

Gas Law Problems (and a lot of 'em)

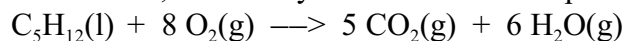
1. A balloon is filled with 30 L of helium gas at 100 kPa. What is the volume when the balloon rises to an altitude where the pressure is only 25 kPa ?
2. The pressure on 2.50 L of anesthetic gas is changed from 100 kPa to 40 kPa. Find the new volume.
3. A balloon is inflated in an air-conditioned room at 21°C, has a volume of 4.0 L. It is then taken outdoors where the temperature is 32°C. Find the new volume.
4. If a sample of gas occupies a volume of 6.8 L at 327°C, Find its volume at 27°C.
5. The gas left in an aerosol can is at a pressure of 100 kPa at 27°C. If the can is thrown into a fire at 927°C, find the internal pressure of the gas.
6. A gas has a pressure of 6.58 kPa at 540 K. What will be the pressure at 200 K ?
7. A cylinder of compressed oxygen gas has a volume of 30 L and 10 000 kPa pressure at 27°C. The cylinder is cooled until the pressure is 500 kPa. What is the new temperature ?
8. A container with an initial volume of 1.0 L is occupied by a gas at a pressure of 150 kPa at 25°C. By changing the volume, the pressure of the gas increases to 600 kPa as the temperature is raised to 100°C. Find the new volume.
9. A rigid steel cylinder with a volume of 20.0 L is filled with nitrogen gas to a final pressure of 20 000 kPa at 27°C. How many moles of nitrogen does the cylinder contain ?
10. When a rigid hollow sphere containing 680 L of helium gas is heated from 300 K to 600 K, the pressure of the gas increases to 1800 kPa. How many moles of helium does the sphere contain ?
11. A deep underground cavern contains 2.24×10^6 L of methane gas at a pressure of 1500 kPa and a temperature of 42°C. What mass of methane does is contained in this natural gas deposit ?
12. A child has a lung capacity of 2.2 L. How many grams of air do his lungs hold at a pressure of 100 kPa and a normal body temperature of 37°C ? Assume the molar mass of air to be 29 g/mol.
13. A metal cylinder contains 1 mol of nitrogen gas at STP. What will happen to the pressure if another mole of gas is added to the cylinder but the temperature and volume do not change ?
14. If a gas is compressed from 4 L to 1 L and the temperature remains constant, what happens to the pressure ?
15. A gas with a volume of 4 L is allowed to expand to a volume of 12 L. What happens to the pressure in the container if the temperature remains constant ?
16. The gas in a container has a pressure of 300 kPa at 27°C. Find the pressure if the temperature is lowered to -173°C.

