Review Session of Homework problems from Chapter 7.

Boyle's Law	Boyle's Law	Charle's Law	Combined Gas Law	Combined Gas Law	Ideal Gas Law	Dalton's Law
32 ✓	Scuba diver ✓	36 ✓	38 ✓	44 ✓	50 ✓	59 ✓

7.32 Boyle's Law

Assume a fixed amount of gas @ constant temp = (n & T are fixed)

$$\frac{P_1V_1}{\cancel{n_1T_1}} = \frac{P_2V_2}{\cancel{n_2T_2}}$$

$\boxed{\text{Boyle's Law} \quad P_1V_1 = P_2V_2}$

	P_1	V_1	P_2	V_2
a	2.5 atm	1.5 L	3.8 atm	? L
b	2.0 atm	350 mL	750 mmHg	? mL
c	75 mmHg	9.1 mL	? mmHg	890 mL

a) $$\frac{P_1V_1}{P_2} = \frac{\cancel{P_2}V_2}{\cancel{P_2}}$$

$$V_2 = \frac{P_1V_1}{P_2} = \frac{\overset{2}{(2.5\,\cancel{atm})}\overset{2}{(1.5\,L)}}{\underset{2}{(3.8\,\cancel{atm})}} = 0.986842\ L$$

$\boxed{= 0.99\,L}$

b) $V_1 = 350\ mL$

$P_1 = 2.0\ atm$

$V_2 = ?$

$$P_2 = \overset{2}{750}\ mmHg \times \frac{1\ atm}{760\ mmHg} = 0.986842\ atm$$

Exact

$= 0.99\ atm$

$$\frac{P_1 V_1}{P_2} = \frac{\cancel{P_2} V_2}{\cancel{P_2}}$$

$$V_2 = \frac{P_1 V_1}{P_2} = \frac{(\overset{2}{2.0}\ \cancel{atm})(\overset{2}{350}\ mL)}{\underset{2}{0.99}\ \cancel{atm}} =$$

$= 709.33\overline{3}\ mL$

$$\boxed{= 710\ mL}$$

Problem Like 7.33

1.0 atm

Vol of air in lungs at surface?

33 ft = 1 atm

3.5 atm

4.0 L of air in lungs

$P_1 = 3.5\text{ atm}$

$V_1 = 4.0\text{ L}$

$P_2 = 1.0\text{ atm}$

$V_2 = ?$

$$\frac{P_1V_1}{P_2} = \frac{\cancel{P_2}V_2}{\cancel{P_2}}$$

$$V_2 = \frac{P_1V_1}{P_2}$$

$$V_2 = \frac{\overset{2}{(3.5\text{ atm})}\overset{2}{(4.0\text{ L})}}{\underset{2}{(1.0\text{ atm})}} = 14\text{ L}$$

$$= \boxed{14\text{ L}}$$

How much air in lungs expands

7.36

n & P are constant Charle's Law

	V_1	T_1	V_2	T_2
a)	10.0 mL	210 K	?	450 K
b)	255 mL	55°C	?	150 K
c)	13 L	−150°C	52 L	?

must always be in K for gas Laws

	°C	K Absolute scale
Boiling	100°C	373.15 K
Freezing	0°C	273.15 K
	−273.15°C	0 K no negative K

7.36 a

P & n constant

$V_1 = 10.0\ mL$

$T_1 = 210\ K$

$V_2 = ?$

$T_2 = 450\ K$

$$\frac{\cancel{P_1} V_1}{\cancel{n_1} T_1} = \frac{\cancel{P_2} V_2}{\cancel{n_2} T_2}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$ Charle's Law

solve for V_2

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

$$V_2 = \frac{T_2 V_1}{T_1} = \frac{(\overset{2}{450\ \cancel{K}})(\overset{3}{10.0\ mL})}{(\underset{2}{210\ \cancel{K}})}$$

$$= 21.428\,571\,428\ mL$$

$$\boxed{V_2 = 21\ mL}$$

7.36 c

$V_1 = 13.0\ L$

$T_1 = -150\ °C + 273.15$

$$\begin{array}{r} 273.15 \\ -\ 150 \\ \hline 123.15 \end{array} = 120\ K$$

$V_2 = 52\ L$

$T_2 = ?$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \text{Charle's Law}$$

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

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

$$T_2 = \frac{V_2 T_1}{V_1} = \frac{(52\ \cancel{L})(120\ K)}{(13.0\ \cancel{L})}$$

$$= 480\ K$$

$$= 480\ K$$

$$\begin{array}{r} -\ 273.15 \\ \hline 206.85 \end{array}$$

$$\boxed{T_2 = 210\ °C}$$

7.38

How hot must the air be heated if initially it has a volume of 750. L at 20 °C and the final volume must be a 1000. L?

