Boyle's Law Practice

STP = "Standard Temperature and Pressure"
Standard Temperature = 273 K
Standard Pressure = 1.00 atm = 101.325 kPa = 760 mm Hg = 760 torr
Boyle's Law is an indirect relationship.

Most of these problems can be done in your head without showing your work.

1. Herman has 30.0 L of helium gas trapped in a cylinder by a piston. The pressure of the gas is 1.0 atmosphere.
   A) What will the pressure become if the volume is reduced to half of its original value?
   B) What will the pressure become if the volume is doubled?
   C) What will the pressure become if the volume is tripled?
   D) What will the pressure become if the volume is reduced to 10.0 L?
   E) What will the volume become if the pressure is doubled?
   F) What will the volume become if the pressure is tripled?
   G) What will the volume become if the pressure is reduced to half of its original value?
   H) What will the volume become if the pressure is increased to 5.0 atmospheres?

2. Melanie and Violetta performed an experiment where they took a gas trapped in a cylinder, adjusted the volume and then measured the resulting pressure. Make a graph of their data and use it to answer the following questions.

Volume (mL)	Pressure (atm)
40	5.00
80	2.50
120	1.67
160	1.25
200	1.00
240	0.83
280	0.71
320	0.62
360	0.56
400	0.50

   A) Predict the pressure for a volume of 100 mL.
   B) Predict the pressure for a volume of 250 mL.
   C) Predict the volume for a pressure of 4.00 atm
   D) Predict the volume for a pressure of 0.90 atm.
   E) Predict the volume for a pressure of 1.75 atm.
   F) Predict the pressure for a volume of 800 mL.

Boyle's Law Practice

Please use your head, but show your work in the manner demonstrated by your instructor. Remember to include the correct units and round off to significant digits.

These problems should be done on a separate sheet of paper.

3. What was the original volume of a gas that was collected at an atmospheric pressure of 0.750 atm if it now occupies a volume of 22.4 L at 1.00 atm?

4. A gas is confined to a volume of 900. cm^3 at a pressure of 1.80 atm What would its pressure be if the volume is decreased to 300. cm^3?

5. What was the original pressure of a gas that was confined in a volume of 250 cm^3 if it is now occupying 400. cm^3 at a pressure of 2.00 atm?

6. A gas is confined to a volume of 120 cm^3 at a pressure of 8.00 atm. What would its volume be at standard pressure?

7. A gas has a pressure of 1.50 atm. What happens to the pressure if it's volume is doubled?

8. The volume of a gas is 40.0 mL at 900. torr. What is the new volume if the pressure is changed to 400 torr?

9. A sample of Helium at 1500 kPa and 450 mL is compressed to 225 mL. What is the new pressure?

10. A balloon holds 975 mL of gas at 760 mm Hg. It is then expanded to 2000 mL. What is the new pressure?

Charles' Law Practice

STP = "Standard Temperature and Pressure"
Standard Temperature = 273 K
Standard Pressure = 1.00 atm = 101.325 kPa = 760 mm Hg = 760 torr
Kelvin = Celsius + 273
Charles' Law is a direct relationship.

Most of these problems can be done in your head without showing your work.

1. Frau Freud and her friend Klaus have 36 L of helium trapped in a steel cylinder by a piston at a temperature of 200 K.
   A) What will the volume of the gas become if the temperature is lowered to 100 K?
   B) What will the volume of the gas become if the temperature is raised to 400 K?
   C) What will the volume of the gas become if the temperature is raised to 300 K?
   D) What will the temperature need to be for the gas to occupy a volume of 9 L?
   E) What will the temperature need to be for the gas to occupy a volume of 81 L?

2. Roger and Virginia took 400 mL of He gas and performed an experiment in which they heated and cooled it and then measured the resulting volumes. Here is their data. Make a graph of their data and use it to answer the following questions.

Temperature (K)	Volume (mL)
240	480
280	560
320	640
360	720
400	800
440	880
480	960
520	1040
560	1120
600	1200

   A) Predict the volume for a temperature of 300 K.
   B) Predict the volume for a temperature of 530 K.
   C) Predict the volume for a temperature of 800 K.
   D) Predict the temperature needed for a volume of 1000 mL.
   E) Predict the temperature needed for a volume of 700 mL.
   F) Predict the temperature needed for a volume of 320 mL.