17. A gas with a volume of 4.0 L at a pressure of 91.2 kPa is allowed to expand until the pressure drops to 20.3 kPa. What is the new volume ?
18. A given mass of air has a volume of 6.0 L at 100 kPa. What volume will it occupy at 25.3 kPa ?
19. Five litres of air at -50°C are warmed to 100°C . What is the new volume ?
20. The pressure in a car tire is 200 kPa at 27°C . At the end of a trip on a warm day, the pressure has risen to 223 kPa. Find the temperature of the air in the tire.
21. A 5.0 L air sample at a temperature of -50°C has a pressure of 107 kPa. What will be the new pressure if the temperature is raised to 100°C and the volume expands to 7.0 L ?
22. What volume will 12.0 g of oxygen gas occupy at 25°C and a pressure of 52.7 kPa ?
23. Calculate the volume occupied, at STP, by
a) 2.5 mol N_2 (b) 0.600 g H_2 (c) 0.350 mol O_2
24. What pressure will be exerted by 0.450 mol of a gas at 25°C if it is contained in a vessel whose volume is 0.65 L ?
25. Determine the volume occupied by 0.582 mol of a gas at 15°C if the pressure is 82.9 kPa.
26. If 4.50 g of methane gas are introduced into an evacuated 2.00 L cylinder at 35°C , what is the pressure in the container ?
27. A gas with a volume of 0.300 L at 150°C is heated until its volume is 0.600 L. Find the new temperature of the gas.
28. A 5.00 L flask at 25°C contains 0.200 mol of Cl_2 . What is the pressure in the flask ?
29. Calculate the volume of a gas in litres at 100 kPa if its volume at 120 kPa is 1.50 L.
30. A 3.50 L gas sample at 20°C and a pressure of 86.7 kPa is allowed to expand to a volume of 8.00 L. The final pressure of the gas is 56.7 kPa. Find the final temperature in degrees Celsius.
31. A gas cylinder contains nitrogen gas at 1000 kPa pressure and a temperature of 20°C . The cylinder is left in the sun and the temperature of the gas rises to 50°C . What is the pressure in the cylinder ?
32. A weather balloon has a volume of 25 L on the ground where the temperature is 17°C and the atmospheric pressure is 93.5 kPa. Find its volume at an altitude where the temperature is -25°C and the pressure is 80 kPa.
33. Find the volume occupied by 2.35 g of carbon dioxide at STP.
34. Find the volume occupied by 2.35 g of nitrogen dioxide at STP.

35. At 20.0°C a balloon has a volume of 51.3 L and an external pressure of 102.0 kPa. Calculate the pressure in the balloon if the temperature is decreased to 0.0°C while the volume is increased to 63.5 L.
36. Assuming constant volume, at what Celsius temperature does hydrogen gas exert a pressure of 50.5 kPa against the walls of a 12.7 L metal container if the original conditions were 105 kPa and 15.2°C ?
37. A student is testing the combined gas law by changing the temperature and pressure on a sample of nitrogen. If the volume is initially 1.00 L, what will be the volume after the absolute temperature is doubled and the pressure is tripled ?
38. A cylinder fitted with a piston contains 800 mL of air at a pressure of 100 kPa. Find the pressure when the piston is compressed to 300 mL.
39. The volume of a helium balloon is 8.00 L indoors, where the temperature is 22°C. What volume will the helium occupy outdoors where the temperature is -13°C ?
40. A 29.3 g sample of liquid oxygen is allowed to vaporize inside a balloon. To what volume will the balloon expand at SATP ?
41. The air trapped inside a 100 L steel drum exerts 120 kPa pressure on a hot day when the temperature is 35°C. To what Celsius temperature must the drum be cooled to lower the pressure to 100 kPa ?
42. A 50.0 L cylinder is filled with helium. What mass of the gas would be present at STP ?
43. A chemistry is excited about everything they are learning about gases and decide to release a bunch of helium balloons. One of the balloons has a volume of 20.0 L on the ground where the temperature is 12°C and the pressure is 94.6 kPa. What will be its volume at an altitude where the pressure is 82.3 kPa and the temperature is -15°C ?
44. Combustion of methane in a Bunsen burner produces 72.5 L of carbon dioxide gas at SATP. Calculate the number of moles of gas produced.
45. Pentane is a common fuel in camp stoves and burns as in the reaction below.
$$\text{C}_5\text{H}_{12(l)} + 8\text{O}_{2(g)} \rightarrow 5\text{CO}_{2(g)} + 6\text{H}_2\text{O}_{(g)}$$
- a) If 16 L of oxygen are used in the reaction, what volume of carbon dioxide and water vapor are produced at STP ?
- b) What is the volume occupied by 1.0 g of carbon dioxide at SATP ?
46. What is the volume of 26.5 kmol of chlorine gas at 400 kPa and 35°C ?
47. What amount of bromine is present in an 18.8 L sample of gas at 60 kPa and 140°C?
48. The volume of a helium balloon is 8.00 L indoors, where the temperature is 22°C. Assuming no change in pressure, what volume will the helium occupy outdoors when it cools to the ambient temperature of -13°C?
49. Combustion of methane in a bunsen burner produces 72.5 L of carbon dioxide at SATP. Calculate the amount, in moles, of carbon dioxide produced.

