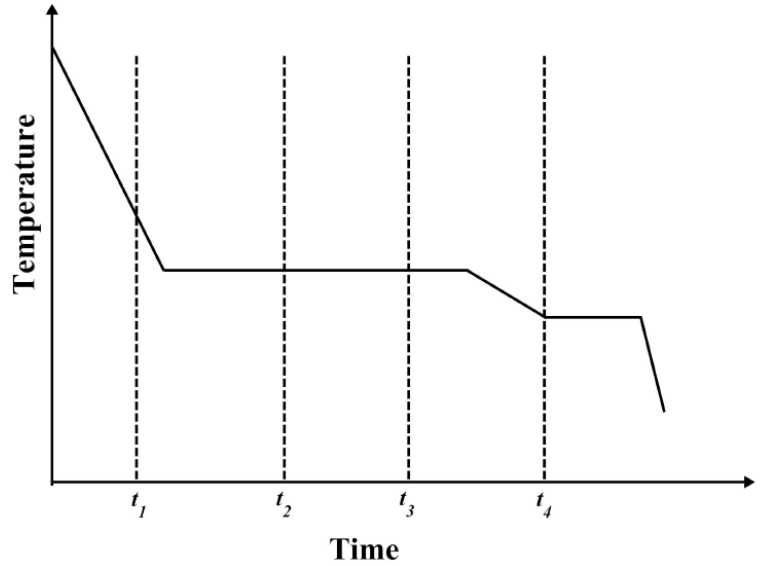
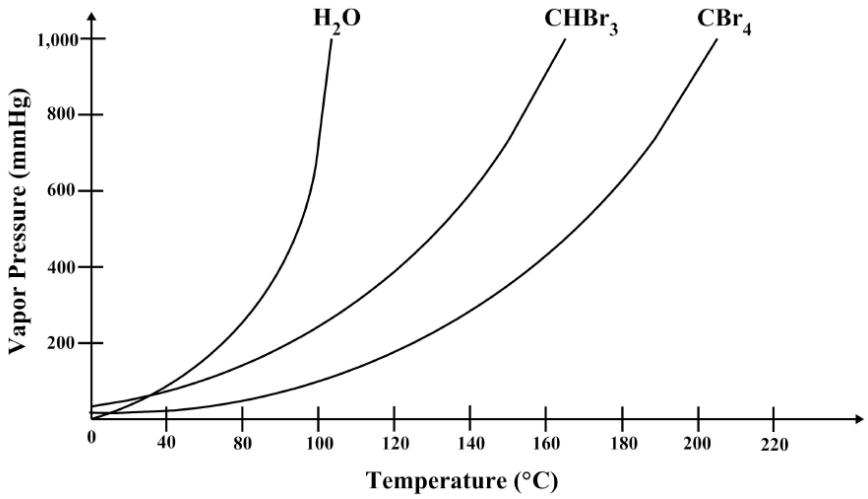
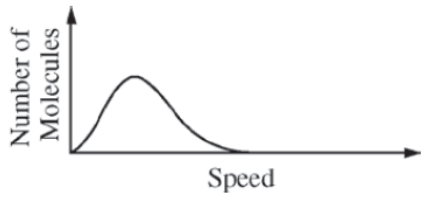
Gases & States of Matter Study Guide Part 2



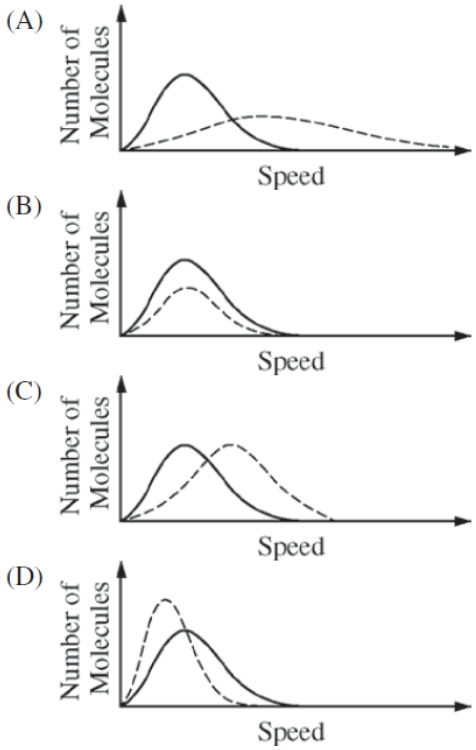
1. The cooling curve above shows how the temperature of a sample varies with time as the sample goes through phase changes. The sample starts as a gas, and heat is removed at a constant rate. At which time does the sample contain the most liquid?
   (a) t_2
   (b) t_3
   (c) t_4
   (d) t_5



2. Which liquid above would be expected to have the highest equilibrium vapor pressure at 55°C?
   (a) H_2O
   (b) $CHBr_3$
   (c) CBr_4
   (d) All three would have the same vapor pressure at 55°C.



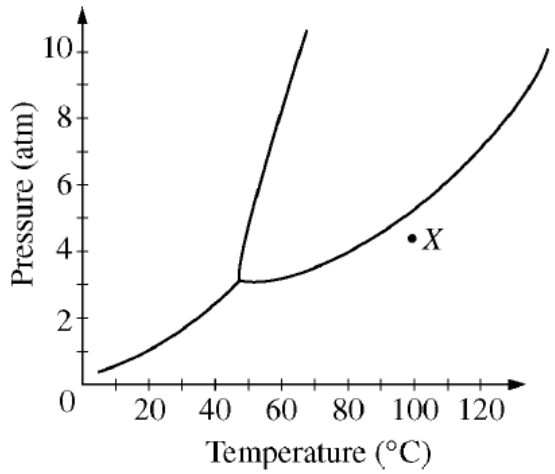
3. The graph above shows the speed distribution of molecules in a sample of gas at a certain temperature. Which of the following graphs shows the speed distribution of the same molecules at a lower temperature (as a dashed curve)?



