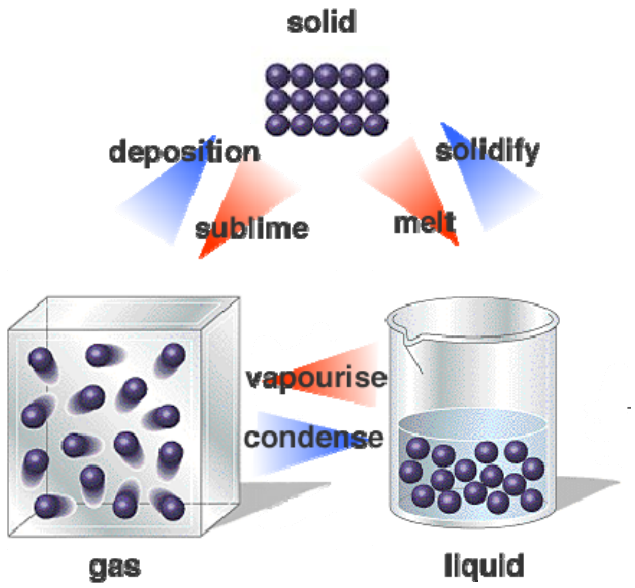
PRACTICE PACKET

Unit 6:

Physical Behavior of Matter (PBOM)



Temperature Homework:

1) Convert -83°C to Kelvin

2) What is the relationship between temperature and kinetic energy of the particles in a substance?

3) How many Celsius degrees separate the freezing and boiling points of water? _____
   What are these two temperatures? _____ & _____

4) What is the lowest possible temperature in °C? _____

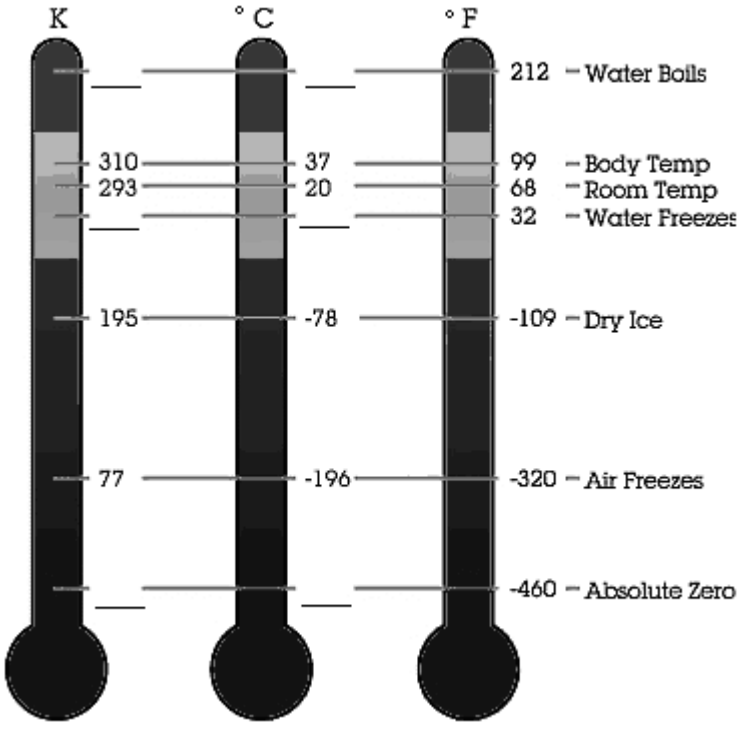
5) How many Kelvins separate the freezing and boiling points of water? _____
   What are these two temperatures? _____ & _____

6) What is the lowest possible temperature in Kelvins? _____

7) Using the temperature conversion formula on Table T in your Reference Tables, convert the following temperatures to either Celsius or Kelvin.

	383 K
80 °C	
	323 K
10 °C	
- 10 °C	
	243 K

Complete the following diagram by filling in temperatures at the designated lines. Also identify which scale is represented by each thermometer by placing C, K, or F at the top of each.



FILL IN THE BLANKS HW - WORDS CAN BE USED MORE THAN ONCE!

Word Bank: Celsius, Kelvin, Fahrenheit, phases, heat, temperature, higher, lower, energy, kinetic, motion, potential, absolute zero, gases, positive, 273, 0, -273, 373, 100

The particles making up any sample of matter are in random motion. Hence, they have _____ energy, which is defined as the energy of _____. The _____ of a body is a measure of the average _____ energy of the particles making up the body. The form of energy called _____ flows from a body at a _____ temperature to a body at a _____ temperature. We therefore say that the hotter body "heats up" the cooler body. Bodies that have the same _____ are composed of particles that have the same average _____ energy. While a substance changes _____, there is a change in the amount of _____ present, but there is no change in _____. This is because it is the _____ energy of a substance that changes during a phase change. It is important to note that only one type of _____ can change at a time. The temperature scale most closely associated with the metric or the S.I. system is called _____. The melting/freezing point of water according to this scale is _____ degrees, and the boiling point is _____. The coldest temperature possible according to the Celsius scale is _____ degrees. The _____ scale was developed mainly to allow scientists to perform calculations involving _____ because it's a scale that uses only _____ numbers. The melting/freezing point of water according to Kelvin scale is _____, and the boiling point is _____. The coldest temperature possible according to the Kelvin scale is _____, otherwise known as _____.