50. One method of determining the molar mass of a substance is to vaporize it and use the ideal gas relationships. For example, 0.688 g of an unknown liquid is introduced into an evacuated bulb of volume 450 mL. All of the liquid is vaporized, and the resulting gas pressure is 37.6 kPa at 80°C. Calculate a reasonable molar mass for the unknown liquid.

51. Pentane, commonly used as fuel in campstoves, burns as shown by the following equation.



If 16 L of oxygen are used in the reaction, what volumes of carbon dioxide and water vapor are produced? Assume all gases are measured at STP.

52. Imagine doing the following investigation.

Problem: What is the molar mass of methane?

Experimental Design: A sample of methane gas from a canister is collected in a graduated cylinder by downward displacement of water. The volume, temperature, and pressure of the gas are measured, along with the change in the mass of the canister.

Evidence:

initial mass of canister = 152.54 g

final mass of canister = 152.27 g

atmospheric pressure = 93.42 kPa

room temperature = 23.4°C

volume of gas = 445 mL

53. Imagine doing the following investigation.

Problem: What is the molar mass of propane?

Experimental Design: A sample of propane gas from a canister is collected in a graduated cylinder by downward displacement of water. The volume, temperature, and pressure of the gas are measured, along with the change in the mass of the canister.

Evidence:

initial mass of canister = 252.46 g

final mass of canister = 251.71 g

atmospheric pressure = 93.42 kPa

water temperature = 21.6°C

volume of gas = 435 mL

54. In many ways, hydrogen seems like an ideal fuel for automobiles. It burns to form water vapor, producing no pollution whatever, and is originally produced from water — an inexhaustible resource on this planet. Storing enough fuel for reasonable vehicle range is a problem though, because hydrogen has such a low density. One proposed fuel tank would store hydrogen under high pressure in tanks made from carbon fiber composites — a lighter and much stronger material than steel.

If 20 kg of gaseous hydrogen are stored in a C-fiber tank with a volume of 250 L, what will be the pressure inside such a tank on a hot day at 34°C ?

55. In an experiment designed to determine the molar mass of a gaseous sample, a student determines that a 10.00 g sample of a gas occupies 12.3 L at 20.8°C and 102 kPa. Find the molar mass of the sample.
56. Propane, $C_3H_8(g)$, is a convenient fuel for camping stoves, heaters and lanterns. It is easily carried (as a liquid under pressure) in small quantities in disposable steel cylinders. If 25.0 g of propane are used to cook a meal by a camper, what volume would this much gas occupy at 14.3°C and 96.6 kPa?
57. At 20.0°C, a balloon filled to a volume of 51.3 L has an internal gas pressure of 102.0 kPa. Calculate the pressure in the balloon if the temperature is decreased to 0.0°C while the volume is increased to 63.5 L.
58. What mass of hydrogen is needed to inflate a balloon to a volume of 100 L, when the atmospheric pressure is 97.5 kPa and the temperature is 25°C?
59. The air trapped in a 100 L steel drum exerts 120 kPa of pressure on a hot day when the temperature is 35°C. To what temperature, measured in Celsius degrees, must the air be cooled to lower the pressure to 100 kPa?
60. Find the mass of hydrogen gas needed to inflate a balloon to a volume of 50.0 L, when the atmospheric pressure is 95.3 kPa and the temperature is 22.5°C.
61. Find the pressure that 5.00 mol of oxygen gas will exert in a 4.00 L container when the temperature is 29°C.
62. The air in an automobile tire exerts 200 kPa pressure when the temperature is 15°C. Assuming the volume of the tire does not change, what pressure will the air exert when the temperature rises to 30°C?
63. What is the new volume of a 28.8 L sample of hydrogen in which the pressure is increased from 100 kPa to 350 kPa?