

Name: SOLUTIONS

Chem B Unit 8 Homework Packet

Hour: _____

Chapter 13 problems

Day 2: Kinetic Theory and Properties of Gases

- 1) What pressure, in kilopascals and in atmospheres, does a gas exert at 385 mm Hg?

$$\frac{385 \text{ mmHg}}{760 \text{ mmHg}} \left| \frac{1 \text{ atm}}{760 \text{ mmHg}} \right. = 0.507 \text{ atm}$$

$$\frac{385 \text{ mmHg}}{760 \text{ mmHg}} \left| \frac{101.3 \text{ kPa}}{760 \text{ mmHg}} \right. = 51.3 \text{ kPa}$$

- 8) A cylinder of oxygen gas is cooled from 300 K (27°C) to 150 K (-123°C). By what factor does the average kinetic energy of the oxygen molecules in the cylinder decrease?

Because average kinetic energy of a system is directly related to the temperature of the system, any change in ave KE will be reflected in the change in temperature.

$\Delta T \rightarrow$ Been \downarrow by $\frac{1}{2}$ \therefore ave KE has been \downarrow by $\frac{1}{2}$
(or by a factor of 2).

- 32) Which of these statements are characteristic of matter in the gaseous state?

- a. Gases fill their containers completely.
- b. Gases exert pressure.
- c. Gases have mass. \rightarrow KMT assumes gases has insignificant volume & mass
- d. The pressure of a gas is independent of the temperature. \rightarrow P is proportional to its T.
- e. Gases are compressible.

- 39) What is significant about the temperature absolute zero? Describe the motion of molecules at this temperature.

Absolute zero (0 K or -273°C) is the lowest temperature possible. It signifies the temperature at which all kinetic energy of molecules has stopped. Thus, since Temp is a measure of ave KE, if KE is zero, temp must be zero.

Day 3: The Nature of Liquids and Solids

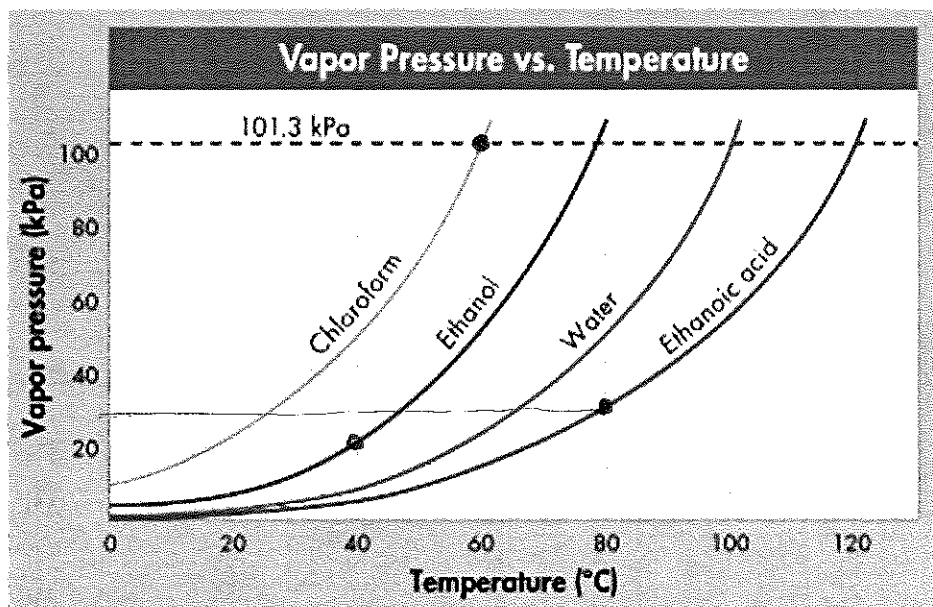
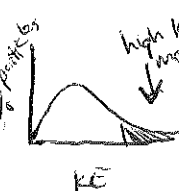


Figure 13.9: Vapor Pressure vs. Temperature

On the graph, the intersection of a curve with the 101.3 kPa line indicates the boiling point of that substance at standard pressure.

- Read Graphs:** What is the boiling point of chloroform at 101.3 kPa? 60°C
- Read Graphs:** What is the vapor pressure of ethanol at 40°C? 20 kPa (will boil well below standard pressure.)
- Predict:** What would atmospheric pressure need to be for ethanoic acid to boil at 80°C?
 Ethanoic acid can boil at 80°C if its VP = atmospheric pressure. Since its VP = 30 kPa at 80°C, atmospheric pressure must also be 30 kPa

11) In terms of kinetic energy, explain how a molecule of a liquid evaporates.



