Basic Gas Laws Mixed Practice

1. The gas in a sealed can is at a pressure of 3.00 atm at 25°C. A warning on the can tells the user not to store the can in a place where the temperature will exceed 52°C. What would the gas pressure in the can be at 52°C?

a) What law is this? gay-Lussac's
b) What is the relationship? direct
c) Predict whether the variable asked for will increase or decrease increase
d) Solve the problem

	1	2
P	3.00atm	X
V		
T	298K	325K

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$\frac{(3.00\,atm)}{298K} = \frac{X}{325K}$

$X = 3.27\,atm$

2. A sample of hydrogen exerts a pressure of 0.329 atm at 47°C. The gas is heated 77°C at constant volume. What will its new pressure be?

a) What law is this? Gay-Lussac's
b) What is the relationship? direct
c) Predict whether the variable asked for will increase or decrease increase
d) Solve the problem

	1	2
P	0.329atm	X
V		
T	320K	350K

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$\frac{0.329\,atm}{320K} = \frac{X}{350K}$

$X = 0.36\,atm$

3. A sample of neon gas occupies a volume of 752 mL at 25°C. What volume will the gas occupy at standard temperature if the pressure remains constant?

a) What law is this? Charle's law
b) What is the relationship? direct
c) Predict whether the variable asked for will increase or decrease ~~increase~~ decrease
d) Solve the problem

	1	2
P		
V	752mL	X
T	298K	273K

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

$\frac{752mL}{298K} = \frac{X}{273K}$

$X = 689\,mL$

4. A sample of oxygen gas has a volume of 150 mL when its pressure is 440 mmHg. If the pressure is increased to standard pressure and the temperature remains constant, what will the new gas volume be?

a) What law is this? Boyle's law
b) What is the relationship? inverse
c) Predict whether the variable asked for will increase or decrease decrease
d) Solve the problem

	1	2
P	440 mmHg	760 mmHg
V	150 mL	X
T		

$P_1V_1 = P_2V_2$

$(440\text{mmHg})(150\text{mL}) = (760\text{mmHg})(x)$

$x = 87\text{ mL}$

5. Ralph had a helium balloon with a volume of 4.88 liters at 150 kPa of pressure. If the volume is changed to 3.15 liters, what would be the new pressure in atm?

a) What law is this? Boyle's law
b) What is the relationship? inverse
c) Predict whether the variable asked for will increase or decrease increased
d) Solve the problem

	1	2
P	150 kPa	x
V	4.88 L	3.15 L
T		

$P_1V_1 = P_2V_2$

$(150\text{kPa})(4.88\text{L}) = x(3.15\text{L})$

$x = 232\text{ kPa}$

6. 5.36 liters of nitrogen gas are at -25°C and 733 mm Hg. What would be the volume at 128°C and 1.5atm?

a) What law is this? combined gas law
b) Solve the problem

	1	2
P	733 mmHg	1100 mmHg
V	5.36 L	x
T	248 K	401 K

$1.5\text{atm} \mid \frac{760\text{mmHg}}{1\text{atm}} = 1140\text{ mmHg} \rightarrow 1100\text{ mmHg}$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{(733\text{mmHg})(5.36\text{L})}{(248\text{K})} = \frac{(1100\text{mmHg})(x)}{401\text{K}}$

$5.8\text{ L} = x$

7. At constant temperature, 2 L of a gas at 4 atm of pressure is expanded to 6 L. What is the new pressure?

a) What law is this? Boyle's law
b) What is the relationship? inverse
c) Predict whether the variable asked for will increase or decrease decrease
d) Solve the problem

	1	2
P	4atm	x
V	2L	6L
T		

$P_1V_1 = P_2V_2$

$(4\text{atm})(2\text{L}) = x(6\text{L})$

$x = 1\text{ atm}$

8. A sample of gas at 15 °C has a volume of 2.58 L. What volume will this gas occupy at 38 °C?

a) What law is this? Charle's
b) What is the relationship? direct
c) Predict whether the variable asked for will increase or decrease increase
d) Solve the problem

	1	2
P		
V	2.58L	X
T	288K	311K

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\quad \frac{(2.58L)}{288K} = \frac{X}{311K}$

X = 2.79 L

9. A helium balloon has a volume of 500 mL at STP. What must the temperature be, in °C, if the volume increased to 750 mL and the pressure decreased to 0.5 atm?

a) What law is this? combined
b) Solve the problem

	1	2
P	1.0atm	0.5atm
V	500mL	750mL
T	273K	X

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{(1.0atm)(500mL)}{273K} = \frac{(0.5atm)(750mL)}{X}$

X = 200 K → -73 °C

10. Seaweed plants release oxygen gas during photosynthesis. A 0.10 cm^3 bubble is released under water at pressure of 176 kPa and a temperature of 10°C. What volume will this bubble occupy at the surface, where the temperature is 15°C and the pressure is 250 kPa?

