Test Review - Gases

Write the equation, show work as done in class, include units, observe sig figs.

Gas Law Buffet

1. A rigid cylinder of compressed oxygen gas has a volume of 30 L and 100 atm of pressure at 27°C. The cylinder is cooled until the pressure is 5.0 atm. What is the new temperature of the gas in the cylinder?

2. An aerosol spray can with a volume of 250. mL contains 2.30 g of propane gas (C_3H_8) as a propellant. a) If the can is at 23°C, what is the pressure in the can? b) What volume would the propane occupy at STP? c) The can says the exposure to temperatures above 130°F may cause the can to burst. What is the pressure in the can at this temperature?

3. A sample of a gas (5.0 mol) at 1.5 atm is expanded from 10 L to 19 L at constant temperature. Calculate the new pressure.

4. If 3.21 mol of a gas occupies 56.2L, what volume will 5.29 mol of gas occupy under constant temperature and pressure?

5. At what temperature, in °C, will .444 mol of CO occupy 11.8L at 889 torr?

6. How many molecules are there in 4.00L of oxygen gas at 500°C and 50.0 torr?

7. A sample of helium gas has a volume of 200.0 mL at 0.960atm. What pressure, in atm, is needed to reduce the volume at constant temperature to 50.0 mL?

8. What mass of nitrogen dioxide gas is contained in a 4.32L vessel at 48°C and 141600 Pa?

Gas "Stoichin"

9. Magnesium nitride(s) reacts with water to produce magnesium hydroxide (aq) and ammonia (NH_3) gas. What volume (L) of NH_3 gas at STP is produced by the complete reaction of 7.5 g of liquid water?

10. If 706 L of oxygen gas is consumed in the combustion of C_2H_6, how many grams of C_2H_6 are required to react with this amount of oxygen? What volume of water vapor will be produced?

See Drill #2 ("Stoichin" at conditions other than STP practice)

Practice with molar volume at STP

11. How many moles of gas are contained in:
    a) 5.60 L of chlorine gas at STP? b) 70.0mL NH_3 at STP

12. How many grams would be contained in:
    a) 2.80 L carbon dioxide at STP b) 15.0 mL sulfur dioxide at STP

Dalton's Law of Partial Pressure

11. A mixture of 3 gases, A,B,and C, has a total pressure of 245 kPa. If the pressures of gases A and B are 107 kPa and 55 KPa, respectively, what is the pressure of gas C?

12. Oxygen gas is collected over water vapor at a temperature of 25 °C. If the collected sample has a pressure of 740. torr, what is the partial pressure of oxygen in the container? (water vapor exerts a pressure of 23.8 torr at 25 °C)

Molecular Weight (g/mol)

13. Find the molecular weight of a gas if 3.5g occupies 2.1 L at STP.
14. Find the molecular weight of a gas that has a density of 6.70 g/L at STP.

Density of a gas

15. Find the density of dinitrogen monoxide gas at 1.53 atm and 45.2°C.
16. Find the density of ammonia gas (NH_3) in a 4.32L container at 837 torr and 45.0 °C.

Rates of effusion

17. Compare the rate of effusion of carbon dioxide with that of hydrogen chloride at the same temperature and pressure.

18. A sample of hydrogen effuses through a porous container about 9 times faster that an unknown gas. Estimate the molar mass of the unknown gas.

19. Ammonia (NH_3) and alcohol (C_2H_6O) are released together across a room. Which will you smell first and why?

1) rigid container, 30L (just information) the volume does not change in this problem.

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\quad \frac{100.\text{atm}}{300.\text{K}} = \frac{5.0\text{atm}}{T_2}$ $\quad \boxed{T_2 = 15\text{K}}$

2) a) $PV = nRT$

$2.30\text{g}\,C_3H_8 \left| \frac{1\text{mol}}{44.11\text{g}} \right. = .0521\text{mol}\ C_3H_8$

$P(.250\text{L}) = (.0521\text{mol})(.0821)(296\text{K})$

$\boxed{P = 5.06\text{ atm}}$

b) $PV = nRT$ (moles did not change)

$(1.00\text{atm})\ V = (.0521\text{mol})(.0821)(273\text{K})$

$\boxed{V = 1.17\text{L}}$

c) $°C = \frac{F° - 32}{1.8}$ $\quad °C = \frac{130°F - 32}{1.8}$ $\quad °C = 54°C$

$+ 273 = 327\text{K} = T$

$PV = nRT$

$P(.250\text{L}) = (.0521\text{mol})(.0821)(327\text{K})$

$\boxed{P = 5.59\text{ atm}}$

3) (mol - did not change, temp did not change)

$P_1V_1 = P_2V_2$ $\quad (1.5\text{atm})(10.\text{L}) = P_2(19\text{L})$

$\boxed{.79\text{atm} = P_2}$

4) $\frac{n_1}{V_1} = \frac{n_2}{V_2}$ $\quad \frac{3.21\text{mol}}{56.2\text{L}} = \frac{5.29\text{mol}}{V_2}$ $\quad \boxed{V_2 = 92.6\text{L}}$