A liquid's molecules have a range of kinetic energies, where the average KE is measured as the temperature of the liquid. Some molecules will have enough KE to break the intermolecular forces it experiences with other molecules and will escape into the vapor phase. This leaves the remaining liquid cooler because these high KE molecules are now gone.

15) Why does the boiling point of a liquid vary with atmospheric pressure?

The boiling point of a liquid is the temperature at which the liquid's vapor pressure is equal to the atmospheric pressure surrounding the liquid. Thus, as AP ↓, the boiling point ↓ (high in the mountains) and as AP ↑, BP ↑ (Dead Sea or using a pressure cooker).

24) Why does a solid have a definite shape and volume while liquids and gases do not?

Solids have a rigid structure due to their HIGH INTERMOLECULAR FORCES - their shape and size don't change much w/ pressure. Liquids' volume also doesn't change much w/ applied pressure. However, liquids and gases have indefinite shapes due to lower IMFs.

Day 4: Changes of State

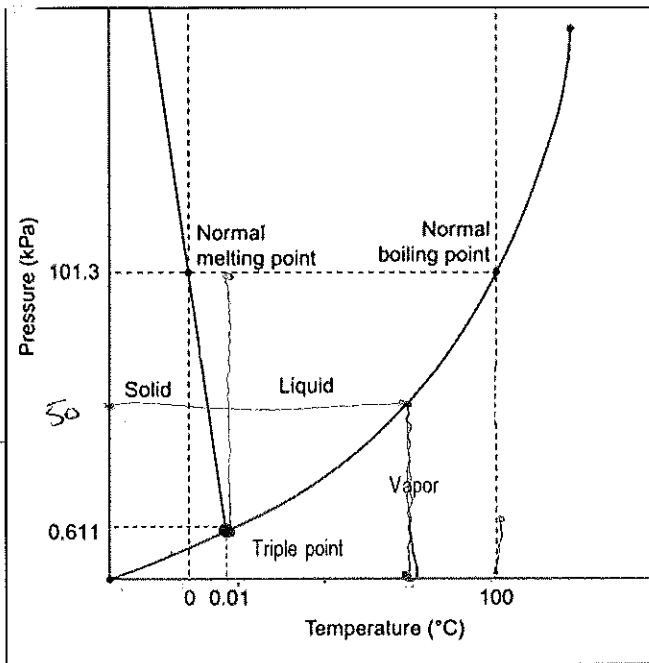


Figure 13.18: Phase Diagram of Water

The phase diagram of water shows the relationship among pressure, temperature, and the physical states of water. Note that the scale of the axes is not linear.

a. **Read graphs:** At the triple point of water, what are the values of temperature and pressure?
 Where substance exists as liquid, solid and gas at the same conditions.
 $P = 0.611 \text{ kPa}$ $T = 0.01^\circ\text{C}$

b. **Identify:** What states of matter are present at the triple point of water?
 S, l and g

c. **Analyze:** Assuming standard pressure, at what temperature is there an equilibrium between water vapor and liquid water? Between liquid water and ice?

Standard pressure: 101.3 kPa
 (l, g) = Boiling point = 100°C (s, l) = freezing point = 0°C

d. **Analyze:** What state(s) does water exist in given the following conditions:

- i. 0.01°C and 101.3 kPa: liquid
- ii. 100°C and 0.611 kPa: vapor

28) Using Figure 13.18, estimate the boiling point of water at a pressure of 50 kPa.

Drawing a line across from 50 kPa to curved line representing equilibrium between l and g and then another line from curve to temperature - this will be the BP temp of this pressure. $\therefore \text{BP}_{50\text{kPa}} \approx 80^\circ\text{C}$

29) What does the triple point on a phase diagram describe?

The pressure and temperature conditions at which a substance exists simultaneously (in equilibrium) as solid, liquid and gas.

54) Explain why a liquid stays at a constant temperature while it is boiling.

A liquid stays at a constant temp boiling while boiling even though we're constantly pumping energy into the system, because all of the energy is going into breaking the IMF between the molecules. Only when all IMF have been broken, will the gas molecules' KE begin to increase & temp will ↑.