* remember $cm^3 = mL$ *

a) What law is this? combined
b) Solve the problem

	1	2
P	176 kPa	250 kPa
V	0.10 mL	X
T	283 K	288K

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{(176kPa)(0.10mL)}{283K} = \frac{(250kPa)(x)}{288K}$

X = 0.072 mL

11. A weather balloon is inflated with 2.94 L of helium at a location where the pressure is 1.06 atm and the temperature is 32 °C. What will be the volume of the balloon at an altitude where the pressure is 0.092 atm and temperature is -35 °C?

a) What law is this? combined
b) Solve the problem

	1	2
P	1.06atm	0.092atm
V	2.94L	X
T	305K	238K

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{(1.06atm)(2.94L)}{305K} = \frac{(0.092atm)(X)}{238K}$

X = 26 L

MIXED GAS LAWS WORKSHEET

1. A gas occupies 3.5L at 2.5 mm Hg pressure. What is the volume at 10 mm Hg at the same temperature?

a) What law is this? Boyle's
b) What is the relationship? inverse
c) Predict whether the variable asked for will increase or decrease decrease
d) Solve the problem

	1	2
P	2.5 mmHg	10 mmHg
V	3.5L	X
T		

$P_1V_1 = P_2V_2$

$(2.5\text{mmHg})(3.5\text{L}) = (10\text{mmHg})(x)$

$x = 0.9\text{ L}$

2. A constant volume of oxygen is heated from 100°C to 185°C. The initial pressure is 4.1 atm. What is the final pressure?

a) What law is this? Gay-Lussac's
b) What is the relationship? direct
c) Predict whether the variable asked for will increase or decrease increase
d) Solve the problem

	1	2
P	4.1atm	X
V		
T	373K	458K

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$\frac{4.1\text{atm}}{373\text{K}} = \frac{x}{458\text{K}}$

$x = 5.0\text{ atm}$

3. A sample of 25L of NH_3 gas at 10°C is heated at constant pressure until it fills a volume of 50L. What the new temperature in °C?

a) What law is this? Charle's law
b) What is the relationship? direct
c) Predict whether the variable asked for will increase or decrease increase
d) Solve the problem

	1	2
P		
V	25L	50L
T	283K	X

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

$\frac{25\text{L}}{283\text{K}} = \frac{50\text{L}}{x}$

$x = 566\text{K}$
$\rightarrow 600\text{K} - 273$
$= 327°\text{C}$

4. An ideal gas occupies 400ml at 270 mm Hg and 65°C. If the pressure is changed to 1.4 atm and the temperature is increased to 100°C, what is the new volume?

a) What law is this? Combined
b) Solve the problem

$\frac{1.4\text{ atm}}{1\text{ atm}} \mid \frac{760\text{ mmHg}}{} = 1064$
$\rightarrow 1100\text{mmHg}$

	1	2
P	270 mmHg	1100 mmHg
V	400mL	X
T	338K	373K

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{(270\text{mmHg})(400\text{mL})}{338\text{K}} = \frac{(1100\text{mmHg})(x)}{373\text{K}}$

$x = 100\text{mL}$

Atmosphere Layers

5. What is the volume of 23g of neon gas at 1°C and a pressure of 2 atm?

a) What law is this? Ideal
b) Solve the problem

$23g\,Ne \times \frac{1\,mol}{20.18\,g\,Ne} = 1.1\,mol\,Ne$

$P = 2\,atm$
$V = ?$
$n = 1.1\,mol$
$R = 0.0821\ \frac{L\,atm}{mol\,K}$
$T = 274K$

