Gas Density & Graham's Law

____1) An assumption of the kinetic theory of gases (the ideal gas model) is that the particles of a gas have

(A) little attraction for each other and a significant volume
(B) little attraction for each other and an insignificant volume
(C) strong attraction for each other and a significant volume
(D) strong attraction for each other and an insignificant volume

____2) When a sample of a gas is heated at constant pressure, the average kinetic energy of its molecules

(A) decreases, and the volume of the gas increases
(B) decreases, and the volume of the gas decreases
(C) increases, and the volume of the gas increases
(D) increases, and the volume of the gas decreases

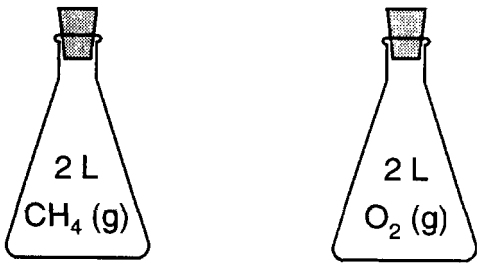
____3) A real gas behaves more like an ideal gas when the gas molecules are

(A) close and have strong attractive forces between them
(B) close and have weak attractive forces between them
(C) far apart and have strong attractive forces between them
(D) far apart and have weak attractive forces between them

____4) Helium is most likely to behave as an ideal gas when it is under

(A) high pressure and high temperature
(B) high pressure and low temperature
(C) low pressure and high temperature
(D) low pressure and low temperature

____5) Each stoppered flask below contains 2 liters of a gas at STP.



Each gas sample has the same

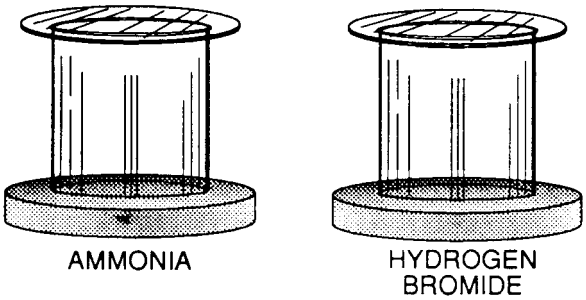
(A) density
(B) mass
(C) number of molecules
(D) number of atoms

____6) Which gas will diffuse at the fastest rate under the same conditions of temperature and pressure?

(A) O_2
(B) N_2
(C) F_2
(D) H_2

7) Consider the two gases Kr and Ar. Which gas will effuse from a small hole in a container more rapidly? How many times more rapidly?

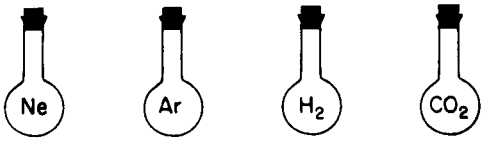
____8) The diagrams below represent 1-mole samples of ammonia (NH_3) and hydrogen bromide (HBr) gases at STP.



Compared to the ammonia sample, the hydrogen bromide sample has a

(A) larger mass and fewer molecules
(B) smaller mass and fewer molecules
(C) larger mass and an equal number of molecules
(D) smaller mass and an equal number of molecules

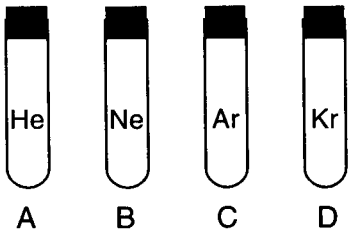
____9) The diagrams below represent four 500-milliliter flasks. Each flask contains the gas represented by its symbol. All gas samples are at STP.



Each flask contains the same number of

(A) atoms, only
(B) molecules, only
(C) atoms and molecules

____10) The stoppered tubes below, labeled *A* through *D*, each contain a different gas.



When the tubes are unstoppered at the same time and under the same conditions of temperature and pressure, from which tube will gas diffuse at the fastest rate?

(A) *A*
(B) *B*
(C) *C*
(D) *D*

11) Consider the two gases ammonia (NH_3) and butane (C_4H_{10}). Which gas will effuse from a small hole in a container more rapidly? How many times more rapidly?

Gas Density & Graham's Law

____12) Which gas diffuses most rapidly at STP?

(A) Ne
(B) Ar
(C) Cl_2
(D) F_2

13) Calculate the densities of the following gases at STP: Xe, Kr, NH_3, and C_4H_{10},

Gas Density & Graham's Law
Answer Key

1) B

2) C

3) D

4) C

5) C

6) D

7) Essay

8) C

9) B

10) A

11) Essay

12) A

13) Essay

Gas Density and Graham's Law

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(6) the one with the lightest particles, H_2

(7) Ar, 1.45 times faster

$$\frac{V_{Ar}}{V_{Kr}} = \sqrt{\frac{M_{Kr}}{M_{Ar}}} = \sqrt{\frac{83.80}{39.95}} = \sqrt{2.0976} = 1.45$$

(8) $NH_3 = 17.0$ g/mol
$HBr = 80.91$ g/mol

(C) same # of molecules (Avogadro's hypothesis) but the molecules weigh more.
Otherwise, use $PV=nRT$ to prove it to yourself.

(9) Molecules, only. Some of the molecules have more atoms than the others.

(10) He has lighter molecules

(11)
$$\frac{V_{NH_3}}{V_{C_4H_{10}}} = \sqrt{\frac{M_{C_4H_{10}}}{M_{NH_3}}} = \sqrt{\frac{58.1}{17.0}} = 1.85$$

NH_3 will effuse 1.85 times faster.

(12) Ne has the lightest molar mass

(13) →

Gas Density + Graham's Law

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$D = \frac{m}{V}$ at STP, one mol = 22.4 L

at any condition, including STP, one mol has a molar mass determined by looking at the per. table.

So, divide molar mass by 22.4

Xe $D = \frac{131.29\,g}{22.4\,L} = 5.86\,g/L$

Kr $D = \frac{83.80\,g}{22.4\,L} = 3.74\,g/L$

NH_3 $D = \frac{17.0\,g}{22.4\,L} = 0.759\,g/L$

C_4H_{10} $D = \frac{58.10\,g}{22.4\,L} = 2.59\,g/L$