Name: _____ Class: _____ Date: Key ID: A

EXAM 4 CHM1151 SPRING 2005

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

C 1. Convert 439 mm Hg to kPa. (1 atm = 760 mm Hg = 101.325 kPa)

a. 0.578 kPa
b. 7.50 kPa
c. 58.5 kPa
d. 81.2 kPa
e. 3.29×10^3 kPa

$$439\ \text{mm Hg} \left| \frac{101.325\ \text{kPa}}{760\ \text{mm Hg}} \right. = \text{kPa}$$

b 2. At 0.966 atm, the height of mercury in a barometer is 734 mm. If the mercury was replaced with water, what height of water (in meters) would be supported at 0.966 atm? The densities of Hg and H_2O are 13.5 g/cm^3 and 1.00 g/cm^3, respectively.

a. 3.19 m
b. 9.91 m
c. 13.0 m
d. 18.4 m
e. 29.2 m

$$734 \times 10^{-3}\ \text{m} \left| \frac{13.5}{1} \right. = 9.91\ \text{m}$$

___ 3. At constant temperature, 10.0 L of N_2 at 0.983 atm is compressed to 2.88 L. What is the final pressure of N_2?

a. 0.283 atm
b. 0.293 atm
c. 2.98 atm
d. 3.41 atm
e. 28.3 atm

$P_1V_1 = P_2V_2$

$$P_2 = \frac{P_1V_1}{V_2} = \frac{(0.983\ \text{atm})(10.0\ \text{L})}{2.88\ \text{L}} = \text{atm}$$

___ 4. If the pressure of a confined gas is tripled while its temperature remains constant, what change will be observed?

a. The volume of the gas will triple.
b. The volume of the gas will decrease to 1/3 its original value.
c. The density of the gas will decrease to 1/3 its original value.
d. The volume will remain unchanged and the velocity of the molecules will increase.
e. The volume will remain unchanged and the velocity of the molecules will decrease.

___ 5. A balloon is filled with H_2 gas to a volume of 2.60 L at 27°C. The balloon is then placed in liquid nitrogen until its temperature reaches -125°C. What is the volume of the cooled balloon?

a. 0.780 L
b. 0.934 L
c. 1.28 L
d. 5.27 L
e. 0.562 L

$-125 + 273 = 148\ \text{K}$

$27 + 273 = 300\ \text{K}$

$P_1V_1T_2 = P_2V_2T_1$

$$V_2 = \frac{P_1V_1T_2}{P_2T_1} = \frac{(2.60\ \text{L})(148\ \text{K})}{(300\ \text{K})}$$

$\Rightarrow$ Assume P = Constant

___ 6. The pressure in a 10.0 L flask is 0.912 atm at 78°C. How many moles of gas are in the flask? (R = 0.08206 L·atm/mol·K)

a. 0.111 mol
b. 0.317 mol
c. 1.42 mol
d. 3.16 mol
e. 241 mol

$PV = nRT$

$$n = \frac{PV}{RT} = \frac{(0.912\ \text{atm})(10.0\ \text{L})}{\left(0.08206\ \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}\right)(78+273)\ \text{K}} = \text{mol}$$

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___ 7. Which of the following gases has the lowest density at 25°C and 5.0 atm?

a. CH_4 Lowest molar mass
b. O_2
c. N_2
d. CO_2
e. F_2

___ 8. A mass of 2.703 g of an unknown gas is introduced into an evacuated 5.00 L flask. If the pressure in the flask is 0.914 atm at 78°C, which of the following gases might be in the flask? (R = 0.08206 L·atm/mol·K)

a. N_2
b. C_2H_2
c. NH_3
d. HCl
e. NO

Find molar mass:
$P = 0.914$ atm
$V = 5.00$ L
$n =$
$T =$

$n = \frac{PV}{RT} = \frac{(0.914\text{ atm})(5.00\text{ L})}{(0.08206\frac{\text{L·atm}}{\text{mol·K}})(351\text{ K})} = 0.1586$ mol

