AP Chemistry
Chapter 5: Gases Practice Quiz Name Key

Solve the following problems showing all work and formulas.

1. An open end manometer contains a column of mercury which is higher on the side connected to the gas. The difference in the levels of mercury in the two arms is 44 mm. If the barometric pressure is 738 torr, what is the pressure of the gas, in torr?

$P_{gas} < P_{atm} \Rightarrow P_{gas} = P_{atm} - \Delta h$

$44 mmHg = 44 torr$

$P_{gas} = (738 - 44) torr = 694 torr$

2. A sample of nitrogen occupies 4.35 L at 732 mmHg. If temperature remains constant, what will the pressure of the gas be if the volume is changed to 12.5 L?

$P_1V_1 = P_2V_2$

$(732)(4.35) = X(12.5)$

$X = \cancel{254.34}\ 255\ mmHg$

3. A balloon is filled with helium. Its volume is 5.90 L at 26°C. What will be its volume at -78°C, assuming no pressure change?

$\frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad \frac{5.9}{299} = \frac{V_2}{195}$

$V_2 = 3.8\ L$

4. What is the volume, in milliliters, of 837 mg of xenon gas at STP?

$$837\,mg \left| \frac{1\,g}{1000\,mg} \right| \left| \frac{1\,mol}{131.29\,g} \right| = 0.006$$

$$(1\,atm)\,V = (.006)(.0821)(273).$$

$$V = 0.153\,L$$

$$153\,mL$$

5. If a fixed amount of gas occupies 2.53 m^3 at a temperature of -15°C and 191 torr, what volume will it occupy at 25°C and 1142 torr?

$$\frac{(2.53\,m^3)(191\,torr)}{258\,K} = \frac{(1142\,torr)\,V}{298}$$

$$V = 0.489\,m^3$$

6. Calculate the pressure , in torr, of 1.57 x 10^{-3}mol of an ideal gas in a volume of 225 mL at 17°C.

$P = ?$,

$n = 1.57 \times 10^{-3}\,mol$

$V = 225\,mL \rightarrow .225\,L$

$T = 17°C \rightarrow 290K$

$$P(.225) = (1.57 \times 10^{-3})(62.4)(290$$

$$P = 126.3\,torr$$

7. Calculate the molecular mass of a liquid that when vaporized at 99°C and 716 torr gave 225 mL of vapor with a mass of 0.773 g.

$M = \frac{m}{n} \rightarrow MPV = \frac{m}{M}RT$

$M = \frac{mRT}{PV} = \frac{(0.773g)(62.4)(372K)}{(716torr)(.225L)}$

$M = 111.4\ g/mol$

8. At what pressure will $N_2(g)$ have a density of 0.985 g/L at 25°C?

$P = ?$
$M = 28\ g/mol$
$d = .985\ g/L$
$T = 298K$

$PM = DRT$

$P = \frac{DRT}{M} = \frac{(.985)(.0821)(298}{28}$

$P = .86\ atm$

654.1 torr

9. How many liters of $O_2(g)$ measured at 22°C and 763 torr are consumed in the complete combustion of 2.55 L dimethyl ether measured at 25°C and 748 torr?

$C_2H_6O(g) + 3O_2(g) \dashrightarrow 2CO_2(g) + 3H_2O(l)$ (unbalanced)

O_2

$T = 295\ K$
$P = 763\ torr$
$M = 32\ g/mol$
$n = 0.3077\ mol$

C_2H_6O

$V = 2.55\ L$
$T = 298\ K$
$P = 748\ torr$
$M = 46\ g/mol$

① mol C_2H_6O by $PV = nRT$

$(748)(2.55) = n(62.4)(298$
$n = 0.1026\ mol$

② mol-mol ratio

$.1026\ mol\ C_2H_6O \left| \frac{3\ mol\ O_2}{1\ mol\ C_2H_6O} \right. =$

$0.3077\ mol\ O_2$

③ V of O_2 by $PV = nRT$

$(763)V = (.3077)(62.4)(295K)$

Ar. (.354 g | 1 mol / 39.948 g)

Ar = $P = \frac{nRT}{V}$ = (.00886)(.0821)(298) / .267 = .812 atm

Ne = $P = \frac{nRT}{V}$ = (.00258)(.0821)(298) / .267 = .236 atm

Kr = $P = \frac{nRT}{V}$ = (.0000585)(.0821)(298) / .267 = .0053 atm

10. A 267 mL sample of a mixture of noble gases at 25.0°C contains 0.354 g Ar, 0.0521 g Ne, and 0.0049 g Kr. What is the total pressure of the mixture?

.354 g Ar | 1 mol / 39.948 g = .00886 mol Ar ; $\frac{.00886}{.0115}$ = .77 Ar (Mole frac.)

.0521 g Ne | 1 mol / 20.179 g = .00258 mol Ne = .224 Ne

.0049 g Kr | 1 mol / 83.80 g = .0000585 mol Kr ; .0050 Kr

mol total = .0115

$P_T = 1.0534$ atm

11. Oxygen is collected over water at 30.°C and a barometric pressure of 742 torr. What is the partial pressure of the oxygen? At 30.°C, P_{H_2O} = 31.8 mmHg

$P_T = P_{H_2O} + P_{gas}$ $P_T = P_{atm}$

742 torr = 31.8 torr + X

$P_{gas} = 710.2$ torr

12. At a certain temperature, the root-mean-square speed of CH_4 molecules is 1610 km/h. What is the root-mean square speed of CO_2 molecules at the same temperature?

$$\frac{rate_{CH_4}}{rate_{CO_2}} = \sqrt{\frac{M_{CO_2}}{M_{CH_4}}}$$

$$\frac{1610}{X} = \sqrt{\frac{44}{16}}$$

CO_2 big, so slower!

X = 970.8 km/h