Heat Calculation Practice

Use the Heat Equations on Table T and the Physical Constants for Water on Table B in your CRT's to complete the following problems. SHOW ALL WORK.

1) A 5.00 gram sample of water is heated so that its temperature increases from 10.0°C to 15.0°C. What is the total amount of energy absorbed by the water?

2) When a sample of 25.0 g of water is cooled from 20.0°C to 10.0°C, what is the number of Joules of energy released?

3) A sample of water is heated from 10.0°C to 15.0°C by adding 125.58 Joules of heat. What is the mass of the water?

4) What is the total number of kilojoules of heat needed to change 150. grams of ice to liquid water at 0°C?

5) How much energy is required to vaporize 10.00 grams of water at its boiling point?

6) How many joules of heat energy are released when 50.0 grams of water are cooled from 70.0 °C to 60.0 °C?

7) What is the total number of joules of heat energy absorbed when the temperature of 200.0 grams of water is raised from 10.0 °C to 40.0 °C?

8) How many kJ of heat energy are absorbed when 100.0 g of water are heated from 20.0 °C to 30.0 °C?

9) The temperature of a sample of water in the liquid phase is raised 30.0 °C by the addition of 3762 J. What is the mass of the water?

10) When 418. joules of heat energy are added to 10.0 grams of water at 20.0 °C, what will the final temperature of the water be?

11) How many grams of water will absorb a total of 2400 joules of energy when the temperature changes from 10.0 °C to 30.0 °C?

12) How much heat is needed to raise the temperature of 20.0 grams of liquid water from 5.0 °C to 20.0 °C?

13) How much heat is released by 200.0 grams of water as it cools from 200.0 °C to 150.0 °C?

14) The temperature of 50.0 grams of liquid water was raised to 50.0 °C by the addition of 500. Joules of heat. What was the initial temperature of the water?

15) How many kilojoules are equivalent to 300. J?

16) When 20.0 grams of a substance is completely melted at 0°C, 3444 J are absorbed. What is the heat of fusion of this substance?

17) What would be the temperature change if 3.0 grams of water absorbed 15 Joules of heat?

1. In a laboratory where the air temperature is 22°C, a steel cylinder at 100.°C is submerged in a sample of water at 40.°C. In this system, heat flows from

   A) both the air and the water to the cylinder
   B) the air to the water and from the water to the cylinder
   C) the cylinder to the water and from the water to the air
   D) both the cylinder and the air to the water

2. A 50.0-gram block of copper at 10.0°C is carefully lowered into 100.0 grams of water at 90.0°C in an insulated container. Which statement describes the transfer of heat in this system?

   A) The water gains heat and the block loses heat until both are at the same temperature that is between 10.0°C and 90.0°C.
   B) The water loses heat to the block until both are at 10.0°C.
   C) The block gains heat from the water until both are at 90.0°C.
   D) The water loses heat and the block gains heat until both are at the same temperature that is between 10.0°C and 90.0°C.

Base your answers to questions **3** through **5** on the information below.

Heat is added to a 200.-gram sample of $H_2O(s)$ to melt the sample at 0°C. Then the resulting $H_2O(\ell)$ is heated to a final temperature of 65°C.

3. Compare the amount of heat required to vaporize a 200.-gram sample of $H_2O(\ell)$ *at its boiling point to the amount of heat required to melt a 200.-gram sample of* $H_2O(s)$ *at its melting point.*

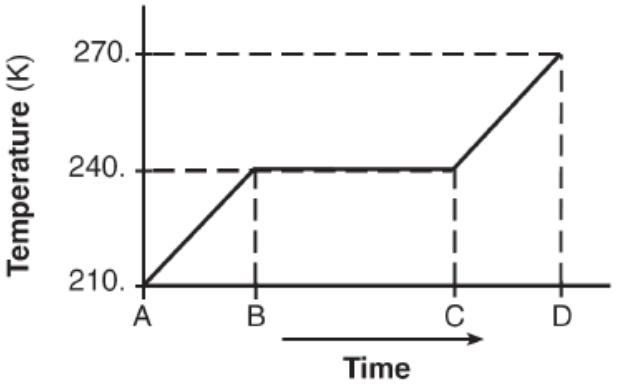
4. In the space below, show a numerical setup for calculating the total amount of heat required to raise the temperature of the $H_2O(\ell)$ from 0°C to its final temperature.

5. Determine the total amount of heat required to completely melt the sample.

Base your answers to questions **6** and **7** on the information below

A 5.00-gram sample of liquid ammonia is originally at 210. K. The diagram of the partial heating curve below represents the vaporization of the sample of ammonia at standard pressure due to the addition of heat. The heat is *not* added at a constant rate.

