299.1499K}$ =2.4454183320463604E-2 moles

molar mass of amm. nitrite =64.0520g/mol

grams of ammonium nitrite=2.4454E-2 mols x 64.052g/mol = 1.57 g ANSWER

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

23) 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 35 g of urea (a nonvolatile, non-electrolyte, MW = 60.0 g/mol) in 75 g of water. 23) _____

A) 2.9 B) 21 C) 3.3 D) 0.88 E) 27

24) What is the freezing point (°C) of a solution prepared by dissolving 11.3 g of $Ca(NO_3)_2$ (formula weight = 164 g/mol) in 115 g of water? The molal freezing point depression constant for water is 1.86 °C/m. 24) _____

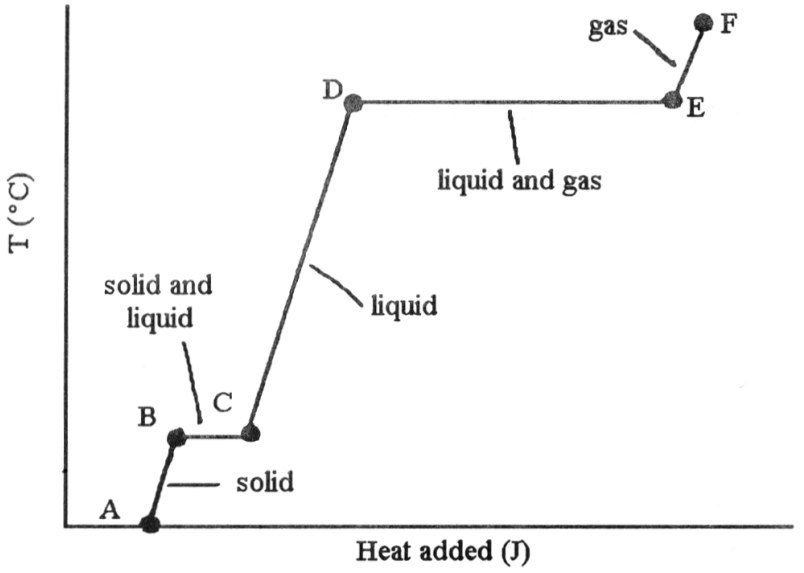
A) -3.34 B) -1.11 C) 3.34 D) 1.11 E) 0.00

25) Of the following, a 0.1 M aqueous solution of _____ will have the lowest freezing point. 25) _____

A) Na_2SO_4 B) $Al(NO_3)_3$ C) NaCl D) K_2CrO_4 E) sucrose

26) Which of the following is not a colloid? 26) _____

A) fog
B) homogenized milk
C) smoke
D) whipped cream
E) air

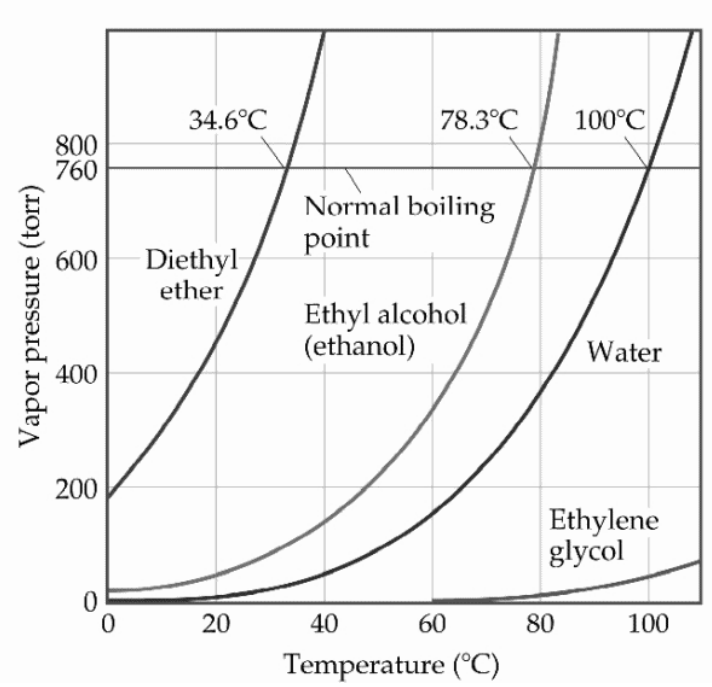


27) The phase changes B → C and D → E are not associated with temperature increases because the heat energy is used up to _____. 27) _____

A) break intramolecular bonds
B) rearrange atoms within molecules
C) increase distances between molecules
D) increase the density of the sample
E) increase the velocity of molecules

28) Ethanol (C_2H_5OH) melts at -114°C. The enthalpy of fusion is 5.02 kJ/mol. The specific heats of solid and liquid ethanol are 0.97 J/g-K and 2.3 J/g-K, respectively. How much heat (kJ) is needed to convert 25.0 g of solid ethanol at -135°C to liquid ethanol at -50°C? 28) _____

A) -12.7 B) 9.21 C) 6.91 D) 207.3 E) 4192



29) Based on the figure above, the boiling point of diethyl ether under an external pressure of 1.32 atm is _____°C. 29) _____

A) 10 B) 20 C) 0 D) 40 E) 30

30) Which of the following is not part of the kinetic-molecular theory? 30) _____

A) Atoms are neither created nor destroyed by ordinary chemical reactions.
B) The volume occupied by all of the gas molecules in a container is negligible compared to the volume of the container.
C) Gases consist of molecules in continuous, random motion.
D) Attractive and repulsive forces between gas molecules are negligible.
E) Collisions between gas molecules do not result in the loss of energy.

31) The density of chlorine gas at 1.21 atm and 34.9 °C is _____ g/L. 31) _____

A) 0.295 B) 0.423 C) 1.70 D) 3.39 E) 0.0479