Charles' Law Practice

Please use your head, but show your work in the manner demonstrated by your instructor. Remember to include the correct units and round off to significant digits.

These problems should be done on a separate sheet of paper.

3. What will the final volume be for a gas if its original volume was 400. mL at a temperature of 300. K and its temperature rose to 540 K?

4. Find the final temperature of a gas whose volume changed from 250.0 mL to 50.0 mL. The original temperature of the gas was 720 K.

5. Find the original volume of a gas whose temperature changed from 27.0° C to 177° C. The final volume of the gas was 420 cm^3.

6. What was the original temperature of a gas now at 17.0° C, if its volume changed from 657 cm^3 to 45.8 cm^3?

7. What will the volume of 254 cm^3 of gas be at STP if its original temperature is 72.6° C?

8. What temperature would be needed to change the volume of 275 mL of gaa at 22°C to 500. mL?

9. If you double the temperature of 25 mL of gas from 25°C to 50°C does the volume double?

10. If you double the temperature of 25 mL of gas from 100 K to 200 K is the new volume going to be 50. mL?

Mixed Up Gas Laws Practice

STP = "Standard Temperature and Pressure"
Standard Temperature = 273 K
Standard Pressure = 1.00 atm = 101.325 kPa = 760 mm Hg = 760 torr
Kelvin = Celsius + 273

These are a mixture of Boyle, Charles, and Gay Lussac's Law problems.

Remember to include the correct units and round off to significant digits. These problems should be done on a separate sheet of paper.

1. Maria and Tom have trapped 240 mL of gas in a tube with a piston at a pressure of 1.00 atm. What will the pressure become if Tom pushes the piston in to make the volume 80.0 mL?

2. Now Maria takes over, as usual. She once again traps 240 mL of gas. She finds its temperature to be 17.0 °C, so she gently warms the gas to a new temperature of 307 °C. What is the new volume of the gas?

3. Tom, trying to be very scientific, measures everything he can think of this time. He collects 180 mL of gas at a pressure of 0.84 atm and a temperature of 21.0 °C. Maria then pulls the piston out so that the volume becomes 360 mL at the same temperature. What is the final pressure of this gas?

4. Find the final volume of a gas that was collected at 47 °C if it is then cooled to 21 °C if its original volume was 273 mL.

5. What was the original pressure of 425 mL of gas if its final pressure is 1.8 atm and its final volume is 85.0 mL? The wording of this is challenging. Read it carefully.

6. What was the original temperature of a gas that was warmed to 98 °C if its volume changed from 43 mL to 569 mL?

7. Find the final volume of 780 mL of gas that is cooled from 16 °C to –96 °C.

8. Find the original volume of a gas whose pressure changed from 7.9 atm to 19.0 atm if its final volume is 714 mL.

9. What is the new pressure when 10.0 atm of Helium at 200 K is heated to 400 K?

10. What is the new pressure when 5.00 atm of Argon is heated from 25 °C to 50° C?

11. What is the new temperature when Xenon at 2.25 atm and 100°C is changed to 7.50 atm?

12. What temperature must Helium be heated to if you want to change it's pressure from 1.00 atm to 2.00 at if it starts at 35°C?

The Combined Gas Law

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Standard Temperature = 273 K
Standard Pressure = 1.00 atm = 101.325 kPa = 760 mm Hg = 760 torr
1 mL = 1 cm^3 = 1 cc
Kelvin = Celsius + 273

Please use your head, but show your work in the manner demonstrated by your instructor. Remember to include the correct units and round off to significant digits.

These problems should be done on a separate sheet of paper.

1. Find the original pressure of a gas if its original volume was 32.6 cm^3 at a temperature of 14.0° C but has a volume of 57.1 cm^3 at STP.

2. Find the original volume of a gas now occupying 224 mL at STP if its original pressure was 98.0 kPa at 7.43° C.

3. Find the original temperature of a gas now at STP if its pressure was 765.4 mm of mercury and if the volume changed from 25.2 cm^3 to 634 cm^3.

4. Find the volume a gas would have at STP if it occupied a volume of 456 cm^3 at a pressure of 754 kPa and a temperature of 800° C.

5. Find the pressure a gas would have if it was collected at a pressure of 104 kPa and its temperature was changed from 14.0° C to 97.3° C and its volume changed from 25.4 cm^3 to 936 cm^3.