Changin Conditions $= \dfrac{\cancel{P_1}V_1}{\cancel{n_1}T_1} = \dfrac{\cancel{P_2}V_2}{\cancel{n_2}T_2}$

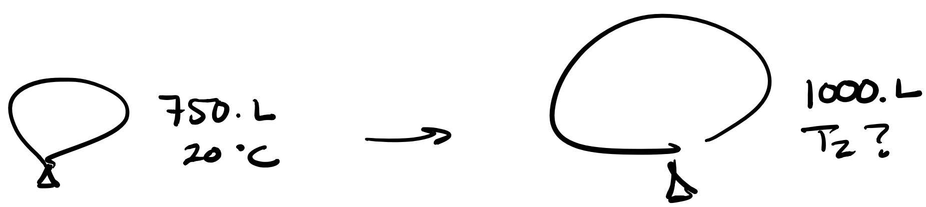
$= \dfrac{V_1}{T_1} = \dfrac{V_2}{T_2}$

$\cancel{P_1} =$ $\quad\quad$ $\cancel{P_2} =$

$V_1 = 750.\ L$ $\quad\quad$ $V_2 = 1000.\ L$

$\cancel{n_1} =$ $\quad\quad$ $\cancel{n_2} =$

$T_1 = 20\ °C + 273.15$
$= 290\ K$ $\quad\quad$ $T_2 = ?$



$T_2 \times \dfrac{V_1}{T_1} = \dfrac{V_2}{T_2} \times T_2$

$\dfrac{\cancel{T_1}}{\cancel{V_1}} \times \dfrac{T_2\cancel{V_1}}{\cancel{T_1}} = V_2 \times \dfrac{T_1}{V_1}$

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

$$T_2 = \frac{\overset{4}{(1000.\,\cancel{K})}\,\overset{2}{(290\,K)}}{\underset{3}{(750.\,\cancel{K})}} = 386.66\,K$$

$$\begin{array}{r} 390\,K \\ -\;273.15 \\ \hline 116.50 \end{array}$$

$$\boxed{T_2 = 120\,^\circ C}$$

7.44 Combined gas law

	P_1	V_1	T_1	P_2	V_2	T_2
⇒ a)	0.55 atm	1.1 L	340 K	?	3.0 L	298 K
⇒ b)	735 mmHg	1.2 L	298 K	1.1 atm	?	0.0 °C
× c)	7.5 atm	230 mL	−120 °C	15 atm	0.45 L	?

a)

P_1	V_1	T_1	P_2	V_2	T_2
0.55 atm ✓	1.1 L ✓	340 K ✓	?	3.0 L ✓	298 K ✓

$$R = \frac{L\ atm}{mole\ K}$$

$$\frac{P_1V_1}{n_1T_1} = R = \frac{P_2V_2}{n_2T_2}$$

$$\frac{P_1V_1}{\cancel{n_1}T_1} = \frac{P_2V_2}{\cancel{n_2}T_2}$$

$$\frac{T_2}{V_2} \times \frac{P_1V_1}{T_1} = \frac{P_2\cancel{V_2}}{\cancel{T_2}} \times \frac{\cancel{T_2}}{\cancel{V_2}}$$

$$P_2 = \frac{T_2V_1P_1}{T_1V_2}$$

$$P_2 = \frac{T_2 V_1 P_1}{T_1 V_2} = \frac{(\overset{3}{298\,\cancel{K}})(\overset{2}{1.1\,\cancel{L}})(\overset{2}{0.55\,atm})}{(\underset{2}{340\,\cancel{K}})(\underset{2}{3.0\,\cancel{L}})}$$

$$= 0.176754901\ atm$$

$$\boxed{= 0.18\ atm}$$

$298 \times 1.1 \times 0.55 \div 340 \div 3.0 =$

$298 \times 1.1 \times 0.55 \div (340 \times 3.0) =$

$$\frac{ABC}{DE} = \frac{A}{1} \times \frac{B}{1} \times \frac{C}{1} \times \frac{1}{D} \times \frac{1}{E}$$

$$A \times B \times C \div D \div E$$

7.44 b

	P_1	V_1	T_1	P_2	V_2	T_2
⇒ b)	735 mmHg	1.2 L	298 K	1.1 atm	?	0.0 °C

$P_1 = 735\ mmHg \times \frac{1\ atm}{760\ mmHg} = 0.967105\ atm = 0.967\ atm$

$V_1 = 1.2\ L$

$T_1 = 298\ K$

$P_2 = 1.1\ atm$

$V_2 = ?$

$T_2 = 0.0\ °C$

$$\begin{array}{r} 0.0\ °C \\ +\ 273.15 \\ \hline 273.15\ K \end{array} = 273.2\ K$$

