Introductory General Chemistry

Instructor: Bill Farina
Materials today cover
Lessons 12.1 – 12.5

Reminders

You should have completed the following:

- Online reading:
  - You should have completed Lessons 12.1 – 12.5 this week online.
- ALEKS:
  - Objective 12 is due next Tuesday!
- Homework Assignments:
  - Supplementary Problems 12.1-12.15

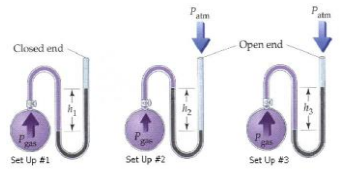
Upcoming Due Dates:

- Second Unit Quiz will be available tomorrow

Group Problems

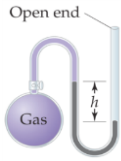
Problem 1A

How do you find the pressure of the gas for each of the three set-ups shown below?



Problem 1B

The height of the column of mercury in the open ended manometer shown at the below is found to be 65 mm. If the external pressure is 1.06 atm, what is the gas pressure inside the bulb?



Problem 1B Work Area

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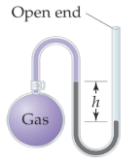


Problem 2A

A cylinder containing 20.0 L of compressed nitrogen is connected to an empty (evacuated) vessel with an unknown volume. The gas pressure in the cylinder starts at 25 atm and drops to 2 atm without a change in temperature. Determine the volume of the vessel.

HINT: Draw Pictures!

Problem 2A Work Area

A cylinder containing 20.0 L of compressed nitrogen is connected to an empty (evacuated) vessel with an unknown volume. The gas pressure in the cylinder starts at 25 atm and drops to 2 atm without a change in temperature. Determine the volume of the vessel. As a follow up, can you identify the gas law used?

Problem 2B

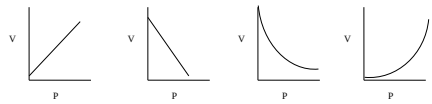
A sample of oxygen is confined at 273 K in a cylinder with a movable piston. The gas has an initial pressure of 1.0 atm. The piston compresses the gas so that the final volume is half the initial volume. The final pressure is 2.2 atm. What is the final temperature?

Problem 2B Work Area

A sample of oxygen is confined at 273 K in a cylinder with a movable piston. The gas has an initial pressure of 1.0 atm. The piston compresses the gas so that the final volume is half the initial volume. The final pressure is 2.2 atm. What is the final temperature?

Problem 3

Which plot depicts the relationship between the volume and pressure of an ideal gas at constant n and T?



Follow-up: can you draw a plot of T vs V, and n vs. V??

Problem 4

A. What conditions are represented by the abbreviation STP?
B. What is the molar volume of a gas at STP
C. What is the molar volume of a gas at room temperature (25°C) and 1 atm?
D. What is the volume of 0.5 moles of an ideal gas at STP?

Problem 4 Work Area

A. What conditions are represented by the abbreviation STP?

B. What is the molar volume of a gas at STP

C. What is the molar volume of a gas at room temperature (25°C) and 1 atm?

D. What is the volume of 0.5 moles of an ideal gas at STP?

Problem 5A

An *ideal* gas in a 300 L vessel has a pressure of 560 mmHg and at 23ºC, how many moles of that gas are in the vessel?

Problem 5B

If the gas in *5A* is hydrogen, what is its density?

Problem 6

A gaseous hydrocarbon has an empirical formula: CH_3. The density of the gas is 1.34 g/L at STP. Determine the molecular formula of this hydrocarbon.

Problem 7A

A mixture of H_2 and He are in a 10.0 L vessel at 273 K. The total pressure is 756 torr. What is the partial pressure of H_2 in the vessel if $X_{He} = 0.75$? (What does X_{He} represent?)

Problem 7B

- In *7A*, what is the partial pressure of He?

Problem 8

The gas in a 3.4-L flask containing CO_2 at 993 mm Hg is allowed to expand into a 6.6-L flask containing N_2 that was initially at a pressure of 465 mm Hg. The total volume of the combined vessels is 10.0 L. The temperature remains constant at 298 K. What is the mole fraction of CO_2 in the final mixture?

Problem 8 Work Area

The gas in a 3.4-L flask containing CO_2 at 993 mm Hg is allowed to expand into a 6.6-L flask containing N_2 that was initially at a pressure of 465 mm Hg. The total volume of the combined vessels is 10.0 L. The temperature remains constant at 298 K. What is the mole fraction of CO_2 in the final mixture?

Problem 9

What change or changes in the state of a gas bring about each of the following effects?

A. The number of impacts per unit time on a given container wall increase.
B. The average energy of impact of molecules with the wall of the container decrease.
C. The average distance between gas molecules increases.
D. The average speed of molecules in the gas mixture is increased.

Problem 10

It takes 21.3 s for N_2 (g) to effuse from a 1.0 L container at 30°C. In a separate experiment, it takes 25.4 s for an unknown gas to effuse under identical conditions. Which of the following gases can be the unknown gas?? (Hint: what is the relationship between rate and time? Consider this *before* plugging numbers into any needed equations).

Problem 10 Work Area

It takes 21.3 s for N_2 (g) to effuse from a 1.0 L container at 30°C. In a separate experiment, it takes 25.4 s for an unknown gas to effuse under identical conditions. Which of the following gases can be the unknown gas?? (Hint: what is the relationship between rate and time? Consider this *before* plugging numbers into any needed equations).

A. Cl_2
B. O_2
C. Kr
D. Ar
E. Ne

Problem 11

A mixture of gases at 25°C has the following mole fractions $X_{Cl2} = 0.467$, $X_{CO} = 0.346$, $X_{Xe} = 0.007$, $X_{N2} = 0.090$, and $X_{H2} = 0.090$. Which gas has the greatest root mean square speed?

A. H_2
B. CO
C. Xe
D. N_2
E. Cl_2

Problem 12A

- Under what conditions do real gas properties deviate from those properties predicted for an ideal gas?

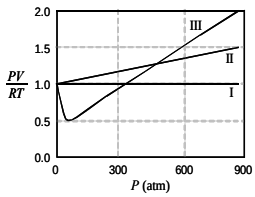
Problem 12B

Which of the following gases would be most likely to exhibit ideal-gas behavior?

A. He at 1 atm and 10 K
B. Ne at STP
C. Ar at 10 torr and 400 K
D. Ne at 100 atm and 273 K
E. Ar at 50 atm and 100 K

Problem 12C

Identify the ideal gas among the three that are indicated in the graph below.



Problem 13

The C–Cl bond dissociation energy of CF_3Cl is 339 kJ/mol. What is the maximum wavelength of photons that can rupture this bond? (Consider the following: what is the energy of one photon? What is the relationship between E and λ?)

Problem 13 Work Area

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Problem 14

The concentration of carbon monoxide (CO) that can cause health problems is 50 ppm. If a room at 82°C and 725 torr has a total of 1.0×10^6 mol of gas and 2×10^2 mol of CO, what is the concentration (in ppm) of CO? Is this enough to cause health problems? What is the partial pressure of CO in the room?

Problem 14 Work Area

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