Partial Heating Curve for Ammonia



Some physical constants for ammonia are shown in the data table below.

Some Physical Constants for Ammonia

specific heat capacity of $NH_3(\ell)$	4.71 J/g•K
heat of fusion	332 J/g
heat of vaporization	1370 J/g

6. Describe what is happening to *both the potential energy and the average kinetic energy of the molecules in the ammonia sample during time interval BC. Your response must include both potential energy and average kinetic energy.*

7. Calculate the total heat absorbed by the 5.00-gram sample of ammonia during time interval AB. Your response must include *both* a correct numerical setup and the calculated result.

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8. Base your answer to the following question on the following paragraph.

The boiling point of a liquid is the temperature at which the vapor pressure of the liquid is equal to the pressure on the surface of the liquid. The heat of vaporization of ethanol is 838 joules per gram. A sample of ethanol has a mass of 65.0 grams and is boiling at 1.00 atmosphere.

Calculate the minimum amount of heat required to completely vaporize this sample of ethanol. Your response must include *both* a correct numerical setup and the calculated result.

9. What is the total amount of heat energy, in joules, absorbed by 25.0 grams of water when the temperature of the water increases from 24.0°C to 36.0°C?

10. Base your answer to the following question on the information below.

At a pressure of 101.3 kilopascals and a temperature of 373 K, heat is removed from a sample of water vapor, causing the sample to change from time gaseous phase to time liquid phase. This phase change is represented by the equation below.

$$H_2O(g) \rightarrow H_2O(\ell) + \text{heat}$$

Determine the total amount of heat released by 5.00 grams of water vapor during this phase change.

Heat Calculations

Directions: Read and answer each of the following questions. Make sure to show all work, include proper units, report the answer to the correct number of significant figures, and box your answers.

1. How many grams of water will absorb a total of 2,400 J of energy when the temperature changes from 10.0°C to 30.0°C?

2. How much heat is needed to raise the temperature of 20.0 grams of liquid water from 5.0°C to 20.0°C?

3. How much heat is released by 200.0 grams of water as it cools from 200.0°C to 150.0°C?

4. How many joules are equivalent to 30 Kilojoules?

5. What is the total number of joules required to freeze a 10 g sample of water at 0°C?

6. How much energy is required to vaporize 10.00 g of water at its boiling point?

7. Calculate the amount of energy required heat 100. g to the following:
    a. $H_2O(s)$ changes to $H_2O(l)$ at 0°C

    b. $H_2O(l)$ changes to H_2O (s) at 0°C

    c. $H_2O(l)$ at 10°C changes to $H_2O(l)$ at 20°C

Practice Problems: Answer the following. Make sure to include units, the correct number of significant figures, and box your answers.

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1. What is the specific heat of silver if a 93.9 g sample cools from 215.0°C to 196.0°C with the loss of 428 J of energy?

2. What is the total number of kilojoules of heat needed to change 25 g of ice to water at 0°C?

3. In question 2, is heat being absorbed or released? Is this process endothermic or exothermic?

4. What is the total number of kilojoules required to completely boil 50.0 g of water at 100°C.

5. If 100.0 J are added to 20.0 g of water at 30.0°C, what will be the final temperature of the water?

6. At 1 atmosphere of pressure, 25.0 g of a compound at its normal boiling point are converted to a gas by the addition of 34,400 J. What is the heat of vaporization for this compound?

7. The temperature of a sample of water in the liquid phase is raised 30.0°C by the addition of 3762 J. What is the mass of the water?

Mixing it Up: Heat Calculations

1) When 20.0 grams of a substance are completely melted at its melting point, 3444 J are absorbed. What is the heat of fusion of this substance?

2) What would be the temperature change if 3.0 grams of water absorbed 15 Joules of heat?

3) What is the specific heat of silver if a 93.9 g sample cools from 215.0°C to 196.0°C with the loss of 428 J of energy?

4) What is the total number of kilojoules of heat needed to change 15 g of ice to water at 0°C?

5) In question 2, is heat being absorbed or released? Is this process endothermic or exothermic?

6) What is the total number of kilojoules required to completely boil 100.00 g of water at 100°C?

7) If 100.0 J are added to 20.0 g of water at 30.0°C, what will be the final temperature of the water?

8) At 1 atmosphere of pressure, 25.0 g of a compound at its normal boiling point are converted to a gas by the addition of 34,400 J. What is the heat of vaporization for this compound?

9) The temperature of a sample of water in the liquid phase is raised 30.0°C by the addition of 3762 J. What is the mass of the water?

10) How many grams of steam will produce 216 calories as it condenses at 100°C?

11) How many grams of water can be melted by 400 calories?

12) A quantity of water is heated from 10°C to 50°C. During the process, 11,905 calories are added to the water. How many grams of water are heated?

