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 demostrated by your instructor. Remember to include the correct units and round off to significant digits.

3. What was the original volume of a gas that was collected at an atmospheric pressure of 745 mm of Hg if it now occupies a volume of 22,400 cm^3 at standard pressure?

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?

Charles' Law Practice

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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 demostrated by your instructor. Remember to include the correct units and round off to significant digits.

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 mL to 50 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 current temperature is 72.6° C?

8. What temperature must 90.5 cm^3 of gas be made to have if its final volume is to be 181 cm^3. The original temperature of the gas is 42.5° C.

Mixed Up Gas Law Practice

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Standard Temperature = 273 K
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Kelvin = Celsius + 273

Most of these problems can be done in your head without writing down any math. Explain your answers in words!

1. What will the volume of a gas become if its pressure is changed from 2.0 atm to 6.0 atm and its original volume was 450 mL?

2. What will the pressure of a gas become if its volume is changed from 400 mL to 100 mL and its original pressure was 1.6 atm?

3. What will the final volume of a gas be if its temperature is changed from 300 K to 150 K and its original volume was 700 mL?

4. What will the final temperature of a gas need to be if its volume is changed from 240 mL to 600 mL at a constant pressure? The original temperature of the gas was 300K.

5. What was the original volume of a gas whose pressure was changed from 1.2 atm to 0.80 atm at a constant temperature of 273 K if its final volume is 240 mL?

6. What was the original volume of a gas whose temperature was changed from 240 K to 160 K at a constant pressure of 101.325 kPa if its final volume is 840 mL?

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.

7. 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?

8. 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?

9. 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?

10. 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.

11. 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?

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

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

14. 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.

Extra Credit:

15. Find the final volume of 451 mL of gas that is collected at 25 °C and a pressure of 1.4 atm if it is first cooled to 0 °C and then reduced in pressure to 1.0 atm.

16. Find the original volume of a gas that now occupies 400 mL at a pressure of 2.00 atm and a temperature of 27 °C if its original pressure was 6.00 atm and if its original temperature was –73 °C.

Combined Gas Law

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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.

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.

Ideal Gas Law

STP = "Standard Temperature and Pressure"
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 LTorr/moleK

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 be at 27.0 °C if its pressure is 157 kPa?

5. A sample of gas is confined inside of a 500 mL flask at a temperature of 23.5°C. If the flask contains 0.00123 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 100 kPa?

7. How many moles of an ideal gas are in 4.75 L if the pressure is 225 kPa and the temperature is 37°C?

8. Extra Credit:
   A) What is the density of He gas at STP?
   B) What is the density of air, a mixture of about 80% nitrogen gas and 20% oxygen gas, at STP? [Hint: Dalton's Law will help: $P_{tot} = P_1 + P_2$]

Densities and Molar Masses of Gases

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1. What volume will 5.00 g of krypton gas occupy at STP?

2. Find the density of HCl gas at STP 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. 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. 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?

2. 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?