6. Find the temperature a gas would have if it was collected at 18.6° C and its volume was changed from 963 cm^3 to 461 cm^3 and the pressure changed from 783 kPa to 12.0 kPa.

The Ideal Gas Law

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Standard Temperature = 273 K
Standard Pressure = 1.00 atm = 101.325 kPa = 760 mm Hg = 760 torr
1 mL = 1 cm^3 = 1 cc
Kelvin = Celsius + 273
The Universal Gas Constant R = 8.314 L·kPa/mol·K = 0.0821 L·atm/mol·K = 62.4 L·Torr/mole·K

These problems should be done on a separate sheet of paper.

1. The book claims that the volume of one mole of an ideal gas at STP is 22.4 L. Use the Ideal Gas Law to confirm this. Show your work in the manner demonstrated by your instructor and remember to include the correct units and round off to significant digits.

For Problems 2 and 3, use the above information and your head to answer the following questions. No calculators allowed!. Remember to include the correct units.

2. What will be the volume at STP of?
   A) 1 mole of gas?
   B) 3 moles of gas?
   C) 0.5 moles of gas?
   D) 2.5 moles of gas?

3. How many moles of gas at STP will have a volume of …
   A) 33.6 L?
   B) 56.0 L?
   C) 5.60L?
   D) 112L

Please use your head, but show your work in the manner demonstrated by your instructor. Remember to include the correct units and round off to significant digits.

4. What is the volume of 2.30 mole of oxygen gas at 27.0 °C if its pressure is 1.50 atm?

5. A sample of gas is confined inside of a 500. mL flask at a temperature of 23.5°C. If the flask contains 0.0123 moles of gas, what is the pressure of this gas?

6. What temperature would be needed to confine 2.40 moles of an ideal gas to a volume of 40.0 L at a pressure of 0.95 atm?

7. How many moles of an ideal gas are in 4.75 L if the pressure is 2.25 atm and the temperature is 37°C?

8. What is the volume of 32.00 g of O_2 gas at 27°C and 0.75 atm?

9. What is the volume of 14.0 g of N_2 gas at 127°C and 105 kPa?

10. What is the volume of 25.0 g of CO_2 gas at 125°C and 750 torr?

Densities and Molar Masses of Gases

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The Universal Gas Constant R = 8.314 L·kPa/mol·K = 0.0821 L·atm/mol·K = 62.4 L·Torr/moleK

These problems should be done on a separate sheet of paper.

1. Find the density of HCl gas at STP to three significant figures.

2. Find the density of HCl gas at 127 °C and 0.500 atm to three significant figures.

3. The mass of 1.00 L of a certain gas at STP is 2.75g. Calculate the molecular weight (molar mass) of this gas.

4. What is the density of uranium hexafluoride at STP?

5. The density of an unknown gas is 0.556 g/L at 373 K and 1.00 atm. What is the molar mass of the gas?

6. The density of a different unknown gas at 373 K and 1.00 atm is 1.04 g/L. What is the molar mass of this gas?

7. The density of a gas is found to be 0.441 g/L at 750 torr and 100 °C. What is the molar mass of the gas?

8. Try to identify the gases in questions 5,6, and 7.

9. You have data showing that a gas is 92.24% C and 7.76% H. If 632 mL of the gas at 750 Torr and 27°C has a mass of 0.65 g what is the molecular formula of the gas?

10. The mass of 1.00 L of nitrogen gas at STP is 1.25g.
    A) Use these data to calculate the molecular mass of nitrogen gas.
    B) From this calculated molecular mass and the given data, determine the number of *atoms* in a *molecule* of nitrogen.

Stoichiometry with Gases

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The Universal Gas Constant R = 8.314 L·kPa/mol·K = 0.0821 L·atm/mol·K = 62.4 L·Torr/moleK

1. Consider the following reaction:

$$\_\_\_HgO \rightarrow \_\_\_Hg + \_\_\_O_2$$

What volume of O_2 can be formed from 100.0 g of HgO at STP?

2. Consider the following reaction:

$$\_\_\_KClO_3 \rightarrow \_\_\_KCl + \_\_\_O_2$$

What mass of $KClO_3$ is needed to make 5.00L of O_2 at STP?