13) How many calories of heat will be released when 850 grams of steam condenses back to water?

14) If 700 grams of water at 90°C loses 643 calories of energy, what is its final temperature?

VAPOR PRESSURE PROBLEMS

1. Temperature and intermolecular forces are two factors that affect the rate of evaporation. Explain your reasoning behind this for both factors.

   _____

   _____

2. Explain how temperature and vapor pressure are related.

   _____

   _____

3. What happens when the pressure above the surface of a liquid is equal to the vapor pressure of the liquid? Explain.

   _____

   _____

4. The particles that make up a solid at room temperature are said to be arranged in a regular geometric fashion. Are these particles still moving? Explain.

   _____

   _____

5. If the pressure on the surface of water in the liquid state is 30 kPa, the water will boil at what temperature?

   _____

   _____

6. What is the vapor pressure of ethanol at its normal boiling point?

   _____

   _____

7. As the pressure on a liquid is changed from 100. kPa to 120.0 kPa, what happens to the boiling point? Explain your answer.

   _____

   _____

1. At which temperature is the vapor pressure of ethanol equal to 80. kPa?

   A) 48°C B) 73°C
   C) 80°C D) 101°C

2. Which compound has the *lowest* vapor pressure at 50°C?

   A) ethanol B) water
   C) ethanoic acid D) propanone

3. At standard pressure, a certain compound has a low boiling point and is insoluble in water. At STP, this compound most likely exists as

   A) polar molecules
   B) ionic crystals
   C) metallic crystals
   D) nonpolar molecules

4. Which liquid has the highest vapor pressure at 75°C?

   A) propanone B) ethanoic acid
   C) ethanol D) water

5. Based on intermolecular forces, which of these substances would have the highest boiling point?

   A) CH_4 B) He C) O_2 D) NH_3

6. Using your knowledge of chemistry and the information in Reference Table *H*, which statement concerning propanone and water at 50°C is true?

   A) Propanone has a higher vapor pressure and weaker intermolecular forces than water.
   B) Propanone has a lower vapor pressure and weaker intermolecular forces than water.
   C) Propanone has a higher vapor pressure and stronger intermolecular forces than water.
   D) Propanone has a lower vapor pressure and stronger intermolecular forces than water.

7. According to Reference Table *H*, what is the vapor pressure of propanone at 45°C?

   A) 33 kPa B) 70 kPa
   C) 22 kPa D) 98 kPa

8. As the temperature of a liquid increases, its vapor pressure

   A) decreases B) increases
   C) remains the same

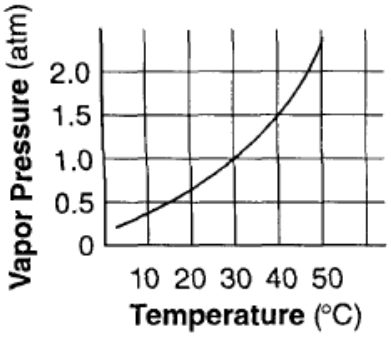
9. Which sample of water has the *lowest* vapor pressure?

   A) 100 mL at 50°C B) 200 mL at 30°C
   C) 300 mL at 40°C D) 400 mL at 20°C

10. Based on Reference Table *H*, which substance has the weakest intermolecular forces?

    A) propanone B) ethanol
    C) water D) ethanoic acid

11. The graph below shows the relationship between vapor pressure and temperature for substance *X*.



    What is the normal boiling point for substance *X*?

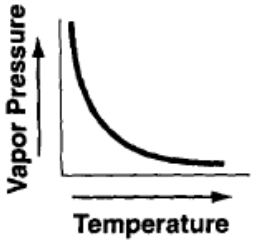
    A) 20°C B) 30°C
    C) 50°C D) 40°C

12. When the vapor pressure of water is 30 kPa, the temperature of the water is

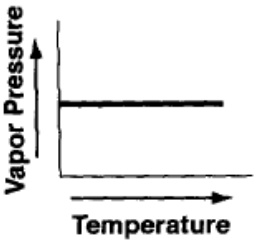
    A) 20°C B) 100°C
    C) 70°C D) 40°C

13. Which graph best represents the variation in the vapor pressure of water as temperature changes?

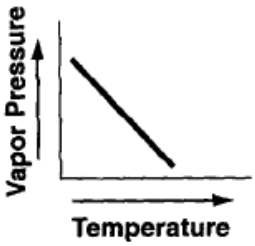
A)



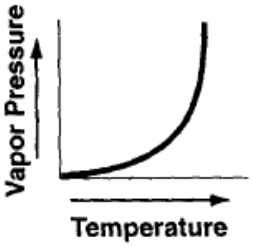
B)