4. A molecular solid coexists with its liquid phase at its melting point. The solid-liquid mixture is heated, but the temperature does not change while the solid is melting. The best explanation for this phenomenon is that the heat absorbed by the mixture
   (a) is lost to the surroundings very quickly
   (b) is used in overcoming the intermolecular attractions in the solid
   (c) is used in breaking the bonds within the molecules of the solid
   (d) causes evaporation of the liquid, which has a cooling effect

5. Which of the following pairs of substances has the greatest difference in melting points at 1 atm?
   (a) Sr versus Ba
   (b) SO_2 versus SO_3
   (c) KCl versus $CaCl_2$
   (d) NaCl versus C_3H_8

6. A certain crystalline substance that has a low melting point does not conduct electricity in solution or when melted. This substance is likely to be
   (a) a covalent network solid
   (b) a metallic solid
   (c) an ionic solid
   (d) a molecular solid



7. Shown above is the phase diagram of a pure substance. The substance under the conditions corresponding to point X on the diagram is cooled to 40°C while the pressure remains constant. As the substance cools, the phase of the substance changes from
   (a) gas to liquid to solid
   (b) gas to solid to liquid
   (c) liquid to solid to gas
   (d) liquid to gas to solid

8. Under which of the following conditions of temperature and pressure will H_2 gas be expected to behave most like an ideal gas?
   (a) 50 K and 0.10 atm
   (b) 50 K and 5.0 atm
   (c) 500 K and 0.10 atm
   (d) 500 K and 50 atm

9. A 2 L sample of $N_2(g)$ and a 1 L sample of Ar(g), each originally at 1 atm and 0°C, are combined in a 1 L tank. If the temperature is held constant, what is the total pressure of the gases in the tank?
   (a) 2 atm
   (b) 3 atm
   (c) 4 atm
   (d) 5 atm

FRQ's

1. A rigid 5.00 L cylinder contains 24.5 g of $N_2(g)$ and 28.0 g of $O_2(g)$
   (a) Calculate the total pressure, in atm, of the gas mixture in the cylinder at 298 K.
   (b) The temperature of the gas mixture in the cylinder is decreased to 280 K. Calculate each of the following.
      (i.) The mole fraction of $N_2(g)$ in the cylinder.
      (ii.) The partial pressure, in atm, of $N_2(g)$ in the cylinder.
   (c) If the cylinder develops a pinhole-sized leak and some of the gaseous mixture escapes, would the ratio $\frac{N_2(g)}{O_2(g)}$ in the cylinder increase, decrease, or remain the same? Justify your answer.

   A different rigid 5.00 L cylinder contains 0.176 mol of $NO(g)$ at 298 K. A 0.176 mol sample of $O_2(g)$ is added to the cylinder, where a reaction occurs to produce $NO_2(g)$.
   (d) Write the balanced equation for the reaction.
   (e) Calculate the total pressure, in atm, in the cylinder at 298 K after the reaction is complete.

$$2\ H_2O_2(aq) \rightarrow 2\ H_2O(l) + O_2(g)$$

2. The mass of an aqueous solution of H_2O_2 is 6.951 g. The H_2O_2 in the solution decomposes completely according to the reaction represented above. The $O_2(g)$ produced is collected in an inverted graduated tube over water at 23.4°C and has a volume of 182.4 mL when the water levels inside and outside of the tube are the same. The atmospheric pressure in the lab is 762.6 torr, and the equilibrium vapor pressure of water at 23.4°C is 21.6 torr.
   (a) Calculate the partial pressure, in torr, of $O_2(g)$ in the gas-collection tube.
   (b) Calculate the number of moles of $O_2(g)$ produced in the reaction.
   (c) Calculate the mass, in grams, of H_2O_2 that decomposed.
   (d) Calculate the percent of H_2O_2 , by mass, in the original 6.951 g aqueous sample.

3. Two types of intermolecular forces present in liquid H_2S are London (dispersion) forces and dipole-dipole forces.
   (a) Compare the strength of the London (dispersion) forces in liquid H_2S to the strength of London (dispersion) forces in liquid H_2O, Explain.
   (b) Compare the strength of the dipole-dipole forces in liquid H_2S to the strength of dipole-dipole forces in liquid H_2O. Explain.

4. Use principles of atomic structure, bonding and/or intermolecular forces to respond to each of the following. Your responses <u>must</u> include specific information about <u>all</u> substances referred to in each question.
   (a) At a pressure of 1 atm, the boiling point of $NH_3(l)$ is 240 K, whereas the boiling point of $NF_3(l)$ is 144 K.
      (i.) Identify the intermolecular forces(s) in each substance.
      (ii.) Account for the difference in the boiling points of the substances.
   (b) The melting point of $KCl(s)$ is 776˚C, whereas the melting point of $NaCl(s)$ is 801˚C.
      (i.) Identify the type of bonding in each substance.
      (ii.) Account for the difference in the melting points of the substances.