CHAPTER 11 Review

Reflecting on Chapter 11

Summarize this chapter in the format of your choice. Here are a few ideas to use as guidelines.

- Describe the structure of solids, liquids, and gases in simple terms.
- Compare the intermolecular forces that hold solids together with those that hold liquids and gases together.
- Use the kinetic molecular theory to describe the behaviour of ideal gases.
- Explain Boyle's law.
- Explain Charles' law.
- Explain Gay-Lussac's law.
- Describe how gases under pressure are the cause of some of the natural wonders of our Earth.
- Describe how gases under pressure have many industrial and medical uses.
- Explain Dalton's law of partial pressure.

Reviewing Key Terms

For each of the following terms, write a sentence that shows your understanding of its meaning.

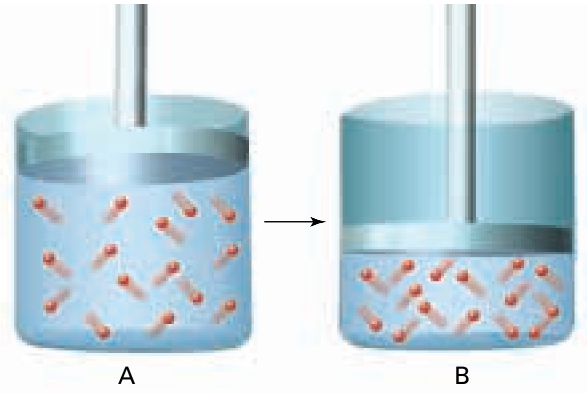
atmospheres	absolute zero
Boyle's law	Charles' law
closed system	combined gas law
Condensation	fuel cell
Dalton's law of partial pressures	Gay-Lussac's law
fusible plugs	kilopascals
ideal gas	mmHg
Kelvin scale	pressure-relief valve
kinetic molecular theory of gases	standard temperature and pressure (STP)
pascal	standard temperature
standard atmospheric pressure	standard atmospheric pressure
standard ambient temperature and pressure (SATP)	

Knowledge/Understanding

1. Gases behave differently than solids and liquids. Using what you know about forces between molecules, explain some of these differences.
2. Using the kinetic molecular theory, answer each of the following questions.
   (a) What does it mean when we say that the pressure of a gas has increased?
   (b) What does it mean when we say that the temperature of a gas has decreased?
3. (a) Give a real example that illustrates Boyle's law.
   (b) Give an example that illustrates Charles' law.
4. What is the kinetic molecular theory explaination for 0 K?
5. Explain Gay-Lussac's law in terms of the motion of gas particles.
6. Explain Dalton's law of partial pressures in terms of the motion of gas particles.
7. How is a volcano an example of a natural occurrence in which pressures of gases are of major importance?
8. List four major and four minor components of the atmosphere.
9. How is pure oxygen used medically and industrially?
10. Nitrogen is one of the most important industrial substances produced on Earth. Why is it so important industrially?
11. Would the column of mercury in a barometer be shorter at the top of a mountain or at the base of the mountain? Explain.
12. Using the kinetic molecular theory, explain why the density of a gas is less than that of a liquid. (Density is mass per unit of volume.)
13. A weather balloon containing helium is released into the atmosphere. As it rises, atmospheric pressure and temperature both decrease. Explain why the size of the balloon increases.

Inquiry

14. Below are two diagrams showing a trapped gas. The volume of the gas in container A can be changed to become the same volume as the gas in container B. Describe how you could do this in the laboratory.



15. You have carried out investigations to determine the relationship between pressure and volume, and between temperature and volume. How could you investigate the relationship between pressure and temperature?
  (a) Write up a procedure to determine the relationship between the pressure and temperature of a gas.
  (b) Identify any problems with your procedure. How could you overcome these problems?
  (c) What materials will you need?
  (d) What variables will you hold constant?
  (e) What variable will you change?
  (f) What variable will you measure?
16. The pressure exerted on 0.25 L of nitrogen is 120 kPa. What volume will this gas occupy at 60 kPa if the temperature and number of moles is constant?
17. Ammonia gas, $NH_{3(g)}$, is used in the production of fertilizer. At 55.0˚C, a sample of ammonia gas is found to exert a pressure of 7.5 atm. What pressure will the gas exert if its volume is reduced to one fifth of its original volume at 55.0˚C?
18. A 35.0 L sample of dry air at 750 torr is compressed to a volume of 20 L. What is the final pressure exerted on the gas if the temperature remains constant?
19. A 25 g sample of dry air in a large party balloon at 20˚C occupies a volume of 20 L. If the temperature is increased to 40˚C at constant pressure, how large will the balloon become?
20. A sample of nitrogen gas has a volume of 10 L at 101.3 kPa and 20˚C. To preserve biological tissue, the nitrogen gas is cooled to –190˚C, almost the temperature of liquid nitrogen, at a pressure of 101.3 kPa. What volume will the nitrogen occupy at this temperature?
21. A 75.3 L sample of oxygen gas at 25.7˚C is cooled until its final volume becomes 10 L. If the pressure remains constant, what is the final temperature (in ˚C)?
22. Calculate the volumes that each of the following gases would occupy at STP.
  (a) 22.4 L of oxygen at 75˚C and 700 torr.
  (b) 100 cm^3 of nitrogen at 20˚C and 150.0 kPa.
  (c) 45 mL of neon at –50.˚C and 200 kPa.
23. A birthday balloon contains 2.0 L of air at STP. What volume will the balloon have at SATP?
24. A mixture of neon and argon gases is collected at 102.7 kPa. If the partial pressure of the neon is 52.5 kPa, what is the partial pressure of argon?
25. A 250 mL glass vessel is filled with krypton gas at a pressure of 700 torr at 25.0˚C. If the glass vessel is made to withstand a pressure of 2.0 atm, to what maximum temperature (in ˚C) can you safely heat the flask?
26. A cylinder with a moveable piston contains hydrogen gas collected at 30˚C. The piston is moved until the volume of the hydrogen is halved. The pressure inside the container has increased to 125 kPa at 30˚C. What was the initial pressure inside the cylinder?
27. Argon gas is used inside light bulbs because it is a plentiful inert gas. 650 cm^3 of argon gas at STP is heated in order to double its volume at 101.3 kPa. What is the final temperature (in ˚C)?
28. A truck leaves Yellowknife in early January when the temperature is –30.0˚C. The tires of the truck are inflated to 210 kPa. Four days later, the truck arrives in California where the temperature is 30.0˚C. What is the air pressure in the tires when the truck arrives at its destination?
29. Methane (CH_4), a natural gas, is stored in a 100 L tank at –10˚C and a pressure of 125 atm. The gas is used to provide fuel for a furnace that heats a country home during the winter. The furnace consumes an average of 500 L of methane a day. How long will this supply of methane last if it is burned at 450˚C at a pressure of 102 kPa?