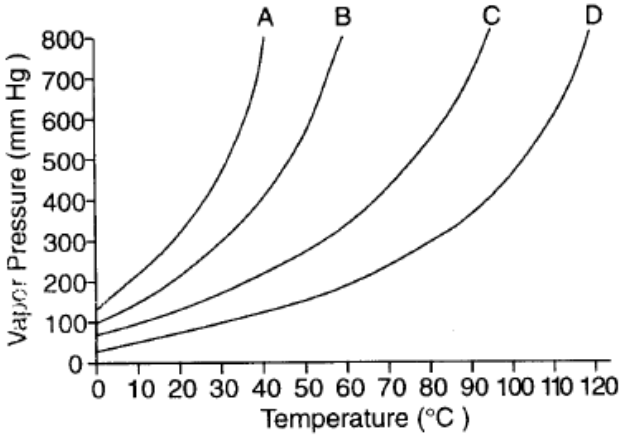
C)



D)



14. Base your answer to the following question on The graph below represents the vapor curves of four liquids.



Which liquid has the highest normal boiling point?

A) *A* B) *B* C) *C* D) *D*

15. Which two compounds readily sublime at room temperature (25°C)?

A) $CO_2(s)$ and $C_6H_{12}O_6(s)$
B) NaCl(s) and $I_2(s)$
C) $CO_2(s)$ and $I_2(s)$
D) NaCl(s) and $C_6H_{12}O_6(s)$

16. In a closed system, as the temperature of a liquid increases, the vapor pressure of the liquid

A) decreases B) increases
C) remains the same

17. When the vapor pressure of a liquid is equal to the atmospheric pressure, the liquid will

A) condense B) melt
C) boil D) freeze

18. If the pressure on the surface of water in the liquid state is 47 kPa, the water will boil at

A) 101.3°C B) 80°C
C) 40°C D) 0.0°C

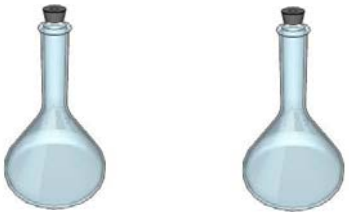
19. When the temperature of a sample of water is changed from 45°C to 70.°C, the change in its vapor pressure is

A) 1.0 kPa B) 20. kPa
C) 25 kPa D) 101.3 kPa

Avogadro's Gas Law I

Questions 1-5 are based on the following information:

Two samples of gas are contained in separate flasks as shown in the drawing. Both flasks have a volume of 1 liter. An oxygen molecule has a great mass than a nitrogen molecule. Choose a phrase from the list A-C below to complete each statement.



Flask 1 (O_2) Flask 2 (N_2)

A - flask number 1 is greater B - flask number 2 is greater C - each flask is the same

1. If each sample is at STP, then the number of molecules in _____
2. If each sample is at STP, then the mass of the contents of _____
3. If each sample is sealed and heated to the same temperature, then the pressure in _____
4. If the temperature of both flasks is doubled, then the average kinetic energy of the molecules in _____
5. If the temperature of both flasks is doubled, then the average kinetic molecular velocity in _____

Question 6-9 are based on the chart below. Please read each question and determine whether Gas A, B, C, or D is the best answer

Sample	Quantity (moles)	Pressure (mmHg)	Temperature (K)
Gas A	2	760	273
Gas B	1	380	273
Gas C	1	760	273
Gas D	2	760	546

6. Which sample contains molecules with the highest average kinetic energy? _____
7. Which sample contains the same number of molecules as sample A? _____
8. Which sample occupies the smallest volume? _____
9. Which is the ratio of the volume of sample D to the volume of sample A?

a. $\frac{1}{1}$ b. $\frac{2}{1}$ c. $\frac{1}{2}$ d. $\frac{4}{1}$

1. Which rigid cylinder contains the same number of gas molecules at STP as a 2.0-liter rigid cylinder containing $H_2(g)$ at STP?

   A) 1.0-L cylinder of $O_2(g)$
   B) 2.0-L cylinder of $CH_4(g)$
   C) 1.5-L cylinder of $NH_3(g)$
   D) 4.0-L cylinder of $He(g)$

2. The table below shows data for the temperature, pressure, and volume of four gas samples.

Data for Four Gas Samples

Gas Sample	Temperature (K)	Pressure (atm)	Volume (mL)
A	100.	2	400.
B	200.	2	200.
C	100.	2	400.
D	200.	4	200.

   Which two gas samples have the same total number of molecules?

   A) *A* and *C* B) *A* and *B*
   C) *B* and *C* D) *B* and D

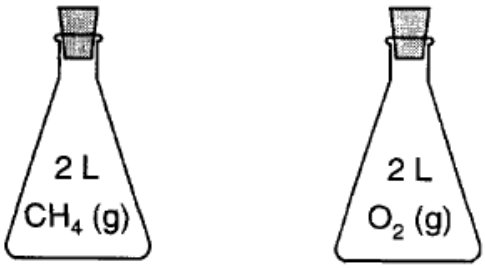
3. A sample of oxygen gas is sealed in container X. A sample of hydrogen gas is sealed in container Z. Both samples have the same volume, temperature, and pressure. Which statement is true?

