Chemistry 101 - Unit 8
Answers to Practice Problem

1) A fixed quantity of gas at constant volume has a pressure of 0.26 atm at 13 ºC. Determine the new pressure at 76 ºC.

	Pressure (P)	Volume (V)	Temperature (T)
Initial	0.26 atm	-	13 ^{o}C ➔ 13 + 273 = 286 K
Final	?	-	76 ^{o}C ➔ 76 + 273 = 349 K

Constant Volume: Use Guy Lussac's Equation:

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

Substituting:

$$\frac{0.26 \text{ atm}}{286 \text{ K}} = \frac{P_2}{349 \text{ K}}$$

Rearranging:

$$P_2 = \frac{(0.26 \text{ atm})(349 \text{ K})}{(286 \text{ K})}$$

Solving:

$$P_2 = 0.32 \text{ atm}$$

(Note: P & T are directly proportional, so when T↑, P↑)

2) A gas at constant volume shows a pressure change from 778 torr to 623 torr. If the initial temperature was 25 ºC, determine the final temperature.

	Pressure (P)	Volume (V)	Temperature (T)
Initial	778 torr	-	25 ^{o}C ➔ 25 + 273 = 298 K
Final	623 torr	-	?

Constant Volume: Use Guy Lussac's Equation:

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

Substituting:

$$\frac{778 \text{ torr}}{298 \text{ K}} = \frac{623 \text{ torr}}{T_2}$$

Rearranging:

$$T_2 = \frac{(623 \text{ torr})(298 \text{ K})}{(778 \text{ K})}$$

Solving:

$$T_2 = 239 \text{ K} \quad (239 \text{ K} = {}^{o}\text{C} + 273 \rightarrow {}^{o}\text{C} = -34)$$

(Note: P & T are directly proportional, so when P↓, T↓)

3) A gas at constant pressure shows a volume change from 25.0 mL to 36.0 mL. If the initial temperature was 0 ºC, what is the final temperature?

	Pressure (P)	Volume (V)	Temperature (T)
Initial	-	25.0 mL	0 ^{o}C ➔ 0 + 273 = 273 K
Final	-	36.0 mL	?

Constant Pressure: Use Charles's Equation:

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

Substituting:

$$\frac{25.0\ mL}{273\ K} = \frac{36.0\ mL}{T_2}$$

Rearranging:

$$T_2 = \frac{(36.0mL)(273\ K)}{(25.0\ mL)}$$

Solving:

T_2 = 393 K (393 K = 0 ^{o}C + 273 ➔ 120 ^{o}C)

(Note: V & T are directly proportional, so when V↑, T↑)

4) A 54 mL sample of a gas at constant pressure is cooled from 136 ºC to 25 ºC. Determine the final volume.

	Pressure (P)	Volume (V)	Temperature (T)
Initial	-	54 mL	136 ^{o}C ➔ 136 + 273 = 409 K
Final	-	?	25 ^{o}C ➔ 25 + 273 = 298 K

Constant Pressure: Use Charles's Equation:

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

Substituting:

$$\frac{54\ mL}{409\ K} = \frac{V_2}{298\ K}$$

Rearranging:

$$V_2 = \frac{(54\ mL)(298\ K)}{(409\ K)}$$

Solving:

V_2 = 39 mL

(Note: V & T are directly proportional, so when T↓, V↓)

5) A 156 mL sample of gas at constant temperature undergoes a pressure increase from 0.56 atm to 1.38 atm. Determine the final volume of the sample.

	Pressure (P)	Volume (V)	Temperature (T)
Initial	0.56 atm	156 mL	-
Final	1.38 atm	?	-

Constant Temperature: Use Boyle's Equation:

$$P_1V_1 = P_2V_2$$

Substituting:

$$(0.56\ atm)\ (156\ mL) = (1.38\ atm)\ V_2$$

Rearranging:

$$V_2 = \frac{(0.56\ atm)\ (156\ mL)}{(1.38\ atm)}$$

Solving:

$$V_2 = 63\ mL$$

(Note: P & V are inversely proportional, so when P↑, V↓)

6) A gas at constant temperature undergoes a volume change from 1.60 L to 2.70 L. If the initial pressure was 746 torr, what is the final pressure?

	Pressure (P)	Volume (V)	Temperature (T)
Initial	746 torr	1.60 L	-
Final	?	2.70 L	-

Constant Temperature: Use Boyle's Equation:

$$P_1V_1 = P_2V_2$$

Substituting:

$$(746\ torr)\ (1.60\ L) = P_2\ (2.70\ L)$$

Rearranging:

$$P_2 = \frac{(746\ torr)\ (1.60\ L)}{(2.70\ L)}$$

Solving:

$$P_2 = 442\ torr >> 440\ torr\ (only\ 2\ sig\ figs\ allowed)$$

(Note: P & V are inversely proportional, so when V↑, P↓)

7) A 1.60 L sample of nitrogen gas initially at STP conditions undergoes a temperature increase to 343K and a volume increase to 3.00 L. Determine the final pressure in torr.

	Pressure (P)	Volume (V)	Temperature (T)
Initial	760 torr	1.60 L	273 K
Final	?	3.00 L	343 K

P, V & T change: Use General Gas Law Equation:

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

Substituting:

$$\frac{(760 \text{ torr})\,(1.60 \text{ L})}{273 \text{ K}} = \frac{(P_2)\,(3.00 \text{ L})}{343 \text{ K}}$$

Rearranging:

$$P_2 = \frac{(760 \text{ torr})\,(1.60 \text{ L})(343 \text{ K})}{(273 \text{ K})\,(3.00 \text{ L})}$$

Solving:

$$P_2 = 509 \text{ torr}$$

(Note: P & V are inversely proportional, so when V↑, P↓)
(Note: P & T are directly proportional, so when V↑, T↑)

8) A sample of oxygen gas is in a 2.3 L container at 25 ºC and a pressure of 1.6 atm. Determine the volume of the sample at STP conditions.

	Pressure (P)	Volume (V)	Temperature (T)
Initial	1.6 atm	2.3 L	25 ^{o}C ➔ 25 + 273 = 298 K
Final	1.0 atm	3.0 L	273 K

P, V & T change: Use General Gas Law Equation:

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

Substituting:

$$\frac{(1.6 \text{ atm})\,(2.3 \text{ L})}{298 \text{ K}} = \frac{(1.0 \text{ atm})\,V_2}{273 \text{ K}}$$

Rearranging:

$$V_2 = \frac{(1.6 \text{ atm})\,(2.3 \text{ L})(273 \text{ K})}{(273 \text{ K})\,(1.0 \text{ atm})}$$

Solving:

$$V_2 = 3.4 \text{ L}$$

(Note: P & V are inversely proportional, so when V↑, P↓)
(Note: P & T are directly proportional, so when T↓, V↓)