Chapter 5 HW ~~9, 11, 13, 21, 23, 25, 27, 31, 33, 35, 37, 44, 46, 48, 52, 54, 56, 58, 67, 69, 73, 78, 87, 91, 95, 108, 111, 113, 142, 144~~

(9) (a) $76.8\text{ cmHg} \times \frac{10\text{ mmHg}}{1\text{ cmHg}} \times \frac{1\text{ atm}}{760\text{ mmHg}} = \boxed{1.01\text{ atm}}$

(b) $27.5\text{ atm} \times \frac{101.325\text{ KPa}}{1\text{ atm}} = \boxed{2786.44\text{ KPa}}$

(c) $6.50\text{ atm} \times \frac{1.01325\text{ bar}}{1\text{ atm}} = \boxed{6.586\text{ bar}}$

(d) $0.937\text{ KPa} \times \frac{760\text{ torr}}{101.325\text{ KPa}} = \boxed{7.03\text{ torr}}$

(11) $\Delta H = 1.30\text{ cm} = 13\text{ mm}$

atm pressure $= 765.2\text{ mmHg}$

$P_{gas} = 765.2 - 13 = \boxed{752.2\text{ mmHg}}$

$752.2\text{ mmHg} \times \frac{101.325\text{ KPa}}{760\text{ mmHg}} = \boxed{100.3\text{ KPa}}$

(13) $\Delta H = 3.56\text{ cm} = 35.6\text{ mmHg} \times \frac{101.325\text{ KPa}}{760\text{ mmHg}} = 4746.26\text{ Pa}$ $\boxed{4.75 \times 10^3\text{ Pa}}$

(21) have 1 mol gas

(a) 760 torr to $202\text{ KPa} \times \frac{760\text{ torr}}{101.325\text{ KPa}} = 1515\text{ torr}$ pressure doubles

310.15 K to 155 K pressure decrease by ½

$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T}$ $\frac{760(1)}{310.1K} = \frac{1515(V)}{155} = V_2 = 0.25L$

(21b) $T_1 = 305K$ $T_2 = 32°C = 305.15K$

$P_1 = 2atm$ $P_2 = 101kPa \times \frac{1atm}{101kPa} = 1atm$

$\frac{P_1V_1}{\cancel{T_1}} = \frac{P_2V_2}{\cancel{T_2}}$ $2(1) = 1(V_2)$

$V_2 = 2L$ ☆ volume doubles at pressure decrease by ½

(c) Pressure reduced by factor of 4 at Constant T

$P_1V_1 = P_2V_2$

$4(1) = 1(x)$ ☆ volume will be 4x greater if pressure reduced by factor of 4

$V_2 = 4$

(23) (a) $P_1 = 722\ torr \times \frac{1atm}{760\ torr} = 0.95atm$ $P_2 = 0.950atm$ neither pressure or temperature change so **NO** change in Volume

$T_1 = 0C + 273.15 = 273.15K$ $T_2 = 273K$

(b) half of gas escapes, volume is ½.

(c) $P = 1$ $P = 0.25atm$

$T = 100K$ $T = 25K$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ volume remains constant under these conditions

$\frac{1(1)}{100} = \frac{0.25(V_2)}{25}$

$V_2 = 1$

(25) $CH_4$ $V = 10.0L$ $V = 7.50L$ $P_1V_1 = P_2V_2$

$T = 25C = 298.15K$ $T = 298.15K$ $725(10) = P_2(7.50)$

$P = 725mmHg$ $P = ?$ $\boxed{P_2 = 966.67\,mmHg}$

(27) $V = 93L$ $V_2 = ?$

$T_1 = 145°C = 418.15$ $T_2 = -22°C = 251.15K$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad \frac{93}{418.15} = \frac{V_2}{251.15}$$