   A) Container X contains fewer gas molecules than container Z.
   B) Container X contains more gas molecules than container Z.
   C) Containers X and Z both contain the same number of gas molecules.
   D) Containers X and Z both contain the same mass of gas.

4. At the same temperature and pressure, 1.0 liter of $CO(g)$ and 1.0 liter of $CO_2(g)$ have

   A) equal masses and the same number of molecules
   B) equal volumes and the same number of molecules
   C) different volumes and a different number of molecules
   D) different masses and a different number of molecules

5. Each stoppered flask below contains 2 liters of a gas at STP.



   Each gas sample has the same

   A) density
   B) number of atoms
   C) number of molecules
   D) mass

6. Equal volumes of all gases at the same temperature and pressure contain an equal number of

   A) molecules B) atoms
   C) protons D) electrons

7. According to the kinetic molecular theory, the particles of an ideal gas

   A) are arranged in a regular, repeated geometric pattern
   B) have no potential energy
   C) have strong intermolecular forces
   D) are separated by great distances, compared to their size

8. Which statement describes the particles of an ideal gas?

   A) The volume of the particles is negligible.
   B) There are forces of attraction between the particles.
   C) The particles move in well-defined, circular paths.
   D) When the particles collide, energy is lost.

9. According to the kinetic molecular theory, which statement describes the particles in a sample of an ideal gas?

   A) The force of attraction between the gas particles is strong.
   B) The motion of the gas particles is random and straight-line.
   C) The separation between the gas particles is smaller than the size of the gas particles themselves.
   D) The collisions between the gas particles cannot result in a transfer of energy between the particles.

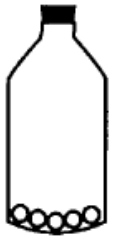
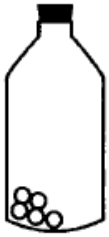
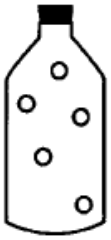
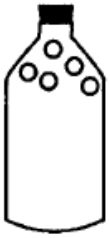
10. Standard pressure is equal to

   A) 1 atm B) 273 kPa
   C) 1 kPa D) 273 atm

11. A sample of a gas is contained in a closed rigid cylinder. According to kinetic molecular theory, what occurs when the gas inside the cylinder is heated?

   A) The volume of the gas decreases.
   B) The number of gas molecules increases.
   C) The average velocity of the gas molecules increases.
   D) The number of collisions between gas molecules per unit time decreases.

12. Which diagram best represents a gas in a closed container?

   A) 
   B) 
   C) 
   D) 

13. The concept of an ideal gas is used to explain

   A) the mass of a gas sample
   B) why some gases are diatomic
   C) why some gases are monatomic
   D) the behavior of a gas sample

14. Under which conditions does a real gas behave most like an ideal gas?

   A) at high temperatures and high pressures
   B) at low temperatures and low pressures
   C) at low temperatures and high pressures
   D) at high temperatures and low pressures

15. Two basic properties of the gas phase are

   A) a definite shape and a definite volume
   B) no definite shape but a definite volume
   C) no definite shape and no definite volume
   D) a definite shape but no definite volume

Problem Set A: Combined Gas Law I

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1. A gas has a volume of 50. mL at a temperature of 10.0 K and a pressure of 760. mm Hg. What will be the new volume when the temperature is changed to 20.0 K and the pressure is changed to 380. mm Hg?

2. The volume of a sample of a gas at 273 K is 100.0 L. If the volume is decreased to 50.0 L at constant pressure, what will be the new temperature of the gas?

3. A gas has a volume of 2.00 L at 323 K and 3.00 atm. What will be the new volume if the temperature is changed to 273 K and the pressure is changed to 1 atm?

4. What will be the new volume of 100. mL of gas if the Kelvin temperature and the pressure are both halved?

5. A gas occupies a volume of 500. mL at a pressure of 380. torr and a temperature of 298 K. At what temperature will the gas occupy a volume of 250. mL and have a pressure of 760. torr?

6. A gas at STP has a volume of 1.00 L. If the pressure is doubled and the temperature remains constant, what is the new volume of the gas?

7. A 2.5 L sample of gas is at STP. When the temperature is raised to 373°C and the pressure remains constant what will the new volume of the gas be?

8. A cylinder of a car's engine has a volume of 0.725 L when the piston is at the bottom of the cylinder. When the piston is at the top of the cylinder it has a volume of 0.050L. If the cylinder is filled with air at a pressure of 1 atm when the piston is at the bottom, what is the pressure when the piston is at the top if the temperature remains constant?

9. You are given two equally sized containers of He(g) and H_2(g) that both behave as ideal gasses and have equal pressures and temperatures.

a. Does each container have the same number of particles? Explain.

_____

_____

b. Do they have the same number of atoms? Explain.

_____

_____

c. Do they have the same mass? Explain.

