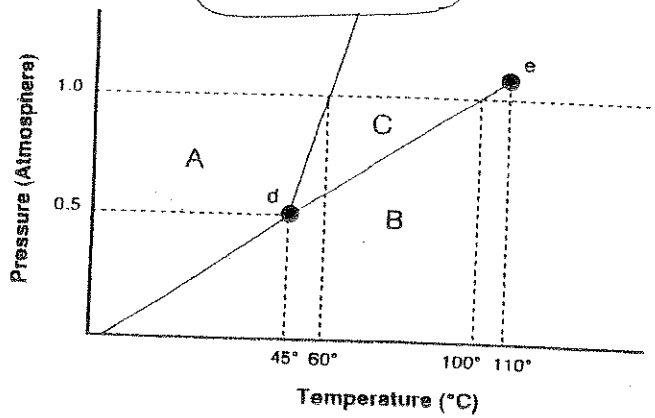
PHASE DIAGRAM

KMT Wksh

Name _____



Answer the following questions using the chart above.

1. What section represents the solid phase? _____
2. What section represents the liquid phase? _____
3. What section represents the gas phase? _____
4. What letter represents the triple point? _____
5. What letter represents the critical point? _____
6. What is this substance's normal melting point? _____
7. What is this substance's normal boiling point? _____
8. Above what temperature is it impossible to liquify this substance no matter what the pressure? _____
9. At what temperature and pressure do all three phases coexist? _____
10. [redacted]
11. Would an increase in pressure cause this substance to freeze or melt? _____

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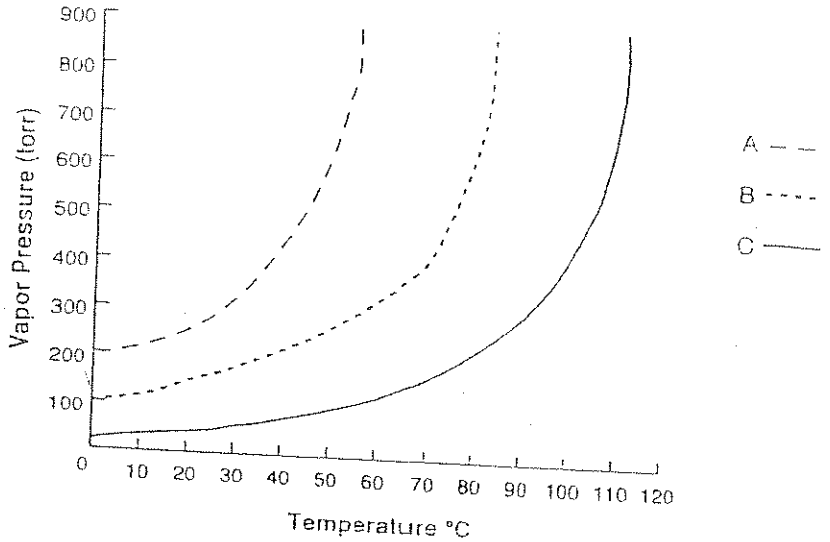
1

A liquid will boil when its vapor pressure equals atmospheric pressure. Use the graph to answer the questions following the graph.



1. At what temperature would Liquid A boil at an atmospheric pressure of 400 torr? _____
2. Liquid B? _____
3. Liquid C? _____
4. How low must the atmospheric pressure be for Liquid A to boil at 35° C? _____
5. Liquid B? _____
6. Liquid C? _____
7. What is the normal boiling point of Liquid A? _____
8. Liquid B? _____
9. Liquid C? _____
10. Which liquid has the strongest intermolecular forces? _____

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2

'LE'S LAW

Name _____

's Law states that the volume of a gas varies inversely with its pressure if temperature constant. (If one goes up, the other goes down.) We use the formula:

$$P_1 \times V_1 = P_2 \times V_2$$

he following problems (assuming constant temperature).

sample of oxygen gas occupies a volume of 250. mL at 740. torr pressure. What lume will it occupy at 800. torr pressure? (231.2 mL)

sample of carbon dioxide occupies a volume of 3.50 liters at 125 kPa pressure. hat pressure would the gas exert if the volume was decreased to 2.00 liters? (218.8 kPa)

20 liter container of nitrogen had a pressure of 3.2 atm. What volume would be ecessary to decrease the pressure to 1.0 atm? (6.4 L)

mmonia gas occupies a volume of 450. mL at a pressure of 720. mm Hg. What olume will it occupy at standard pressure? (426.3 mL)

175 mL sample of neon had its pressure changed from 75 kPa to 150 kPa. What is its new volume? (87.5 mL)

sample of hydrogen at 1.5 atm had its pressure decreased to 0.50 atm producing new volume of 750 mL. What was its original volume? (250 mL)

hlorine gas occupies a volume of 1.2 liters at 720 torr pressure. What volume will it ccupy at 1 atm pressure? (1.14 L)

hlorine gas exerts a pressure of 900. torr. When the pressure is changed to 1.50 atm, its volume is 250. mL. What was the original volume?