$(2atm)(x) = (1.1mol)(0.0821)(274K)$

$x = 10\,L$

6. The pressure is 6.5 atm, 2.3 mole of Br_2 gas occupies 9.3 L. What is the temperature in °C?

a) What law is this? ideal
b) Solve the problem

$P = 6.5\,atm$
$V = 9.3L$
$n = 2.3\,mol\,Br_2$
$R = 0.0821$
$T = x$

$(6.5\,atm)(9.3L) = (2.3mol)(0.0821)(x)$

$x = 320K \rightarrow 47°C$

7. A 600mL balloon is filled with helium at 700mm Hg barometric pressure. The balloon is released and climbs to an altitude where the barometric pressure is 400mm Hg. What will the volume of the balloon be if, during the ascent, the temperature drops from 24 to 5°C?

a) What law is this? combined
b) Solve the problem

	1	2
P	700mmHg	400mmHg
V	600mL	x
T	297K	278K

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{(700mmHg)(600mL)}{297K} = \frac{(400mmHg)(x)}{278K}$

$x = 1000\,mL$

8. An unknown gas has a volume of 200L at 5 atm and -140°C. What is its volume at STP (standard temp = 273K, standard pressure = 1 atm)?

a) What law is this? combined
b) Solve the problem

	1	2
P	5atm	1atm
V	200L	x
T	133K	273K

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{(5atm)(200L)}{133K} = \frac{(1atm)(x)}{273K}$

$x = 2000\,L$

9. In an autoclave, a constant amount of steam is generated at a constant volume. Under 1.00 atm pressure the steam temperature is 100°C. What pressure setting should be used to obtain a 165°C steam temperature for the sterilization of surgical instruments?

a) What law is this? Gay-Lussac's
b) What is the relationship? direct
c) Predict whether the variable asked for will increase or decrease increase
d) Solve the problem

	1	2
P	1.00atm	X
V/I	373K	438K

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$\frac{(1.00atm)}{373K} = \frac{x}{438K}$

$x = 1.17\,atm$

46

Atmospheric Pressure

10. Three 1.0L vessels each contain one gas, all three vessels are simultaneously opened and allowed to mix into a single 1.0L container. Vessel 1 contains oxygen at 93.8kPa; Vessel 2 contains argon at 63.4kPa; and Vessel 3 contains hydrogen at 1.0atm. Determine the total pressure of the gases after they are mixed.

a) What law is this? Dalton's law
b) Solve the problem

$P_{total} = ?$
$P_{O_2} = 93.8\ kPa$
$P_{Ar} = 63.4\ kPa$
$P_{H_2} = 1.0\ atm = 101.3\ kPa$

$P_{total} = 93.8\ kPa + 63.4\ kPa + 101.3\ kPa$

$P_{total} = 258.5\ kPa$

11. Which gas will effuse from a balloon faster: nitrogen or carbon dioxide?

a) What law is this? Graham's law
b) What is the relationship? inverse
c) Answer the question. Nitrogen b/c it has a lower mass.
d) Justify your answer using math.

$$\frac{\sqrt{44.01}}{\sqrt{28.02}} = 1.253$$

Nitrogen effuses 1.253 times faster than CO_2.

12. An unknown gas weighs 34g and occupies 6.7L at 2 atm and 245K. What is its molar mass?

a) What law is this? ideal w/ density and MM
b) Solve the problem

$D = \frac{m}{V} = \frac{34g}{6.7L} = 5.1\frac{g}{L}$

$D = \frac{MP}{RT}$

$D = 5.1\ g/L$
$M = ?$
$P = 2atm$
$R = 0.0821\frac{L\,atm}{mol\,K}$
$T = 245\ K$

$\frac{5.1\frac{g}{L}}{1} = \frac{(x)(L\,2atm)}{(0.0821)(L\,245K)}$

$X = 50\ g/mol$

13. Determine the density of oxygen gas at 35.0 degrees Celsius and 2.50 atm.

a) What law is this? ideal w/ density and MM
b) Solve the problem

$D = X$
$M = 32.00\ g/mol$
$P = 2.50\ atm$
$R = 0.0821\frac{L\,atm}{mol\,K}$
$T = 308.0\ K$

$D = \frac{(32.00\ g/mol)(2.50\ atm)}{(0.0821\frac{L\,atm}{mol\,K})(308\ K)}$

$D = 3.16\ g/L$