_____

_____

Problem Set B: Combined Gas Law II

1. At a constant temperature, the pressure on 8.0 L of a gas is increased from 1 atm to 4 atm. What will be the new volume of the gas?

2. A 100. mL sample of a gas at a pressure of 380. torr is reduced to 190. torr at constant temperature. What is the new volume of the gas?

3. A gas occupies a volume of 30.0 mL at 273 K. If the temperature is increased to 364 K while the pressure remains constant, what will be the volume of the gas?

4. At a constant pressure, 50.0 mL of a gas at 20.0°C is heated to 30.0°C. What will be the new volume of the gas?

5. The volume of 50.0 milliliters of an ideal gas at STP increases to 100. mL at a constant pressure. What will the new temperature be?

6. Equal volumes of all gases at the same temperature and pressure contain an equal number of

a) electrons b) protons c) molecules d) atoms

7. What gas law supports your answer from question #6?

8. Draw a graph to illustrate the relationship between the volume of a gas (V) and its temperature (T) when pressure remains constant.

9. Draw a graph that represents the relationship between volume and pressure for an ideal gas at constant temperature.

Combined Gas Law: In practical terms, it is often difficult to hold any of the variables constant. When there is a change in pressure, volume, and temperature, the combined gas law is used.

$$\frac{P_1 \cdot V_1}{T_1} = \frac{P_2 \cdot V_2}{T_2}$$

Using the Combined Gas Law please complete the following chart:

	P_1	V_1	T_1	P_2	V_2	T_2	**Work Shown**
1	1.5atm	3.0 L	20.°C	2.5atm		30.°C	
2	.95 atm	256mL	25°C		250mL	50.°C	
3	.8 atm	2.5L	22°C	1atm	1.8L		
4		750mL	0.0°C	2.0atm	500.mL	25°C	
5	95kPa	4.0L		101kPa	6.0L	471 K	
6			100. °C		225mL	150.°C	
7	1.1atm	1.5L	15°C		2.5L	30. °C	
8	125kPa	125mL		100.kPa	100mL	75°C	

Problem Set C: Dalton's Law of Partial Pressures

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1. What is the total pressure exerted by a mixture containing two gases if the partial pressure of one gas is 70. torr and the partial pressure of the other gas is 30. torr?

2. A 1-Liter flask contains two gases at a total pressure of 3.0 atmospheres. If the partial pressure of one of the gases is 0.5 atmospheres, then the partial pressure of the other gas must be what?

3. A mixture of oxygen, nitrogen, and hydrogen gases exerts a total pressure of 740. mmHg at 0°C. The partial pressure of the oxygen is 200. mmHg and the partial pressure of nitrogen is 400. mmHg. What is the partial pressure of the hydrogen gas in this mixture?

4. What is the total pressure exerted by a mixture containing two gases if the partial pressure of one gas is 70 torr and the partial pressure of the other gas is 30 torr?

5. A 1-Liter flask contains two gases at a total pressure of 3.0 atmospheres. If the partial pressure of one of the gases is 0.5 atmospheres, then the partial pressure of the other gas must be what?

6. A sealed flask contains 1 mole of hydrogen and 3 moles of helium at 20°C. If the total pressure is 400 torr, the partial pressure of the hydrogen is?

7. A 300.-milliliter container that is filled with 100. milliliters of oxygen and 200. milliliters of hydrogen has a total pressure of 750. millimeters of mercury. What is the partial pressure of the oxygen?

8. A mixture of oxygen, nitrogen, and hydrogen gases exerts a total pressure of 740. mmHg at 0°C. The partial pressure of the oxygen is 200. mmHg and the partial pressure of nitrogen is 400. mmHg. What is the partial pressure of the hydrogen gas in this mixture?

9. When 7.00 moles of gas A and 3.00 moles of gas B are combined, the total pressure exerted by the gas mixture is 760. mmHg. What is the partial pressure exerted by gas A in this mixture?

10. A container hold three gases. The total pressure exerted by all three gases is 45.0 atm. If one gas exerts a pressure of 12.0 atm and a second gas exerts a pressure of 9.00 atm, determine the pressure exerted by the third gas.

Gas Law Problems:

1. A gas has a volume of 2.00 L at 323 K and 3.00 atm. What will be the new volume if the temperature is changed to 273 K and the pressure is changed to 1.00 atm?

2. A gas fills a volume of 458 mL at a pressure of 1.01 kPa and a temperature of 295 K. When the pressure is changed, the volume becomes 577 mL. If there is no change in temperature, what is the new pressure?

3. A 10.0 L sample of argon gas is stored in a cylinder at room temperature of 23.8 °C and a pressure of 78.6 psi. The sample is completely transferred to another 2.80 L cylinder. Several hours after the transfer, the second cylinder has also attained room temperature. What is the pressure in the second cylinder?

4. A tank of compressed CO_2 has a temperature of 20.0°C and a volume of 31.4 L. The CO_2 is completely transferred into a smaller tank with a volume of 25.0 L. Assuming none of the CO_2 escapes during the transfer, what does the temperature of the gas in the smaller tank need to be to have the pressure be the same as it was in the larger tank?