(347.8 mL)

Charles' Law ... assuming that pressure is constant. We use the following ...

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \text{or} \quad V_1 \times T_2 = V_2 \times T_1$$

$$K = °C + 273$$

Solve the following problems assuming a constant pressure.

1. A sample of nitrogen occupies a volume of 250 mL at 25° C. What volume will it occupy at 95° C?

(308.7 mL)

2. Oxygen gas is at a temperature of 40° C when it occupies a volume of 2.3 liters. To what temperature should it be raised to occupy a volume of 6.5 liters?

(684.9 K)

3. Hydrogen gas was cooled from 150° C to 50° C. Its new volume is 75 mL. What was its original volume?

(98.2 mL)

Chlorine gas occupies a volume of 25 mL at 300 K. What volume will it occupy at 600 K?

(50. mL)

5. A sample of neon gas at 50° C and a volume of 2.5 liters is cooled to 25° C. What is the new volume?

(2.3 L)

6. Fluorine gas at 300 K occupies a volume of 500 mL. To what temperature should it be lowered to bring the volume to 300 mL?

(180 K)

7. Helium occupies a volume of 3.8 liters at -45° C. What volume will it occupy at 45° C?

(5.3 L)

8. A sample of argon gas is cooled and its volume went from 380 mL to 250 mL. If its final temperature was -55° C, what was its original temperature?

(331.6 K)

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GAY-LUSSAC'S LAW

Gay Lussac's Law states that the pressure of a gas varies directly with the Kelvin temperature, assuming that volume is constant. We use the following formula's:

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \quad \text{or} \quad P_1 \times T_2 = P_2 \times T_1$$

Solve the following problems, assuming constant volume

(1.3 atm) 1. A sample of nitrogen has a pressure of 3.5 atm at 25°C. What pressure will it have at 95°C?

(411.5 K) 2. Oxygen gas is at a temperature of 40°C when it has a pressure of 750 torr. To what temperature should it be raised to have a pressure of 770 torr?

(3.0 atm) 3. A container of nitrogen had a pressure of 3.2 atm at 33°C. What pressure would be necessary to decrease the temperature to 20°C?

(316.2 K) 4. Chlorine gas has a temperature of 15°C at 720 torr. What temperature would it be if the pressure is increased to 790 torr?

(291.2 K) 5. Fluorine exerts a pressure of 900 torr. When the pressure is changed to 1.6 atm, its temperature is 50°C. What was the original temperature?

(115.716 kPa) 6. A sample of carbon dioxide has a temperature of 80°C at 125 kPa pressure. What pressure would the gas exert if the temperature was decreased to 20°C?

(1.15 atm) 7. If the temperature of ammonia gas at STP is raised to 42°C, what will the final pressure be?

Boyle, Charles, Gay-Lussac Practice

(490.7 mL) 1. A 230 mL sample of neon had its pressure changed from 3.2 atm to 1.5 atm. What was its new volume? (Temp. is constant.)

(63.6 mL) 2. Oxygen gas occupies a volume of 50 mL at 20°C. What volume would it occupy at 100°C? (Pressure is constant.)

(327.4 K) 3. Chlorine gas has a temperature of 35°C at 800 torr. What temperature would it be if the pressure is increased to 850 torr? (Volume is constant.)

(364 K) 4. A sample of helium gas is cooled and its volume went from 410 mL to 320 mL. If its final temperature was 15°C, what was its original temperature? (Pressure is constant.)

(1.23 atm) 5. If the temperature of ammonia gas at STP is raised to 63°C, what will the final pressure be? (Volume is constant.)

(299.6 mL) 6. Fluorine gas exerts a pressure of 700 torr. When the pressure is changed to 2.3 atm, its volume is 120 mL. What was the original volume? (Temp. is constant.)

(4.5 atm) 7. A sample of nitrogen has a pressure of 4.2 atm at 40°C. What pressure will it have at 62°C? (Volume is constant.)

(376.4 K) 8. A sample of oxygen gas is at a temperature of 55°C when it occupies a volume of 3.4 liters. To what temperature should it be raised to occupy a volume of 3.9 liters? (Pressure is constant.)