$V_2 = 55.9L$

(31) 1 inhale = 500mL = $1\times10^{22}$ molecules $\quad$ ~~P~~V = n~~RT~~

$$\frac{500}{1\times10^{22}} = \frac{350}{x}$$

$x = 7.0\times10^{21}$ molecules of air

(33) $V = 3.65L$ $V_2 = ?$

$T = 298K$ $T_2 = -14°C = 259.15$

$P = 745\text{ torr} \times \frac{1\text{ atm}}{760\text{ torr}} = 0.980\text{ atm}$ $\quad P_2 = 367\text{ torr}$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{745(3.65)}{298} = \frac{367(V_2)}{259.15}$$

$V_2 = 6.44\text{ L}$

(35) $n = 1.47\times10^{-3}$ mol $\quad PV = nRT$

$V = 75.0mL = 0.075L$ $\quad P(0.075) = 1.47\times10^{-3}(0.0821)(299.15)$

$T = 26°C = 299.15$ $\quad P = 0.481\text{ atm} \times \frac{760\text{ torr}}{1\text{ atm}} = 365.8\text{ torr}$

$P = ?$ torr

(37) $n = 75.0g\ N_2O \times \frac{1\text{ mol}}{44\text{ g}} = 1.705\text{ mol}$

$V = 3.1L$ $\quad PV = nRT$

$P = ?$ atm $\quad P(3.1) = 1.705(0.0821)(388.15)$

$T = 115°C = 388.15K$ $\quad P = 17.53\text{ atm} = 18\text{ atm}$

(44) (a) highest partial pressure = gas C (green) most # particles

(b) lowest partial pressure = gas B (black) fewest # particles

(c) $P_{tot} = 0.75$ atm

$\chi_{O_2} = \frac{4}{16} = 0.25$ so $0.25(0.75) =$ 0.19 atm is partial pressure of $O_2$

(46) ? density Freon-11 ($CFCl_3$) at 120°C = 393.15 P = 1.5 atm

$$d = \frac{P(M)}{RT} \quad \frac{1.5(137.36)}{0.0821(393.15)} = \boxed{6.38\,g/L}$$

(48) d = 2.71 g/L
P = 3.0 atm
T = 273.15 K

$$d = \frac{P(M)}{RT} \quad 2.71 = \frac{3.0(M)}{0.0821(273.15)}$$

$$\boxed{M = 20.3\,g/mol = \text{Neon gas}}$$

(52) V = 355 mL
n = 0.146 g Ne
n = ? g Ar
$P_{tot}$ = 626 mmHg = .824 atm
? mol Ar
T = 35°C = 308.15

PV = nRT
0.824(0.355) = n(0.0821)(308.15)
n = 0.01156 moles = total moles

$$0.146g \times \frac{1\,mol}{20.18g} = 0.0072\,mol\ Ne$$

mol Ar = 0.01156 − 0.0072 = 0.0043 mol Ar

(54) $2KClO_{3(s)} \rightarrow 2KCl_{(s)} + 3O_2$
?g .638 L

V = 0.638 L of $O_2$
T = 128°C = 401.15 K

$$P = 752\,torr \times \frac{1\,atm}{760\,torr} = 0.989\,atm$$

PV = nRT
0.989(0.638) = n(0.0821)(401.15)

$$n = 0.019\,mol\ O_2 \times \frac{2\,mol\ KClO}{3\,mol\ O_2} \times \frac{122.55\,g}{1\,mol\ KClO} = \boxed{1.55\,g\ KClO}$$

(56) $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$ ★ limiting problem
at STP 35.6 L 40.5 L ?g

$$35.6\,L\,NH_3 \times \frac{4\,L\,NO}{4\,L\,NH_3} = 35.6\,L\,NO$$

$$40.5\,L \times \frac{4\,mol\ NO}{5\,mol\ O_2} = 32.4\,L$$

PV = nRT
1(32.4) = n(0.0821)(273.15)

$$n = 1.44\,mol \times \frac{30g}{1\,mol} = \boxed{43.2g\ NO}$$

(58) ?L $H_2$ collected over water

$T = 18°C = 291.15K$

$P = 725 mmHg$ $P_{H_2O} = 15.5 torr$

$2Li + 2H_2O \rightarrow H_2 + 2LiOH$

0.84g → ?L

$0.84g\,Li \times \frac{1\,mol\,Li}{6.94\,g\,Li} \times \frac{1\,mol\,H_2}{2\,mol\,Li} = 0.0605\,mol\,H_2$ formed

