

# Exercise 11.1a

## Measuring Gases

Name: \_\_\_\_\_

Date: \_\_\_\_\_ Per: \_\_\_\_\_

Pressure is defined as the force exerted over an area. In the case of gases, that force is exerted as gas particles collide with the surface area in question. In chemistry gases are contained and the pressure comes from collisions between the gases and the walls of the container.

There are many different units for measuring pressure that have been developed over the years. The SI unit of pressure is the pascal (Pa), but other units used in chemistry might include millimeters of mercury (mm Hg), atmospheres (atm), pounds per square inch (psi), and a variety of others. One atmosphere (1 atm) is defined as the mean atmospheric pressure at the mean sea level at the latitude of Paris, France.

In order for scientists to compare gases under similar conditions, they have created “standard conditions” at which various properties of gases can be described. Standard temperature and pressure (STP) is defined as 0°C and 1 atm when referring to gases.

**DIRECTIONS: Complete the following in the space provided.**

- Convert 11400 mm Hg to atm.
- Convert 4.50 atm to mm Hg
- Convert 24.8 psi to mm Hg
- Convert 1260 mm Hg to atm
- Convert 45.3 atm to mm Hg

- | Pressure Unit Equivalences |                                     |
|----------------------------|-------------------------------------|
| 1.00 atm = 760 mm Hg       | 1.00 atm = 1013 mbars               |
| 1.00 atm = 14.7 psi        | 1.00 atm = 760 Torr                 |
| 1.00 atm = 101 325 Pa      | 1.00 atm = 29.92 in Hg              |
| 1.00 atm = 101.325 kPa     | 1.00 atm = 407 in. H <sub>2</sub> O |
- Convert 950. mm Hg to kPa
  - Convert 78.3 atm to mm Hg
  - Convert 450. mm Hg to atm
  - Convert 30.9 psi to atm
  - Convert 10278.2 in. H<sub>2</sub>O to mbars

Standard temperature is usually expressed in kelvins (K). 0 °C = 273 K. To convert °C to kelvins, add 273. To convert kelvins to °C, subtract 273.

- Convert 25.5 °C to kelvins.
- Convert 890. kelvins to °C.
- Convert 125 °C to kelvins.
- Convert 298 kelvins to °C.
- Convert -50.8 °C to kelvins.
- Convert 0 kelvins to °C.
- Convert 0 °C to kelvins.
- Convert 278 kelvins to °C.

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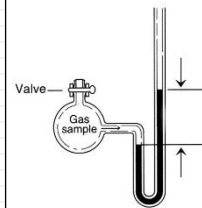
## Measuring Gases

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A manometer is a device for comparing pressures of gases to one another based on how they exert a force on a u-shaped tube filled with mercury. The gas sample with the higher pressure pushes down harder on the mercury causing a difference in the height of the mercury columns in the two glass arms of the tube.

In the diagram at right, the mercury is being pushed harder by the gas sample than by the air from the atmosphere. The difference in height represents how much higher the pressure in the gas sample is compared to the atmospheric pressure. If the atmospheric pressure is known, the pressure of the gas sample may be found or vice-versa.



19. The mercury level on the container side of a manometer is 47.0 mm lower than on the open side. If the atmospheric pressure is 771 mm Hg, what is the pressure of the gas? How much would this be in atm?
20. What is the pressure in a container of gas if the mercury level in the manometer arm attached to the container is 18.5 mm higher than the mercury level in the manometer arm open to the atmosphere? Atmospheric pressure is 0.950 atm.

Dalton's Law of Partial Pressures states that gases act independently in terms of exerting force when placed in the same container. Therefore, the total pressure of a mixture of gases is simply the sum of the pressures each gas exerts on its own.

$$P_{\text{total}} = P_{\text{partial1}} + P_{\text{partial2}} + P_{\text{partial3}} \dots$$

21. If the total pressure of a mixture of gases in a container is 3.40 atm, and the partial pressure of gas A is 0.70 atm and the partial pressure of gas B is 1.30 atm, what is the partial pressure of gas C?
22. In the chem lab, a student filled a balloon with 2 different gases, CO<sub>2</sub> and N<sub>2</sub>. The atmospheric pressure in the chem lab was 770.0 mmHg and the partial pressure of CO<sub>2</sub> added to the balloon was 0.3255 atm. What was the partial pressure of N<sub>2</sub> in the balloon?