Combined Gas Law

The combined gas law shows the relationship between pressure, volume, and temperature: $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

Solve the following problems using the combined gas law:

1. A gas at 1.2 atm and 32°C occupies a volume of 45 mL. What volume will the gas occupy at STP conditions?

2. Oxygen gas at 50°C and 700 torr occupies a volume of 72 mL. What temperature would it be if the pressure changes to 600 torr and the volume changes to 57 mL?

3. A sample of hydrogen gas cooled from 65°C to 39°C, and the volume changed from 20mL to 41mL. What was the original pressure if the final pressure was 2.2 atm?

4. A sample of chlorine gas occupies a volume of 110 mL when the temperature is 44°C and the pressure is 1.9 atm. What would the volume be if the temperature rose to 61°C and the pressure increased to 2.4 atm?

5. A sample of gas at 12°C had a change in volume from 21 mL to 49 mL. If the final conditions of the gas were at STP, what was the original pressure?

6. Determine the original temperature of a gas that had a volume change of 120 mL to 80 mL and a pressure change of 820 torr to 750 torr. The final temperature was 80°C.

Ideal Gas Law

The ideal gas law: PV = nRT, where P = pressure (in torr or atm)
V = volume (in Liters)
n = number of moles
R = universal gas constant
(0.0821 L*atm/mol*K) or
(62.4 L*torr/mol*K)
T = temperature (in Kelvin)

1. How many moles of oxygen will occupy a volume of 25 liters at 1.2 atm and 25°C? (1.23 moles)

2. What volume will 2.0 moles of nitrogen occupy at 720 torr and 20°C? (50.8L)

3. What pressure will 1.1 moles of a gas have if its volume is 120 mL and it has a temperature of 30°C? (228.1 atm OR 173,391 torr)

4. What would the temperature be if 0.8 moles of a gas has a pressure of 2.1 atm and a volume of 220 mL? (7.03K)

5. How many moles of nitrogen gas will occupy a volume of 347 mL at 6680 torr and 27°C? (0.12 moles)

6. How much space would 0.79 moles of a gas occupy if its temperature is 100°C and it has a pressure of 1.2 atm? (20.2L)

7. What would the pressure be for 0.09 moles of a gas that occupies 235 mL at a temperature of 50°C? (10.2 atm OR 7,722.1 torr)

ɔined and Ideal Gas Laws

1. Determine the number of moles of a sample at 1.8atm, 130 mL, and 78°C.

(0.0081 moles)

2. How many milliliters would a sample occupy if the pressure is 780 torr, the temperature is 53°C, and the number of moles is 0.61?

(15,900 mL)

3. A gas at 1.1 atm and 30°C occupies a volume of 41mL. What volume will the gas occupy at STP conditions?

(40.6mL)

4. A gas collected when the temperature is 27°C and the pressure is 800mmHg occupies a volume of 300 mL. What would the final temperature be if the pressure changes to 680mmHg and the volume changes to 250 mL?

(212K)

5. What is the temperature of a sample with 0.81 moles that occupies 400 mL at a pressure of 2.4 atm?

(141.4K)

6. Find the pressure of a sample of 0.9 moles of gas that has a temperature of 15°C, and occupies a 110 mL.

(18.3 atm)

7. A 200 mL sample of gas at 750 torr and a temperature of 70°C changes to 170 mL and 55°C. What is the final pressure?

(713.8 torr)

Dalton's Law of Partial Pressures

Dalton's Law says that the sum of the individual pressures of all the gases that make up a mixture is equal to the total pressure or: $P_T = P_1 + P_2 + P_3 \ldots$ Note: "Atmospheric pressure" refers to the total pressure in the room. Also, the partial pressure of water vapor is dependent on temperature.

1. A scientist collected five samples of gases and mixed them all together. If each sample alone had a partial pressure of 2 atm, what is the pressure of the mixture?

(10atm)

2. A mixture of gases was found to have hydrogen, oxygen and nitrogen. What is the partial pressure of the nitrogen if the atmospheric pressure is 1.1 atm , the partial pressure of oxygen is 0.6 atm, and the partial pressure of hydrogen is 0.3 atm?

(0.2 atm)

3. A 250 mL sample of oxygen is collected over water at 25°C. The atmospheric pressure if 760.0 torr. What is the pressure of the dry gas alone? (Vapor pressure of water at 25°C = 23.8 torr.)

(736.2 torr)

4. A 32.0 mL sample of hydrogen is collected over water at 10°C when the atmospheric pressure is 750.0 torr. What is the volume of the dry gas alone, if the vapor pressure of water at 10°C is 17.5 torr?

(732.5 torr)

5. A 54.0 mL sample of oxygen is collected over water at 23°C. The partial pressure of the dry gas alone was calculated to be 710 torr. What is the atmospheric pressure in the room? (The pressure of water vapor at 23°C = 21.2 torr.)

(731.2 torr)