$$\frac{P_1 V_1}{\cancel{n_1} T_1} = \frac{P_2 V_2}{\cancel{n_2} T_2}$$

$$\frac{T_2}{P_2} \times \frac{P_1 V_1}{T_1} = \frac{\cancel{P_2} \cancel{V_2}}{\cancel{T_2}} \times \frac{\cancel{T_2}}{\cancel{P_2}}$$

$$V_2 = \frac{T_2 P_1 V_1}{T_1 P_2} = \frac{\overset{4}{(273.2\,\cancel{K})}\overset{3}{(0.967\,\cancel{atm})}\overset{2}{(1.2\,L)}}{\underset{3}{(298\,\cancel{K})}\underset{2}{(1.1\,\cancel{atm})}}$$

$$= 0.967117992\ L$$

$$\boxed{= 0.97\ L}$$

7.5D Ideal Gas Law

How many moles of gas are contained in a compression tank for scuba diving that has a volume of 7.0 L and pressure of 210 atm at 25°C?

$\Rightarrow$ 1 set of conditions

$$PV = nRT$$

$P = 210\ \text{atm}$

$V = 7.0\ \text{L}$

$n = ?\ \ \text{mol}$

$T = 25\,°C + 273.15 = 298.15 = 298\ \text{K}$

$R = 0.0821\ \frac{\text{L atm}}{\text{mol K}}$

$$\frac{PV}{RT} = \frac{n\cancel{R}\cancel{T}}{\cancel{R}\cancel{T}}$$

$$n = \frac{PV}{RT} = \frac{(210\ \cancel{\text{atm}})(7.0\ \cancel{\text{L}})}{(0.0821\ \frac{\cancel{\text{L}}\ \cancel{\text{atm}}}{\text{mol}\ \cancel{\text{K}}})(298\ \cancel{\text{K}})}$$

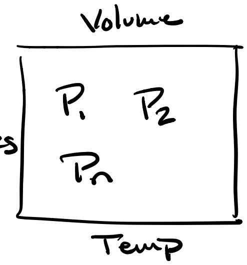
$$\frac{1}{\frac{1}{\text{mol}}} = 1 \times \frac{\text{mol}}{1} = \text{mol}\ ✓$$

$$= 66.809678\ \text{mol}$$

$$\boxed{= 67\ \text{mol of gas}}$$

7.59 Dalton's Law of Partial Pressure

$$P_T = \underbrace{P_1 + P_2 + \ldots + P_n}_{\text{Sum of the partial pressures}}$$



$$PV = nRT$$

$$P = \frac{nRT}{V} \quad \Big| \quad P_1 = \frac{n_1 RT}{V}$$

$$P_2 = \frac{n_2 RT}{V}$$

$$P_T = \frac{n_1 RT}{V} + \frac{n_2 RT}{V} + \ldots + \frac{n_n RT}{V}$$

$$P_T = \frac{\underbrace{(n_1 + n_2 + \ldots + n_n)}_{\text{some of the moles!}} RT}{V}$$

Ideal Gas

7.59

The partial pressure of N_2 in the air is 593 mmHg at 1 atm. What is the partial pressure of N_2 in a bubble of air a scuba diver breaths when he is 66 ft below surface where pressure = 3.0 atm

$$P_T = N_2 + O_2$$

$$1.0\text{ atm} = 593\text{ mmHg} + O_2$$

$\downarrow \times 3$ $\quad\downarrow \times 3$ $\quad\downarrow \times 3$

$$3.0\text{ atm} = N_2 + O_2$$

$$593\text{ mmHg} \times \frac{1\text{ atm}}{760\text{ mmHg}} = 0.780|263\text{ atm}$$

$$= 0.780\text{ atm}$$

$$P_{N_2{}_2} \times \frac{P_{1\text{ atm}}}{P_{N_2{}_1}} = \frac{P_{3\text{ atm}}}{P_{N_2{}_2}} \times P_{N_2{}_2}$$

$$\frac{\cancel{P_{N_2{}_1}}}{\cancel{P_{1\text{ atm}}}} \times \frac{P_{N_2{}_2}\cancel{P_{1\text{ atm}}}}{\cancel{P_{N_2{}_1}}} = P_{3\text{ atm}} \times \frac{P_{N_2{}_1}}{P_{1\text{ atm}}}$$

$$P_{N_{2\,2}} = \frac{P_{3atm} \times P_{N_{2\,1}}}{P_{1atm}}$$

$$= \frac{(3.0\ atm)(0.780\ atm)}{(1.0\ atm)}$$

$$N_2 = \boxed{2.34\ atm}$$