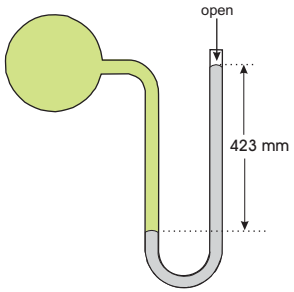
Chapter 7 Exercises

See Appendix B for more exercises on the gas laws.

1. A weather report indicates a barometric pressure of 29.2 in. What is this pressure expressed in torr?

2. What is the volume of the He in the following apparatus if it contains 0.25 g of He at 20 °C, and the barometric pressure is 758 torr?



3. If the gas in Exercise 2 is heated to 35 °C, what would be the separation between the two mercury levels?

4. Convert the following temperatures to the Kelvin scale:
a) 58 °C **b)** -263.08 °C **c)** 42.1 °C **d)** -185 °C

5. Convert the following temperatures to the Celsius scale:
a) 4 K **b)** 350 K **c)** 186.4 K **d)** 657 K

6. What mass of He is required to fill a 5.2-L balloon at 23 °C and 746 torr?

7. What is the pressure inside a 7.20-L container filled with 0.254 moles of CO_2 at 35 °C?

8. To what temperature must a 12.0-L container filled with 1.65 g of Ne be heated to obtain a pressure of 1.60 atm?

9. The pressure of air in a tire at 10 °C is 22 psi. After several miles of driving at high speed, the pressure is 28 psi. Assume the volume of the tire is unchanged and calculate the temperature of the air in the tire.

10. What are the concentrations in mol/L of the gases in Exercises 6 - 8?

11. Determine the concentrations of the following gases in moles/L:
a) 3.0 moles of gas at 900 K and 2.6 atm
b) 6.2 L of a gas at 250 °C and 800 torr
c) 4.0 g of Ne in a 0.56 L container at 200 °C

12. 2.0 mol CO_2 and 1.2 mol O_2 are mixed at 75 °C in a 12-L container. What are the partial pressures of the two gases and the total pressure inside the container expressed in atmospheres?

13. What are the partial pressures in torr of O_2 and N_2 and the total pressure in a 3.5-L flask at 77 °C that contains 4.0 g O_2 and 7.0 g N_2?

14. The total pressure of a mixture of He, Ne, and Ar is 622 torr in a 2.75-L flask at 400 K. If the partial pressure of He and Ne are 175 torr and 326 torr, respectively, how many moles of Ar are in the flask?

15. What is the approximate thermal energy in kJ/mol of molecules at each of the following temperatures?
a) -200 °C **b)** 300 °C **c)** 75 °C

16. At what temperatures would molecules have the following thermal energies?
a) 5 kJ/mol **b)** 25 kJ/mol **c)** 2.5 J/mol

17. How does the thermal energy compare to the energy of attraction between molecules in a solid and in a gas?

18. Rank the strengths of the intermolecular interactions of I_2, CCl_4, and CH_4 given that iodine is a solid, carbon tetrachloride is a liquid and methane (CH_4) is a gas at room conditions.

19. Explain why the boiling point of a substance increases as the pressure increases.

20. What can be concluded about the structures of the solid and liquid states of a compound if the melting point increases as pressure is applied?

21. Explain why bubbles form when a liquid boils.

22. Rapidly cooling a vapor in equilibrium with its liquid causes the liquid to boil. Explain.

23. Which has a greater potential energy at 270 K, ice or water vapor? Explain.

24. Explain why the odor of mothballs (solid naphthalene) becomes stronger when the temperature increases.

25. Why are ionic substances solids under normal conditions?

26. Why are the noble gases all gases under normal conditions?

27. Explain why many gases are liquefied by increasing the pressure.

28. Give three properties of water that can be attributed to hydrogen bonding and the six-sided channels that form when water freezes.

29. Explain how snow can disappear without melting.

30. Explain how perspiration is used to cool the body.

31. Explain why the temperature of a solid $\rightleftharpoons$ liquid mixture does not change when it is heated.

32. Explain why water expands when it freezes.

33. What is a dynamic equilibrium? Give two examples of dynamic equilibria.

34. Define the term "heat of vaporization". The heat of vaporization of water at 100 ^{o}C is 40.7 kJ/mol. Write the chemical equation for the process to which this number applies.

35. Define the term "heat of fusion". The heat of fusion of water at 0 ^{o}C is 6.0 kJ/mol. Write the chemical equation for the process to which this number applies.