$P_{total} = P_{gas} + P_{H_2O}$

$725 = P_{gas} + 15.5$

$P_{gas} = 709.5\,mmHg \times \frac{1\,atm}{760\,mmHg} = 0.9336\,atm$

$PV = nRT$

$0.9336(V) = 0.0605(0.0821)(291.15)$

$\boxed{V = 1.55L}$

(67) volume decrease by ½

4 mol → ?

(in first Container)

$\frac{V_1}{n_1} = \frac{V_2}{n_2}$

$\frac{2}{4} = \frac{1}{x}$ (A)

$2x = 4$

$x = 2$ = # moles of final product

(69) $2HgO \rightarrow 2Hg + O_2$

40.0g

40(0.20)

8g decomposes

V = 502mL 20% by mass decomposes

$P_{O_2}$ ? = atm T = 25°C = 298.15K

$8g \times \frac{1\,mol}{216.59\,g} \times \frac{1\,mol\,O_2}{2\,mol\,HgO} = 0.0185\,mol\,O_2$

$PV = nRT$

$P(0.502) = 0.0185(0.0821)(298.15)$

$\boxed{P = 0.902\,atm}$

(73)

| $H_2$ | $O_2$ |
|---|---|
| 1L | 1L |
| 1atm | 1atm |
| 25C | 25°C |
| 298.15K | 298.15K |

(a) mass = $O_2$ has more mass
(b) density = $O_2$ has greater density
(c) mean free path = same, because both at same T + P
★ not important for AP ↓ average distance traveled between collisions at a given temp & pressure
(d) average kinetic energy = same temp = same average KE
(e) average molecular speed = $H_2$ is lighter + faster
(f) $H_2$ effuses faster

(78) (a) Curve 1 represents gases at lower temp, more molecules at slower speed
(b) higher KE = curve #2
(c) curve 2 = higher rate of diffusion → gas molecules are moving faster so they will mix faster

(87) $SF_6$ bp = 16°C @ 1atm ideal at 150°C or 20°C, explain...
- behaves more ideal at 150°C, molecules have more KE, are spread out farther, exert less force on each other

(91) V = 600L He

| | | | |
|---|---|---|---|
| P = 1.01 atm | P = 0.489 atm | P = 1.01 atm | 1/4 He leaks out |
| T = 305K | T = 218K | T = 250 K | V = ? @ landing |

Initial

$PV = nRT$

$1.01(600) = n(0.0821)(305)$

n = 24.2 mol He to start

lose 25% so $0.75(24.2) = 18.15$ mol at end of trip

$PV = nRT$

$1.01(V) = 18.15(0.0821)(250)$

**V = 369 L**

(95) (a) $P = 2atm$ $P = 1atm$ $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