5. A tank of compressed oxygen has a volume of 3.00 L and a pressure of 400. kPa at room temperature (21.0°C). The tank is accidentally thrown into a fire and the temperature increases to 200.°C. What is the pressure inside the tank?

6. At 75.0°C a gas has a volume of 2.20 L and exerts a pressure of 1.30 atm on the walls of the container. If the gas is compressed to a volume of 1.00 L and temperature is reduced to 10.0°C, what is the new pressure on the walls of the container?

7. A gas at STP occupies a volume of 34.0 liters. What is the temperature of the gas if it is compressed to 20.0 liters by increasing the pressure to 250. kPa?

8. You are given two equally sized containers of Ar and N_2 that both behave as ideal gasses and have equal pressures and temperatures.

a. Does each container have the same number of particles? Explain.

_____

b. Do they have the same number of atoms? Explain.

_____

c. Do they have the same mass? Explain.

_____

9. Using the first page of your Reference Tables, convert 2.6 atm to mmHg.

HEAT CALCULATIONS: Problem Set A. (SHOW ALL WORK)

1) How many kilojoules does it require to melt a 500 gram ice cube?

2) What is the total number of joules of heat energy absorbed when the temperature of 200 grams of water is raised from 10°C to 40°C? What is your answer expressed in kilojoules?

3) What is the total pressure exerted by a mixture containing two gases if the partial pressure of one gas is 70 torr and the partial pressure of the other gas is 30 torr?

4) A 1-Liter flask contains two gases at a total pressure of 3.0 atmospheres. If the partial pressure of one of the gases is 0.5 atmospheres, then the partial pressure of the other gas must be what?

5) A gas occupies a volume of 30 mL at 273 K. If the temperature is increased to 364 K while the pressure remains constant, what will be the new volume of the gas?

6) It takes 113,000 joules of energy to completely boil a sample of water. What is the mass of the sample of water?

HEAT CALCULATIONS: Problem Set B. (SHOW ALL WORK)

1. How much heat is required to completely boil a 50.0 gram sample of water that is at its normal boiling point?

2. Once boiled, how much heat is required to raise the temperature of the gas in the previous problem from 100.°C to 140.°C? (The specific heat for $H_2O(g)$ = 1.84 J/g°C)

3. How much total energy is required to turn a 50.0 g sample of liquid water at 100.°C into 140.°C water vapor?

4. How much heat is required to melt a 50.0 gram ice cube that is at its normal melting point?

5. Once melted, how much heat is required to raise the temperature of the puddle in the previous question from 0.0°C to 40.0°C?

6. Use your answers from the previous questions to rank melting, vaporization, and temperature change from highest to lowest in terms of energy required.

7. If a 25.0 g sample of water at 45°C loses 3657.5 J of heat. What is the final temperature of the water?

8. Which involves a greater amount of energy, melting 35.0 g of solid ice at 0°C or freezing 35.0 g of liquid water at 0°C? Justify your answer.

9. Explain the difference in specific heat capacity for $H_2O(\ell)$ and $H_2O(g)$.

GAS LAW CALCULATIONS: Problem Set C. (SHOW ALL WORK)

1) A sealed flask contains 2 moles of helium and 3 moles of nitrogen. If the total pressure of the container is 200 KPa, what is the partial pressure of the nitrogen?

2) A 6.55 Liter gas canister has a pressure gauge that reads 4.45 atmospheres and a temperature gauge that reads 31.5 °C. How many moles of gas are in the container?

3) At a temperature of 290 Kelvin, a 500 milliliter gas sample has pressure of 1.5 atmospheres. If the pressure is changed to 3.75 atmospheres at which temperature will the gas sample have a volume of 675 milliliters?

4) A gas occupies a volume of 30 milliliters at STP. If the temperature is increased to 350 Kelvin, what will the new volume be if pressure remains constant?

5) Whose law is demonstrated by #24?

6) How much heat energy is needed to convert 350 grams of water to water vapor?

7) 640 joules of energy are released when 4 grams of water is cooled. If the initial temperature of the water was 99°C, what would the final temperature be?

8) How much heat is transferred if 550 grams of liquid water is frozen?

9) Is the situation in # 28 exothermic or endothermic (explain your answer)

10) Draw particle diagrams to represent containers containing the following…

a) Hydrogen gas

b) Solid carbon

c) A solution of table salt dissolved in water

11) From the following solutions, determine if they are saturated, unsaturated, or supersaturated, in 100 grams of water. Assume all the mass of the solute is dissolved.

a) 10 grams of KCl at 50 °C. _____

b) 50 grams of NaCl at 20 °C. _____

12) Determine if the following salts are soluble or insoluble aqueous solutions.

a) calcium carbonate _____

b) sodium phosphate _____

c) calcium hydroxide _____

d) silver chloride _____