Then $2.703\text{ g} \div 0.1586\text{ mol} = 17.04$ g/mol

___ 9. At 298 K and 1.00 atm, what is the volume of a mixture of gases containing 0.12 mol Ne, 0.25 mol He, and 0.30 mol N_2? (R = 0.08206 L·atm/mol·K)

a. 0.061 L
b. 0.67 L
c. 5.2 L
d. 12 L
e. 16 L

$PV = nRT$

$V = \frac{nRT}{P}$

$V = \frac{(0.12+0.25+0.30)\text{ mol}(0.08206\frac{\text{L·atm}}{\text{mol·K}})(298\text{ K})}{1.00\text{ atm}}$

$V = 16.4$ L

___ 10. A mixture of H_2 and Ne is placed in a 5.00 L flask at 20°C. The partial pressure of the H_2 is 1.4 atm and the partial pressure of the Ne is 2.1 atm. What is the mole fraction of H_2?

a. 0.11
b. 0.40
c. 0.60
d. 0.67
e. 1.5

$\frac{1.4}{(1.4+2.1)} = 0.4$

___ 11. Which of the following are postulates of kinetic-molecular theory of gases?

T 1. The distance between gas molecules is large in comparison to their size.
F 2. The velocity of a gas molecule is inversely proportional to its temperature.
T 3. Gas molecules are in constant, random motion.
T 4. At a given temperature, all gases have the same average kinetic energy.

a. 1 and 4
b. 1, 2, and 4
c. 1, 3, and 4
d. 2 and 3
e. 3 and 4

___ 12. Place the following gases in order of increasing average velocity at 25°C: Ar, Cl_2, CH_4, and HCl.

a. $CH_4 < Cl_2 < Ar < HCl$
b. $Cl_2 < Ar < HCl < CH_4$ ← by molar mass
c. $CH_4 < HCl < Cl_2 < Ar$
d. $HCl < Ar < Cl_2 < CH_4$
e. All gas molecules have the same velocity at 25°C.

Smallest is fastest

____ 13. Non-ideal behavior for a gas is most likely to be observed under conditions of
a. high temperature and high pressure.
(b.) low temperature and high pressure.
c. low temperature and low pressure.
d. standard temperature and pressure.
e. high temperature and low pressure.

____ 14. One way in which real gases differ from ideal gases is that the molecules of a real gas
a. have no kinetic energy.
b. occupy no volume.
(c.) are attracted to each other.
d. have positive and negative spins.
e. are always polar.

____ 15. Which one of the following substances will exhibit dipole-dipole intermolecular forces?
a. Kr
b. N_2
c. CO_2
d. CCl_4
(e.) CO ← different en values

____ 16. The following molecules are gases at room temperature: Ne, N_2, O_2, Cl_2, and SiH_4. Which one will have the highest boiling point?
a. Ne
b. N_2
c. O_2
(d.) Cl_2
e. SiH_4

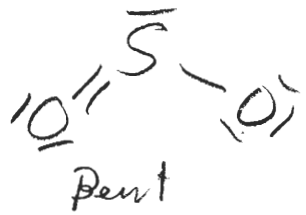
all are nonpolar, Cl_2 is most massive

____ 17. Which intermolecular forces are present in $SO_2(s)$?

1. London dispersion
2. dipole-dipole
3. hydrogen bonding

a. 1 only
b. 2 only
c. 3 only
(d.) 1 and 2
e. 1 and 3

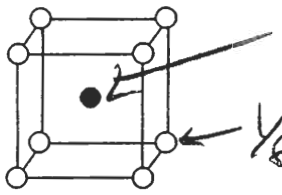
Cl 2×6 / 1×6 — 18 ve.