$T = 200$ $T = 100$

$V = 1$ $V = ?$

$\frac{2(1)}{473} = \frac{1(V)}{373}$

V = 1.5L
volume ↑

(b) $P_1 = 1$ $P_2 = 3atm$ $\frac{1(1)}{373} = \frac{3(V)}{573}$

$T = 373$ $T_2 = 573$

$V = 1$ $V = ?$

V = 0.51L
volume ↓

(c) $P = 3atm$ $P_2 = 6atm$ $\frac{3(1)}{200} = \frac{6(V)}{400}$

$T = -73°C$ $T = 127°C$

$T = 200K$ $T = 400$ $V = 1$

$V = 1$ $V = ?$

no change in volume

(d) $P_1 = 0.2atm$ $P_2 = 0.4atm$ $\frac{0.2(1)}{573} = \frac{0.4(V)}{423}$

$T = 300°C$ $T = 150°C$

$T = 573K$ $T = 423$ $V = 0.369L$

$V = 1$ $V = ?$

volume ↓

(108) $2NH_4NO_3 \rightarrow 2N_2 + O_2 + 4H_2O$ $T = 307°C = 580.15K$

15 Kg $P = 1atm$

$15Kg \times \frac{1000g}{1Kg} \times \frac{1mol}{80.05g} \times \frac{7mol\ gas}{2mol\ NH_4NO_3} =$ 655.85mol gas formed

$PV = nRT$

$1(V) = 655.85(0.0821)(580.15K)$

$V = 3.12 \times 10^4$ L of gas released

(111) $Si_?F_?$ $T = 27°C$ 2.60g $P = 1.50 atm$ $V = 0.250L$

33.01% Si so $0.3301(2.60) = 0.85826g$ Si + 1.74174g F

$0.85826g\ Si \times \frac{1\ mol\ Si}{28.09\ g\ Si} = 0.031 mol\ Si / 0.03 = 1$

$1.74174g\ F \times \frac{1 mol\ F}{19.0g\ F} = 0.09167\ mol\ F / 0.03 = 3$

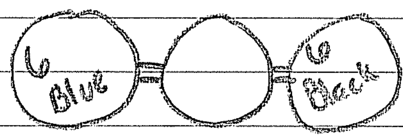
★ multiple ways to get to empirical - be sure to show your work

empirical formula = $SiF_3$

$M = \frac{mRT}{PV} = \frac{2.60(0.0821)(300.15)}{1.50(0.250)} = 170.85 g/mol$

$\frac{170.85 g/mol}{89.06} = 2$ so molecular = $Si_2F_6$

(113)




each = $1 \times 10^6$ particles

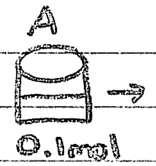
(a) 12 total will evenly spread between all 3 containers. Because at equilibrium there will be $2 \times 10^6$ blue and $2 \times 10^6$ black in each container

(b) same answer as a

(c) $P_{C_i} = 750 torr$ $P_{C\,final} = ?$ → $PV = nRT$ → $\frac{P_1}{n_1} = \frac{P_2}{n_2}$
$n = 6$ $n = 4$

$\frac{750}{6} = \frac{P_2}{4}$ → $P_2 = 500 torr$

(d) $P_B$ will be same as $P_C$ because same # of particles

(142) 


(a) if pressure is doubled volume will decrease by 1/2 **B**

(b) T is decreased by 1/2 volume will decrease by 1/2 **B**

(c) $T = 100°C + 273 = 373K$ $T = 200 + 273 = 473$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{1}{373} = \frac{V}{473}$$

$$V = 1.27$$

**no cylinders match**
volume increasing by 1/4

(d) 0.1 mol gas added (double amt gas) volume will double **C**

(e) $n = 0.1$ $n = 0.2$
$P = 1 atm$ $P = 2atm$
$V = 1$ $V = ?$

$$\frac{P_1 V_1}{n_1} = \frac{P_2 V_2}{n_2}$$

$$\frac{1(1)}{0.1} = \frac{2(V)}{0.2}$$

$V = 1$ **D** volume doesn't change

(144) 6.0L has $CH_4$, Ar, He @ 45°C = 318.15K $P_{tot} = 1.75 atm$
$CH_4$ ↓ 0.4, Ar ↓ 0.35, He ↓ 0.25
? molecules $CH_4$
☆ mole fractions have to total 1

$0.4(1.75) = 0.7 atm = P_{CH_4}$

$PV = nRT$
$0.7(6.0) = n(0.0821)(318.15)$
$n = 0.161 mol \times \frac{6.02 \times 10^{23} molecules}{1 mol} =$ **$9.68 \times 10^{22}$ molecules $CH_4$**