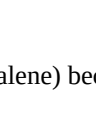
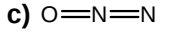
36. Refer to Figure 7.15 to determine whether CCl_4 is a liquid or a gas under the following conditions of temperature and pressure.

a) 50 ^{o}C and 500 torr **b)** 77 ^{o}C; 500 torr **c)** 100 ^{o}C; 800 torr

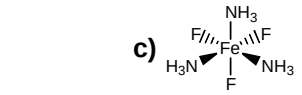
37. Refer to Figure 7.15 to determine whether H_2O is a liquid or a gas under the following conditions of temperature and pressure.

a) 50 ^{o}C and 500 torr **b)** 77 ^{o}C; 500 torr **c)** 100 ^{o}C; 800 torr

38. Identify the polar molecules.

a) **b)**  **c)** 

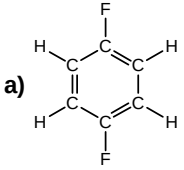
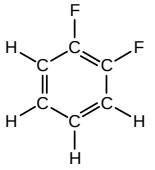
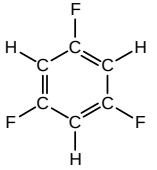
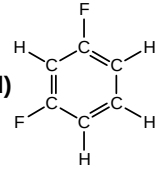
39. Identify the polar molecules.

a)  **b)**  **c)** 

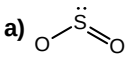
40. Indicate the polar substance in each pair.

a) SO_3 or PF_3 **b)** CCl_4 or $CHCl_3$ **c)** CS_2 or H_2S

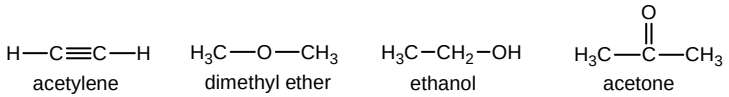
41. Indicate whether or not each of the following compounds is polar.

a)  **b)**  **c)**  **d)** 

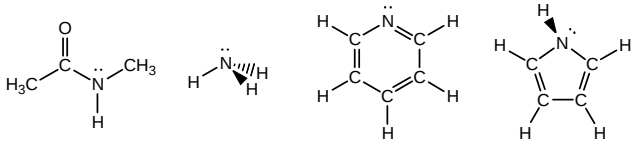
42. Use the arrow notation to indicate the direction of the dipole of the molecules below. Note that, for simplicity, lone pairs are shown on central atoms only.

a)  **b)**  **c)** 

43. In which of the following molecules is hydrogen bonding between like molecules important?



44. In which of the following molecules is hydrogen bonding between like molecules important?



45. Indicate which of the following substances has the higher boiling point and the type of force that is most responsible for the difference:

a) CCl_4 or CF_4 **b)** CH_3-CH_3 or CH_3-NH_2

c) H_2Se or Kr **d)** KF or HF

46. Indicate which of the following molecules has the higher boiling point and the force that is most responsible for the difference:

a) NH_3 or PH_3 **b)** C_2H_5OH or CH_3OCH_3

c) C_4H_8 or $C_{10}H_{20}$ **d)** HCl or F_2

47. There are three different molecules with the formula $C_2H_2F_2$ that differ in the relative positions of the hydrogen and fluorine atoms around the two carbons. The different molecules are called isomers; they are not resonance structures because the positions of the atoms are different. Draw the Lewis structures of the three isomers of $C_2H_2F_2$ and indicate whether each is polar.

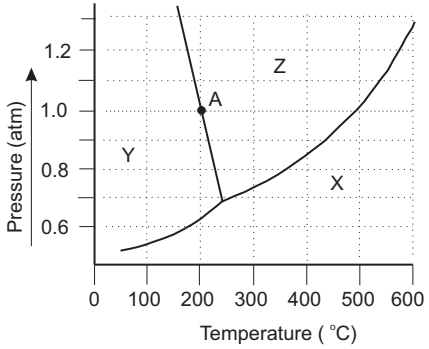
48. Indicate all of the forces that exist between molecules in the condensed states of the following:

a) NCl_3 **b)** SO_3 **c)** SO_2 **d)** HBr **e)** HOCl

49. Indicate all of the forces that exist between molecules in the condensed states of the following:

a) CCl_4 **b)** CH_2O **c)** CO_2 **d)** HF **e)** H_3C-OH

Use the following phase diagram to answer Exercises 50 and 51.



50. Identify the states represented by the regions labeled X, Y, and Z.

51. Consider the preceding phase diagram.

a) What are the normal boiling and melting points of the substance?

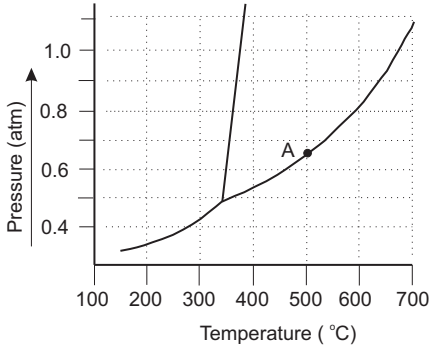
b) In what state of matter does the substance exist under room conditions?

c) What is the vapor pressure of the substance at 300 °C?

d) What transition in state occurs when the pressure at point A is increased?

e) What transition in state occurs when the temperature at point A is increased?

52. Consider the following phase diagram.



a) What are the normal boiling and melting points of the substance?

b) In what state of matter does the substance exist under room conditions?

c) What is the vapor pressure of the substance at 600 °C?

d) What process occurs at point A when the pressure is reduced?

e) What process occurs at point A when the temperature is decreased?

f) Which is more dense, the solid or the liquid?