Pent

____ 18. The normal boiling point is defined as
a. the pressure of a gas when its temperature reaches 373.15 K.
(b.) the temperature at which the vapor pressure of a substance equals 1 atm.
c. the temperature at which water boils.
d. the pressure at which a liquid boils at 273.15 K.
e. the sum of the enthalpies of vaporization and fusion at 298 K.

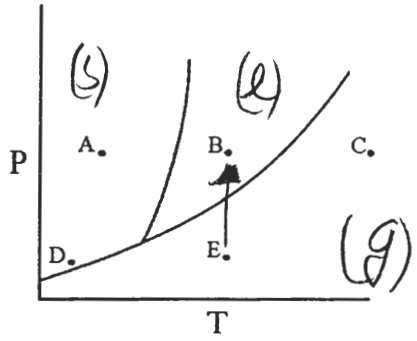
____ 19. In the unit cell below, element X is within the cell and element Y is at the corners. What is the formula for this compound?



$8 \times \frac{1}{8} = 1$ 1 : 1

(a.) XY
b. XY_2
c. XY_4
d. XY_8
e. X_2Y

____ 20. A line drawn between which two points results in a phase transition from gas to liquid?



Note direction of arrow

a. A to B
b. B to C
(c.) E to B
d. E to D
e. B to A

____ 21. To prepare approximately 1 liter of a solution that is 4.75% by mass NaCl, one should
a. dissolve 4.75 g NaCl in water up to a total volume of 1.00 L.
b. dissolve 47.5 g NaCl in 1.00×10^3 g water.
(c.) dissolve 47.5 g NaCl in 952.5 g water.
d. dissolve 952.5 g NaCl in 47.5 g water.
e. dissolve 46.5 g NaCl in 1.00 kg water.

$\frac{\text{part}}{\text{whole}} \times 100$

____ 22. Which of the following aqueous solutions should have the lowest freezing point?
a. pure H_2O
(b.) 1 *m* $CaBr_2$ ← gives 3 particles
c. 1 *m* NH_3
d. 1 *m* $NaNO_3$
e. 1 *m* $C_6H_{12}O_6$

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___ 23. What is the freezing point of a solution containing 5.663 grams naphthalene (molar mass = 128.2 g/mol) dissolved in 32.0 grams paradichlorobenzene? The freezing point of pure paradichlorobenzene is 53.0°C and the freezing point depression constant, K_{fp}, is -7.10°C/*m*.

(a) 43.2°C
b. 47.0°C
c. 51.7°C
d. 53.0°C
e. 69.1°C

$\Delta T_F = K_f m$

$= \frac{-7.10\,^\circ C}{m}\left(\frac{\left(\frac{5.663\,g\ naph}{128.2\,g/mol}\right)\ mol}{0.0320\,kg}\right) = -9.8\,^\circ C$

$53.0 - 9.8$

___ 24. Avogadro's law states that equal volumes of gases under the same conditions of temperature and pressure have equal _____.

a. masses
(b.) numbers of molecules
c. molar masses
d. densities
e. velocities

___ 25. What volume of O_2, measured at 27.2°C and 735 mm Hg, will be produced by the decomposition of 5.22 g $KClO_3$? (R = 0.08206 L·atm/mol·K)

$2\,KClO_3(s) \rightarrow 2\,KCl(s) + 3\,O_2(g)+$

5.22 g ? moles → L

a. 0.0983 L
b. 1.09 L
(c.) 1.63 L
d. 199 L
e. 133 L

$\frac{5.22\,g\ KClO_3}{122.55\,g} \left|\ \frac{3\ mol\ O_2}{2\ mol\ KClO_3}\right. = 0.0639\ mol\ O_2$

$PV = nRT$

$V = \frac{nRT}{P} = \frac{(0.0639\,mol)\left(0.08206\,\frac{L\cdot atm}{mol\cdot K}\right)(300.2\,K)}{\left(\frac{735\,mm\,Hg}{760\,mm\,Hg}\right)(1\,atm)}$

$V = 1.63\,L$