3. Methane is burned according to the following equation:

$$\_\_\_CH_4 + \_\_\_O_2 \rightarrow \_\_\_CO_2 + \_\_\_H_2O$$

What volume of CO_2 at 745 torr and 24°C is collected by burning 25.00 g of CH_4?

4. If 90.0 g of water are decomposed into hydrogen gas and oxygen gas at 25.0°C and standard pressure…
   A) What volume of hydrogen will be produced?
   B) What volume of oxygen will be produced?

5. Ethane gas, C_2H_6, burns in air and produces carbon dioxide gas and water vapor. Assume all measurements are made at STP.
   A) What volume of carbon dioxide are formed if 12.0 L of ethane are burned?
   B) How many moles of water vapor are formed?
   C) How many grams of oxygen gas will be needed?

6. Ammonia gas is formed by the decomposition of NH_4Cl. HCl is the other product.
   A) Write the equation for the chemical reaction.
   B) What volume of NH_3 forms from 25.0 g of NH_4Cl at STP?
   C) What volume of HCl forms from 25.0 g of NH_4Cl at STP?
   D) Why are the answers to B and C are what they are?
   E) How many grams of NH_4Cl are needed to make 15.0L of NH_3 at 27°C and 0.950 atm?

Dalton's Law Problems

STP = "Standard Temperature and Pressure"
Standard Temperature = 273 K
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The Universal Gas Constant R = 8.314 L·kPa/mol·K = 0.0821 L·atm/mol·K = 62.4 L·Torr/mole·K

These problems should be done on a separate sheet of paper.

1. What is Dalton's Law of Partial Pressures?

2. What is a wet gas?

3. You have a container that contains hydrogen gas at 1.5 atm, nitrogen gas at 2.5 atm, and helium gas at 0.75 atm all at the same temperature. What is the total pressure in the container?

4. A gas collection tube contains hydrogen gas and water vapor both at the same temperature. If the total pressure in the tube is 760 torr and the pressure of the hydrogen is 733 torr what is the pressure of the water vapor in the tube?

5. The vapor pressure of water at 25°C is 23.8 torr. If you collect nitrogen gas over water at a total pressure of 755 torr what is the pressure of the nitrogen gas in the sample?

6. Three gases are all in the same container. Each gas produces the same pressure. If the total pressure in the container is 750 torr what is the partial pressure of each gas?

7. You have a mixture of three gases. One at 1.00 atm, one at 2.00 atm, and one at 3.00 atm all in the same container and all at the same temperature and volume. What can you tell me about the number of molecules of each gas?

8. You have a mixture of 1.0 moles of nitrogen, 2.0 moles of helium, and 3.0 moles of hydrogen all at standard temperature. Which gas exerts the highest pressure? The lowest?

9. You have a 5.00L container that contains 5.00 g of helium and 5.00 g of neon both at 25°C. What is the partial pressure of each gas in the container and the total pressure in the container?

10. The vapor pressure of water at 20°C is 17.5 torr. You collect 36.0 mL of hydrogen gas (H_2) over water at 20°C and a total pressure of 750 torr. How many moles of hydrogen gas did you collect?

Graham's Law Problems and The Kinetic Molecular Theory

These problems should be done on a separate sheet of paper.

1) If two ideal gases are both at the same temperature what else is the same for both of them.

2) If two ideal gases are at the same temperature what can you say about the velocities of their particles? Are they the same? Are they different?

3) A 5.00L container contains two gases (helium and argon) that are both at standard temperature and pressure. Which of the following will be the same for both gases? If they are different which one has the greater value and why?

a) Average kinetic energy of the particles
b) Velocity of the particles
c) Moles of the particles
d) Mass of the particles
e) Density of the particles

4) What are the statements (postulates) we use to describe an ideal gas?

5) Which of these postulates are not totally accurate? Why?

6) What are the conditions under which a gas behaves most ideally? Why?

7) What is the difference between diffusion and effusion?

8) What is Graham's Law?

9) What two factors are important when determining how fast a gas diffuses?

10) An unknown gas effuses 1.66 times more rapidly than CO_2. What is the molar mass of the unknown gas.

11) A sample of hydrogen gas effuses through a porous container 9 times faster than an unknown gas. Estimate the molar mass of the unknown gas.

12) How much faster does hydrogen escape through a porous container than sulfur dioxide?

13) What is the rate of effusion for a gas that has a molar mass twice that of a gas that effuses at a rate of 3.62 mol/min?