Test 1

General Chemistry CH116

Summer, 2012

University of Massachusetts,

Boston

Name_____

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

1) Sodium hydride reacts with excess water to produce aqueous sodium hydroxide and hydrogen gas:

$$NaH\ (s) + H_2O\ (l) \rightarrow NaOH\ (aq) + H_2\ (g)$$

How many grams of NaH will produce 982 mL of gas at 28.0°C and 765 torr, when the hydrogen is collected over water. The vapor pressure of water at this temperature is 28 torr. .

2) How much heat is required to heat 10.0 g of ice at -5.00 oC to become liquid water at +7.00 ^{o}C? In this temperature range, the specific heat of ice is 37.7 J/molK, and the specific heat of $H_2O(l)$ is 75.8 J/molK. The molar heat of fusion of ice is 6.01 kJ/mol.

3) A sulfuric acid solution containing 571.6 g of H_2SO_4 per liter has a density of 1.329 g/ cm ^{3}. Calculate the molality of the solution.

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

4) A closed-end manometer was attached to a vessel containing argon. The difference in the mercury levels in the two arms of the manometer was 12.2 cm. Atmospheric pressure was 783 mm Hg. The pressure of the argon in the container was _____ mm Hg. 4) _____
A) 795 B) 122 C) 661 D) 771 E) 882

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

6) A sample of gas initially at 4.00 atm was compressed from 8.00 L to 2.00 L at constant temperature. After the compression, the gas pressure was _____ atm. 6) _____
A) 16.0 B) 1.00 C) 8.00 D) 2.00 E) 4.00

7) If 50.75 g of a gas occupies 10.0 L at STP, 129.3 g of the gas will occupy _____ L at STP. 7) _____
A) 12.9 B) 5.08 C) 50.8 D) 3.92 E) 25.5

8) A sample of N_2 gas (2.0 mmol) effused through a pinhole in 5.5 s. It will take _____ s for the same amount of CH_4 to effuse under the same conditions. 8) _____
A) 3.1 B) 4.2 C) 5.5 D) 7.3 E) 9.6

9) Gaseous mixtures _____. 9) _____
A) are all homogeneous
B) can only contain molecules
C) are all heterogeneous
D) can only contain isolated atoms
E) must contain both isolated atoms and molecules

10) 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)? 10) _____
A) 52 mm
B) 9.7×10^3 mm
C) 1.2×10^4 mm
D) 14 mm
E) 713 mm

11) Of the following, _____ is a correct statement of Boyle's law. 11) _____

A) PV = constant

B) $\frac{P}{V}$ = constant

C) $\frac{n}{P}$ = constant

D) $\frac{V}{T}$ = constant

E) $\frac{V}{P}$ = constant

12) The volume of an ideal gas is zero at _____. 12) _____

A) -273 K B) 0°C C) -363 K D) -273°C E) -45°F

13) The molar volume of a gas at STP is _____ L. 13) _____

A) 14.7 B) 22.4 C) 62.36 D) 1.00 E) 0.08206

14) Standard temperature and pressure (STP), in the context of gases, refers to _____. 14) _____

A) 273.15 K and 1 pascal
B) 298.15 K and 1 atm
C) 273.15 K and 1 atm
D) 298.15 K and 1 torr
E) 273.15 K and 1 torr

15) The kinetic-molecular theory predicts that pressure rises as the temperature of a gas increases because _____. 15) _____

A) the gas molecules collide less frequently with the wall
B) the average kinetic energy of the gas molecules decreases
C) the gas molecules collide more energetically with the wall
D) the gas molecules collide more frequently with the wall
E) both the gas molecules collide more frequently with the wall and the gas molecules collide more energetically with the wall

16) A tank containing both HF and HBr gases developed a leak. The ratio of the rate of effusion of HF to the rate of effusion of HBr is _____. 16) _____

A) 4.04 B) 16.3 C) 2.01 D) 0.497 E) 0.247

17) Which one of the following gases would have the highest average molecular speed at 25°C? 17) _____

A) O_2 B) SF_6 C) N_2 D) CO_2 E) CH_4

18) A sample of oxygen gas was found to effuse at a rate equal to two times that of an unknown gas. The molecular weight of the unknown gas is _____ g/mol. 18) _____

