

## Academic Chemistry – Unit 6 Review

### Chapter 14 – The Behavior of Gases

1. The balloon used by Charles in his historic flight in 1783 was filled with about 1300 mol of hydrogen gas. If the temperature of the gas was 23°C, and its pressure was 750 mm Hg, what was the volume of the balloon?
2. The nitrogen gas in an air bag, with a volume of 65 L, exerts a pressure of 829 mm Hg at 25°C. What quantity of nitrogen gas (in moles) is in the air bag?
3. You have a 22 L cylinder of helium at a pressure of 150 atm and at 31°C. What will the volume of helium be on a day when the atmospheric pressure is 755 mm Hg and the temperature is 22°C? With this volume of helium, how many 5 L balloons can you fill?
4. Helium-filled balloons are used to carry scientific instruments high into the atmosphere. Suppose that a balloon is launched when the temperature is 22.5°C and the barometric pressure is 754 mm Hg. If the balloon's volume is  $4.19 \times 10^3$  L (and no helium escapes from the balloon), what will the volume be at a height of 20 miles, where the pressure is 76 mm Hg and the temperature is -33°C?
5. Suppose you have a sample of CO<sub>2</sub> in a gas-tight syringe. The gas volume is 25 mL at room temperature (20°C). What is the final volume of the gas if you hold the syringe in your hand to raise the temperature to 37°C?
6. A sample of gaseous nitrogen in a 65 L automobile air bag has a pressure of 745 mm Hg. If this sample is transferred to a 25 L bag with the same temperature as before, what is the pressure of the gas in the new bag?
7. A sample of carbon dioxide gas has a pressure of 55 mm Hg in a volume of 125 mL. The sample is compressed so that the new pressure of the gas is 78 mm Hg. What is the new volume of the gas? (The temperature does not change in this process).

8. Convert a pressure of 635 mm Hg into its corresponding value in units of atmospheres and kilopascals.
9. 12.0 g of oxygen gas are required to inflate a balloon to what volume at 27°C and a pressure of 79.8 kPa?
10. Methane burns in oxygen to produce carbon dioxide and water, according to the equation:  
$$\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$$
  
If 22.4 L of gaseous CH<sub>4</sub> is burned, what volume of O<sub>2</sub>(g) is required for complete combustion? What volumes of carbon dioxide and water are produced? Assume all gases have the same temperature and pressure.
11. Halothane has the formula C<sub>2</sub>HBrClF<sub>3</sub>. It is a nonflammable, nonexplosive, nonirritating gas that is commonly used as an inhalation anesthetic. Suppose you mix halothane vapor with a partial pressure of 80.2 mm Hg with oxygen gas that has a partial pressure of 755 mm Hg. What is the total pressure of the mixture of gases?
12. You have a sample of gas in a flask with a volume of 250 mL. At 25.5°C the pressure of the gas is 360 mm Hg. If you decrease the temperature to -5°C, what is the gas pressure at the lower temperature?
13. One of the cylinders of an automobile engine has a volume of 400 cm<sup>3</sup>. The engine takes in air at a pressure of 1.0 atm and a temperature of 15°C and compresses it to a volume of 50 cm<sup>3</sup> at 77°C. What is the final pressure of the gas in the cylinder? *Hint: What is the relationship between cm<sup>3</sup> and mL?*
14. Air-filled balloons at room temperature are placed in liquid nitrogen (77 K). What happens to the volume of the balloons? What happens to the speed and movement of the molecules in the balloon?
15. If a marshmallow is placed into a jar and then that jar is connected to a vacuum pump that takes all of the air out of the jar the marshmallow will expand as a result. Explain why did a marshmallow will expand when the air is pumped out of a bell jar?