5) $PV = nRT$

$\left(\frac{889\text{ torr}}{760\text{ torr}}\right)(11.8\text{L}) = (.444\text{mol})(.0821)T$

(1.17atm)

$\boxed{T = 378.6 - 273 = 106°C}$

6) (Molecules connected to moles) (need moles)

$PV = nRT$

$(50.0\,torr / 760.\,torr)(4.00L) = n(.0821)(273K)$

$n = .00415\,mol \left| \frac{6.02 \times 10^{23}\,molec}{1\,mol} \right. = \boxed{2.50 \times 10^{21}\ molecules}$

7) $P_1V_1 = P_2V_2$

$(.960atm)(200.0mL) = P_2(50.0mL)$

$\boxed{3.84\,atm = P_2}$

8) What mass (g) (need moles)

$PV = nRT$

$(141600\,Pa / 101325\,Pa)(4.32L) = n(.0821)(321K)$

$(1.40atm)$

$n = .229\,mol\,NO_2 \left| \frac{46.01g}{1\,mol\,NO_2} \right. = \boxed{10.5g\,NO_2}$

Stoich

7.5g / .416 mol — ? vol (L)

9) (STP) $Mg_3N_2(s) + \boxed{6}H_2O(l) \rightarrow 3Mg(OH)_2(aq) + \boxed{2}NH_3(g)$

$7.5g\,H_2O \left| \frac{1\,mol\,H_2O}{18.02g\,H_2O} \right. \left| \frac{2\,mol\,NH_3}{6\,mol\,H_2O} \right. = .14\,mol\,NH_3$

$(.416\,mol)$

OR $\frac{1\,mol}{22.4L} = \frac{.14\,mol}{XL}$ $\boxed{X = 3.1L}$

$PV = nRT$

$(1.00atm)(V) = (.14mol)(.0821)(273k)$

$\boxed{V = 3.1L\ NH_3}$

? g — 706L

STP / forgot on sheet

10) $2C_2H_6 + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(g)$

$PV = nRT$

$(1.00atm)(706L) = n(.0821)(273k)$

$n = 31.5\,mol\,O_2 \left| \frac{2\,mol\,C_2H_6}{7\,mol\,O_2} \right. \left| \frac{30.08g}{1\,mol\,C_2H_6} \right. = \boxed{271g\,C_2H_6}$

10) ? vol of $H_2O(g)$ — mol of H_2O

$$31.5\,mol\,O_2 \left| \frac{6\,mol\,H_2O}{7\,mol\,O_2} \right. = 27.0\,mol\ H_2O$$

$PV = nRT$ $\quad (1.00\,atm)V = (27.0\,mol)(.0821)(273\,K)$

$V = 605\,L\ H_2O(g)$

11) $\frac{1\,mol}{22.4\,L} = \frac{x\,mol}{5.60\,L}$ $\quad x = .25\,mol$

12) (CO_2) $\frac{1\,mol}{22.4\,L} = \frac{x\,mol}{2.80\,L}$ $\quad x = .125\,mol\,CO_2 \left| \frac{44.01\,g}{1\,mol\,CO_2} \right. = 5.50\,g\,CO_2$

11. $P_{total} = P_A + P_B + P_C$

$245\,KPa = 107\,KPa + 55\,kPa + P_C$

$83\,kPa = P_C$

12. $P_{dry\,gas} = P_{total} - P_{H_2O}$

$P_{O_2} = 740.\,torr - 23.8\,torr$

$P_{O_2} = 716\,torr$

13. $MM = \frac{m(RT)}{V(P)}$ $\quad MM = \frac{(3.5\,g)(.0821)(273\,K)}{(2.1\,L)(1.00\,atm)} = 37\,g/mol$

14. $MM = \frac{m(RT)}{V(P)}$ $\quad MM = \frac{(6.70\,g)(.0821)(273\,K)}{(L)(1.00\,atm)} = 150.\,g/mol$

15. $d = \frac{(MM)(P)}{RT}$ $\quad (N_2O)$ $\quad d = \frac{(44.02\,g/mol)(1.53\,atm)}{(.0821)(318\,K)} = 2.58\,g/L$

16. $d = \frac{(MM)(P)}{RT}$ $\quad (NH_3)$ $\quad d = \frac{(17.04\,g/mol)(837/760\,torr)}{(.0821)(318\,K)} = .718\,g/L$

(1.10 atm)

17. $\frac{r_{CO_2}}{r_{HCl}} = \sqrt{\frac{36.46\ g/mol}{44.01\ g/mol}} = .91$

CO_2 effuse .91 X as fast as HCl
(heavier & slower)

or HCl effuses 1.1 X faster than CO_2

18. $\frac{r_{H_2}}{r_X} = \sqrt{\frac{MM}{2.02\ g/mol}}$

$9 = \sqrt{\frac{MM}{2.02\ g/mol}}$

$9^2 = \frac{MM}{2.02\ g/mo}$

$MM = 164\ g/mol$

19. 17.04 g/mol (NH_3) vs 46.08 g/mol (C_2H_6O)

Will smell NH_3 1st - less mass, moves faster