30. Neon gas is widely used as the luminous gas in signs. A sample of neon has a volume of 5.5 L at 750 torr at 10.0˚C. If the gas is expanded to a volume of 7.5 L at a pressure of 400 torr, what will its final temperature be (in ˚C)?

31. Halogen lamp bulbs are usually filled with bromine or iodine vapour at 5.0 atm pressure. When turned on, the glass bulb can heat up to more than 1150˚C. If room temperature is 20˚C, what will the pressure in the bulb be when it reaches its operating temperature?

32. Helium gas is stored in a steel cylinder with a volume of 100 L at 20˚C. The pressure gauge on the cylinder indicates a pressure of 25 atm. The cylinder is used to blow up a weather balloon at 25˚C. If the final pressure in the cylinder and the balloon is 1.05 atm, how large will the balloon be?

33. A scuba diver is swimming 30.0 m below the surface of Lake Ontario. At this depth, the pressure of the water is 4.0 atm and the temperature is 8.0˚C. A bubble of air with a volume of 5.0 mL escapes from the diver's mask. What will the volume of the bubble be when it breaks the surface of the water? The atmospheric pressure is 101.3 kPa and the temperature of the water is 24.0˚C.

Communication

34. The weather person on television reports that the barometric pressure is 100.2 kPa. How high a column of mercury will this air pressure support?

35. Convert each of the following pressures:
 (a) 1.5 atm to kPa
 (b) 135.5 kPa to mm Hg
 (c) 750 mm Hg to torr

36. On a visit to your doctor, your blood pressure is taken. The reading is 125.0 mm Hg systolic and 80.0 mm Hg diastolic. What is your blood pressure in kPa?

37. Convert the following temperatures.
 (a) −185.5˚C to K
 (b) 125 K to ˚C

38. Do research to find out how carbonated drinks get their "fizz." Prepare a short PowerPoint™ presentation to the class that describes the manufacture of a typical soft drink.

Making Connections

39. Coal is a fossil fuel that is burned to obtain energy. However, carbon dioxide (CO_2) gas is produced whenever coal is burned. What are the benefits and risks of burning coal to obtain energy? What are the alternatives?
 (a) Do research to answer these questions.
 (b) *Should the government shut down all coal-burning power plants in Canada to help prevent global warming?* Carry out this debate with your class. Divide the class into the executives of a coal-burning power plant, and scientists representing an environmentalist group.

40. Interview a doctor or nurse who works at a hospital. Find out how compressed gases are used at the hospital, and what safety precautions are taken.

41. Suppose you are a member of a consulting firm that is approached by the Ministry of the Environment. You are asked to prepare a report on how the government can help reduce CO_2 and CH_4 gas emissions. Both gases are important greenhouse gases that may be causing global warming.
 (a) Identify the information you will need to prepare this report. This may take the form of a list of questions.
 (b) Research the answers to your questions.
 (c) Prepare a short report giving suggestions on how the Canadian government could help reduce CO_2 and CH_4 gas emissions.

Answers to Practice Problems and Numerical Section Review Questions

Practice Problems: **1.** 1.0×10^3 kPa **2.** 1644 L **3.** 4.5 cm^3 **4.** 0.01 L **5.(a)** 298 K **(b)** 310 K **(c)** 423 K **6.(a)** 100˚C **(b)** –175˚C **(c)** 152˚C **8.** 3.86×10^2 mL **9.** 2.1 L **10.** 606˚C **11.** 957˚C **12.** 127 L **13.** 2.71×10^2 kPa **14.** 18.8 atm **15.** –16˚C **16.** 31˚C **17.** 163 mL **18.** 0.43 atm **19.** 148 K **20.** 310˚C **21.** 6.4×10^2 kPa **22.** 300.6 kPa **23.** 14 kPa, 27 kPa, 75 kPa **24.** 1.08×10^2 kPa **25.** 0.70 atm
Section Review: **11.1** **3.(a)** liquid **(b)** gas **(c)** solid
11.2 **1.(a)** 206 kPa **(b)** 0.841 atm **(c)** 1.14×10^3 torr **(d)** 80.0 kPa **4.** 1.04 L **5.** 152 kPa **6.** 811 torr
11.3 **2.(a)** 52.1 kPa **(b)** 8.3 L **11.4** **1.** 148 K