A) 8 B) 8.0 C) 16 D) 128 E) 64

19) The van der Waals equation for real gases recognizes that _____. 19) _____

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

20) Hydrogen bonding is a special case of _____. 20) _____

A) ion-ion interactions
B) London-dispersion forces
C) dipole-dipole attractions
D) ion-dipole attraction
E) none of the above

21) What type(s) of intermolecular forces exist between Br_2 and CCl_4? 21) _____

A) dispersion forces and ion-dipole
B) dispersion forces, ion-dipole, and dipole-dipole
C) dispersion forces
D) dispersion forces and dipole-dipole
E) None. Since both are gases at room temperature, they do not interact with each other.

22) Which statements about viscosity are true? 22) _____

(i) Viscosity increases as temperature decreases.
(ii) Viscosity increases as molecular weight increases.
(iii) Viscosity increases as intermolecular forces increase.

A) (i) only
B) (i) and (iii)
C) (ii) and (iii)
D) none
E) all

23) Based on the following information, which compound has the strongest intermolecular forces? 23) _____

Substance	ΔH_{vap} (kJ/mol)
Argon (Ar)	6.3
Benzene (C_6H_6)	31.0
Ethanol (C_2H_5OH)	39.3
Water (H_2O)	40.8
Methane (CH_4)	9.2

A) Benzene B) Methane C) Ethanol D) Argon E) Water

24) Large intermolecular forces in a substance are manifested by _____. 24) _____

A) low vapor pressure
B) high boiling point
C) high critical temperatures and pressures
D) high heats of fusion and vaporization
E) all of the above

25) The critical temperature and pressure of CS_2 are 279°C and 78 atm, respectively. At temperatures above 279°C and pressures above 78 atm, CS_2 can only occur as a _____. 25) _____

A) liquid and gas
B) gas
C) liquid
D) supercritical fluid
E) solid

26) The vapor pressure of any substance at its normal boiling point is 26) _____

A) equal to the vapor pressure of water
B) 1 torr
C) 1 Pa
D) 1 atm
E) equal to atmospheric pressure

27) Some things take longer to cook at high altitudes than at low altitudes because _____. 27) _____

A) water boils at a higher temperature at high altitude than at low altitude
B) water boils at a lower temperature at high altitude than at low altitude
C) heat isn't conducted as well in low density air
D) there is a higher moisture content in the air at high altitude
E) natural gas flames don't burn as hot at high altitudes

28) When the phase diagram for a substance has a solid-liquid phase boundary line that has a negative slope (leans to the left), the substance _____. 28) _____

A) sublimes rather than melts under ordinary conditions
B) can go from solid to liquid, within a small temperature range, via the application of pressure
C) cannot go from solid to liquid by application of pressure at any temperature
D) melts rather than sublimes under ordinary conditions
E) cannot be liquefied above its triple point

29) Calculate the freezing point (0°C) of a 0.05500 m aqueous solution of glucose. The molal freezing-point-depression constant of water is 1.86°C/m. 29) _____

A) -0.0562 B) 0.106 C) -0.204 D) -0.102 E) 0.0286

30) When argon is placed in a container of neon, the argon spontaneously disperses throughout the neon because _____. 30) _____

A) of hydrogen bonding
B) a decrease in energy occurs when the two mix
C) of the large attractive forces between argon and neon atoms
D) the dispersion of argon atoms produces an increase in disorder
E) of solvent-solute interactions

31) Which one of the following substances would be the most soluble in CCl_4? 31) _____

A) NH_3
B) NaCl
C) $C_{10}H_{22}$
D) H_2O
E) CH_3CH_2OH

32) The solubility of nitrogen gas at 25°C and 1 atm is 6.8×10^{-4} mol/L. If the partial pressure of nitrogen gas in air is 0.76 atm, what is the concentration (molarity) of dissolved nitrogen? 32) _____

A) 1.1×10^{-5} M
B) 6.8×10^{-4} M
C) 4.9×10^{-4} M
D) 3.8×10^{-4} M
E) 5.2×10^{-4} M

33) Of the following, a 0.1 M aqueous solution of _____ will have the lowest freezing point. 33) _____

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