

Gas law problems worksheet

(2-08)¹

Graham's Law

1. Calculate the ratio of effusion rates for nitrogen (N₂) and neon (Ne).
2. Calculate the ratio of diffusion rates for carbon monoxide (CO) and carbon dioxide (CO₂).
3. 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 3.6 mol/min?

Dalton's Law

4. Find the total pressure for a mixture that contains four gases with partial pressures of 5.00 kPa, 4.56 kPa, 3.02 kPa, and 1.20 kPa.
5. Find the partial pressure of carbon dioxide in a gas mixture with a total pressure of 30.4 kPa if the partial pressures of the other two gases in the mixture are 16.5 kPa and 3.7 kPa.
6. What assumption of the kinetic-molecular theory explains why a gas can expand to fill a container?
7. How does the mass of a gas particle affect its rate of effusion?
8. Explain how changes in atmospheric pressure affect the height of the column of mercury in a barometer.
9. Explain why a tire or balloon expands when air is added.
10. Explain why the container of water must be inverted when a gas is collected by displacement of water

Boyle's Law

11. The volume of a gas at 99.0 kPa is 300.0 ml. If the pressure is increased to 188 kPa, what will be the new volume?

12. The pressure of a sample of helium in a 1.00-liter container is 0.988 atm. What is the new pressure if the sample is placed in a 2.00-liter container?

Charles's Law

13. A gas at 89°C occupies a volume of 0.67 liter. At what Celsius temperature will the volume increase to 1.12 liters?
14. What is the volume of the air in a balloon that occupies 0.620 liter at 25°C if the temperature is lowered to 0.00°C?

Gay-Lussac's Law

15. A gas in a sealed container has a pressure of 125 kPa at a temperature of 30.0 °C. If the pressure in the container is increased to 201 kPa, what is the new temperature?
16. The pressure in an automobile tire is 1.88 atm at 25.0 °C. What will be the pressure if the temperature warms up to 37.0 °C?
17. Explain why gases such as the oxygen found in tanks used at hospitals are compressed. Why must care be taken to prevent compressed gases from reaching a high temperature?

Combined gas law and Avogadro's principle

18. A helium filled balloon at sea level has a volume of 2.1 liters at 0.998 atm and 36 °C. If it is released and rises to an elevation at which the pressure is 0.900 atm and the temperature is 28 °C, what will be the new volume of the balloon?
19. At 0.00 °C and 1.00 atm pressure, a sample of gas occupies 30.0 ml. If the temperature is increased to 30.0 °C and the entire gas sample is transferred to a 20.0 ml container, what will be the gas pressure inside the container?
20. Determine the volume of a container that holds 2.4 mol of gas at STP.
21. How many moles of nitrogen gas will be contained in a 2.00-liter flask at STP?
22. If a balloon will rise off the ground when it contains 0.0226 mol of helium in a volume of 0.460 liter, how many moles of helium

¹ Glencoe, Modern Chemistry, 2005 (modified 3/2017)

are needed to make the balloon rise when its volume is 0.865 l? Assume that temperature and pressure stay constant.

23. How many grams of carbon dioxide gas are in a 1.00 liter balloon at STP?
24. A flexible plastic container contains 0.860 g of helium gas in a volume of 19.2 liters. If 0.205 g of helium is removed without changing the pressure or temperature, what will be the new volume?
25. Think about what happens when a bottle of carbonated soft drink is shaken before being opened. Use the gas laws to explain whether the effect will be greater when the liquid is warm or cold.
26. Imagine that you are going on an airplane trip in an unpressurized plane. You are bringing aboard an air-filled pillow that you have inflated fully. Predict what will happen when you try to use the pillow while the plane is at its cruising altitude.

Ideal Gas Law

27. If the pressure exerted by a gas at 25°C in a volume of 0.044 liter is 3.81 atm., how many moles of gas are present?
28. Calculate the volume that a 0.323-mol sample of a gas will occupy at 265 K and a pressure of 0.900 atm.
29. What is the pressure in atmospheres of a 0.108-mol sample of helium gas at a temperature of 20.0°C if its volume is 0.505 liter?
30. Determine the Kelvin temperature required for 0.0470 mol of gas to fill a balloon to 1.20 liter under 0.988 atm pressure.
31. Calculate the grams of N₂ gas present in a 0.600-liter sample kept at 1.00 atm pressure and a temperature of 22.0°C.
32. What is the density of a gas at STP that has a molar mass of 44.0 g/mol?
33. What is the molar mass of a sample of gas that has a density of 1.09 g/l at 1.02 atm pressure and 25.0° C?
34. Which of the following gases would you expect to behave most like an ideal gas at room temperature and atmospheric pressure: water vapor, carbon dioxide, helium or hydrogen? Explain.
35. The data show the volume of hydrogen gas collected at a number of different temperatures. Illustrate these data with a graph and use them to determine the temperature at which the volume will reach a value of 0 ml. What is this temperature called?

Volume of H₂ collected at different temperatures						
Trial	1	2	3	4	5	6
T (°C)	300	175	110	0	-100	-150
V (ml)	48	37	32	22	15	11

Gas Stoichiometry

36. Determine the volume of hydrogen gas needed to react completely with 5.00 liters of oxygen gas to form water.
37. How many liters of propane gas (C₃H₈) will undergo complete combustion with 34.0 liters of oxygen gas?
38. Ammonium nitrate is a common ingredient in chemical fertilizers. Use the reaction shown to calculate the mass of solid ammonium nitrate that must be used to obtain 0.100 liter of dinitrogen oxide gas at STP.
$$\text{NH}_4\text{NO}_3 (\text{s}) \rightarrow \text{N}_2\text{O} (\text{g}) + 2\text{H}_2\text{O} (\text{g})$$
39. When iron rusts, it undergoes a reaction with oxygen to form iron (III) oxide.
$$4\text{Fe} (\text{s}) + 3\text{O}_2 (\text{g}) \rightarrow 2\text{Fe}_2\text{O}_3 (\text{s})$$

Calculate the volume of oxygen gas at STP that is required to completely react with 52.0 g of iron.
40. A 2.02 g sample of Al is reacted with an excess of HCl (aq) and the liberated hydrogen gas is collected over water at 26°C at a barometric pressure of 752 torr. What is the volume of gas collected? Vapor pressure of water at 26°C = 25.2 torr.