Worksheet 8-1 Pressure

Pressure is defined as the force applied divided by the area over which it is applied. A gas pressure results from the many collisions between gas particles and a surface. The SI unit of pressure is the newton per square meter (N/m^2) called the pascal (Pa). A pascal is very small so it is often reported in thousands of pascals or kilopascals (kPa). The atmosphere surrounding the earth exert a pressure of approximately 1 atmosphere (atm) at sea level. There are other units used to measure pressure shown in the table below.

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

$$P = \frac{F}{A}$$

Useful Conversions
1 atm ≡ 760 mmHg
1 torr ≡ 1 mmHg
1.000 00 atm = 14.695 9 psi = 101 325 Pa
1 in ≡ 25.4 mm

Example 1: A container of gas has a pressure of 104.9 kPa. Convert this pressure to psi.

$$\frac{104.9 \text{ kPa}}{1} \times \frac{1 \times 10^3 \text{ Pa}}{1 \text{ kPa}} \times \frac{14.696 \text{ psi}}{101\ 325 \text{ Pa}} = \boxed{15.21 \text{ psi}}$$

Example 2: Barometric pressure is reported as 30.1 inHg. Convert this to torr.

$$\frac{30.1 \text{ inHg}}{1} \times \frac{25.4 \text{ mmHg}}{1 \text{ inHg}} \times \frac{1 \text{ torr}}{1 \text{ mmHg}} = \boxed{764.5 \text{ torr}}$$

Use the conversion factors in the table to solve the following problems.

1. The pressure is recorded as 738 mmHg. Convert this measurement to atmospheres (atm).
2. A ball is inflated to a pressure of 32.0 pounds per square inch (psi). Convert this pressure to atmospheres (atm).
3. What is the pressure in pascals if the pressure is equal to 380 torr?
4. The air pressure in a tire is 2.38 atm. What is this pressure in kilopascals?
5. The atmosphere supports a column of mercury that is 748 mm in height. What is atmospheric pressure in torr? Convert this pressure to atmospheres (atm).
6. Many pneumatic tools operate at an air pressure of 90 psi. What is the equivalent pressure in kilopascals (kPa)?
7. The safety disk in a scuba tank will blow at a pressure of approximately 25 000 kPa. Convert this pressure to mmHg.
8. When a brake pedal is pressed with a pressure of 100 psi the pressure is converted about 1200 psi in the master cylinder. What is the pressure of the master cylinder in torr?
9. Normal atmospheric pressure in Mexico City is about 565 mmHg. Convert this to atmospheres.
10. If the gas in a container can support 74 inHg, what is the gas pressure in pascals?

1. $\dfrac{738 \cancel{\text{ mmHg}}}{1} \times \dfrac{1 \text{ atm}}{760 \cancel{\text{ mmHg}}} = \boxed{0.971 \text{ atm}}$

2. $\dfrac{32.0 \cancel{\text{ psi}}}{1} \times \dfrac{1 \text{ atm}}{14.695\ 9 \cancel{\text{ psi}}} = \boxed{2.18 \text{ atm}}$

3. $\dfrac{380 \cancel{\text{ torr}}}{1} \times \dfrac{1 \cancel{\text{ mmHg}}}{1 \cancel{\text{ torr}}} \times \dfrac{1 \cancel{\text{ atm}}}{760 \cancel{\text{ mmHg}}} \times \dfrac{101\ 325 \text{ Pa}}{1 \cancel{\text{ atm}}} = \boxed{51\ 000 \text{ Pa}}$

4. $\dfrac{2.38 \cancel{\text{ atm}}}{1} \times \dfrac{101\ 325 \cancel{\text{ Pa}}}{1 \cancel{\text{ atm}}} \times \dfrac{1 \text{ kPa}}{1000 \cancel{\text{ Pa}}} = \boxed{241 \text{ kPa}}$

5. $\dfrac{748 \cancel{\text{ mmHg}}}{1} \times \dfrac{1 \text{ torr}}{1 \cancel{\text{ mmHg}}} = \boxed{748 \text{ torr}}$

   $\dfrac{748 \cancel{\text{ mmHg}}}{1} \times \dfrac{1 \text{ atm}}{760 \cancel{\text{ mmHg}}} = \boxed{0.984 \text{ atm}}$

6. $\dfrac{90 \cancel{\text{ psi}}}{1} \times \dfrac{1 \cancel{\text{ atm}}}{14.695\ 9 \cancel{\text{ psi}}} \times \dfrac{101\ 325 \cancel{\text{ Pa}}}{1 \cancel{\text{ atm}}} \times \dfrac{1 \text{ kPa}}{1000 \cancel{\text{ Pa}}} = \boxed{620 \text{ kPa}}$

7. $\dfrac{25\ 000 \cancel{\text{ kPa}}}{1} \times \dfrac{1000 \cancel{\text{ Pa}}}{1 \cancel{\text{ kPa}}} \times \dfrac{1 \cancel{\text{ atm}}}{101\ 325 \cancel{\text{ Pa}}} \times \dfrac{760 \text{ mmHg}}{1 \cancel{\text{ atm}}} = \boxed{190\ 000 \text{ mmHg}}$

8. $\dfrac{1200 \cancel{\text{ psi}}}{1} \times \dfrac{1 \cancel{\text{ atm}}}{14.695\ 9 \cancel{\text{ psi}}} \times \dfrac{760 \cancel{\text{ mmHg}}}{1 \cancel{\text{ atm}}} \times \dfrac{1 \text{ torr}}{1 \cancel{\text{ mmHg}}} = \boxed{62\ 000 \text{ torr}}$

9. $\dfrac{565 \cancel{\text{ mmHg}}}{1} \times \dfrac{1 \text{ atm}}{760 \cancel{\text{ mmHg}}} = \boxed{0.743 \text{ atm}}$

10. $\dfrac{74 \cancel{\text{ inHg}}}{1} \times \dfrac{25.4 \cancel{\text{ mmHg}}}{1 \cancel{\text{ inHg}}} \times \dfrac{1 \cancel{\text{ atm}}}{760 \cancel{\text{ mmHg}}} \times \dfrac{101\ 325 \text{ Pa}}{1 \cancel{\text{ atm}}} = \boxed{250\ 000 \text{ Pa}}$