Chemistry: *Unit Conversions for the Gas Laws*

Directions: Complete the following tables, showing your work for each lettered box beside the corresponding letter below. Include units on your work, and write your final answers in the tables.

TEMPERATURE	
K	**°C**
373 K	(D)
(A)	56°C
(B)	154°C
128 K	(E)
800 K	(F)
(C)	–10°C

PRESSURE		
mm Hg	**kPa**	**atm**
890 mm Hg	(K)	(O)
(G)	123 kPa	(P)
(H)	(L)	0.64 atm
3140 mm Hg	(M)	(Q)
(I)	(N)	2.35 atm
(J)	25 kPa	(R)

(A)

(B)

(C)

(D)

(E)

(F)

(G)

(H)

(I)

(J)

(K)

(L)

(M)

(N)

(O)

(P)

(Q)

(R)

Boyle's Law   =

1)   If I have 5.6 liters of gas in a piston at a pressure of 1.5 atm and compress the gas until its volume is 4.8 L, what will the new pressure inside the piston be?

2)   I have added 15 L of air to a balloon at sea level (1.0 atm). If I take the balloon with me to Denver, where the air pressure is 0.85 atm, what will the new volume of the balloon be?

3)   I've got a car with an internal volume of 12,000 L. If I drive my car into the river and it implodes, what will be the volume of the gas when the pressure goes from 1.0 atm to 1.4 atm?

Charles's Law   =

1)   If I have 45 liters of helium in a balloon at 25^0 C and increase the temperature of the balloon to 55^0 C, what will the new volume of the balloon be?

2)   Calcium carbonate decomposes at 1200^0 C to form carbon dioxide and calcium oxide. If 25 liters of carbon dioxide are collected at 1200^0 C, what will the volume of this gas be after it cools to 25^0 C?

3)   I have 130 liters of gas in a piston at a temperature of 250^0 C. If I cool the gas until the volume decreases to 85 liters, what will temperature of the gas be?

Combined Gas Law   =

1)   If I initially have 4.0 L of a gas on the surface of the sun at a pressure of 1.1 atm and temperature of 6000^0 C, what will the volume be if I increase the pressure to 340 billion atm and temperature to 15,000,000° C?

2)   A toy balloon has an internal pressure of 1.05 atm and a volume of 5.0 L. If the temperature where the balloon is released is $20.^0$ C, what will happen to the volume when the balloon rises to an altitude where the pressure is 0.65 atm and the temperature is -15^0 C?

3)   A small research submarine with a volume of 1.2×10^5 L has an internal pressure of 1.0 atm and an internal temperature of 15^0 C. If the submarine descends to a depth where the pressure is 150 atm and the temperature is 3.0^0 C, what will the volume of the gas inside be if the hull of the submarine breaks?

4)   People who are angry sometimes say that they feel as if they'll explode. If a calm person with a lung capacity of 3.5 liters and a body temperature of 36^0 C gets angry, what will the volume of the person's lungs be if their temperature rises to 39^0 C. Based on this, do you think it's likely they will explode?

More Combined Gas Law!

1)   A bag of potato chips is packaged at sea level (1.00 atm) and has a volume of 315 mL. If this bag of chips is transported to Denver (0.775 atm), what will the new volume of the bag be?

2)   A Los Angeles class nuclear submarine has an internal volume of eleven million liters at a pressure of 1.250 atm. If a crewman were to open one of the hatches to the outside ocean while it was underwater (pressure = 15.75 atm), what would be the new volume of the air inside the submarine?

3)   A child has a toy balloon with a volume of 1.80 liters. The temperature of the balloon when it was filled was 20^0 C and the pressure was 1.00 atm. If the child were to let go of the balloon and it rose 3 kilometers into the sky where the pressure is 0.667 atm and the temperature is -10^0 C, what would the new volume of the balloon be?

4)   A commercial airliner has an internal pressure of 1.00 atm and temperature of 25^0 C at takeoff. If the temperature of the airliner drops to 17^0 C during the flight, what is the new cabin pressure?

5)   If divers rise too quickly from a deep dive, they get a condition called "the bends" which is caused by the expansion of very small nitrogen bubbles in the blood due to decreased pressure. If the initial volume of the bubbles in a diver's blood is 15 mL and the initial pressure is 12.75 atm, what is the volume of the bubbles when the diver has surfaced to 1.00 atm pressure?

Ideal Gas Law   =

Write the meaning and value for **R** : _____

Solve the following problems using the ideal gas law:

1) How many moles of gas does it take to occupy 120 liters at a pressure of 2.3 atmospheres and a temperature of 340 K?

2) If I have a 50.0 liter container that holds 45 moles of gas at a temperature of $200.^0$ C, what is the pressure inside the container?

3) It is not safe to put aerosol canisters in a campfire, because the pressure inside the canisters gets very high and they can explode. If I have a 1.0 liter canister that holds 2.0 moles of gas, and the campfire temperature is 1400^0 C, what is the pressure inside the canister?

4) How many moles of gas are in a 30. liter scuba canister if the temperature of the canister is 300. K and the pressure is 200. atmospheres?

5) I have a balloon that can hold 100 liters of air. If I blow up this balloon with 3 moles of oxygen gas at a pressure of 1 atmosphere, what is the temperature of the balloon?

Gas Laws Mixture (write the law used in margin)

1) A gas occupies 3.5L at 2.5 mm Hg pressure. What is the volume at 10.0 mm Hg at the same temperature?

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

3) A sample of 25L of NH_3 gas at 10.0ºC is heated at constant pressure until it fills a volume of 50.L. What is the new temperature in ºC?

4) A certain quantity of argon gas is under 16 torr pressure at 253K in a 12L vessel. How many moles of argon are present?

5) An unknown gas weighs 34g and occupies 6.7L at 2.0 atm and 245K. What is its molecular weight (also known as molar mass)?

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

Write the meaning and value for **STP** : _____

7)   What is the volume of 23g of neon gas at 1.0^0C and a pressure of 2.0 atm?

8)   If 11 moles of HCl gas occupies 15L at $300.^0C$, what is the pressure in torr?

9)   The pressure is 6.5 atm, 2.3 mole of Br_2 gas occupies 9.3 L . What is the temperature in ^0C?

10)   A 600.mL balloon is filled with helium at 700.mm Hg barometric pressure. The balloon is released and climbs to an altitude where the barometric pressure is 400.mm Hg. What will the volume of the balloon be if, during the ascent, the temperature drops from 24 to 5.0^0C?

11)   An unknown gas has a volume of 200.L at 5 atm and -140^0C. What is its volume at STP?

12)   In an autoclave, a constant amount of steam is generated at a constant volume. At 1.00 atm pressure the steam temperature is $100.^0C$. What pressure setting should be used to obtain a 165^0C steam temperature for the sterilization of surgical instruments?