

Physics 5D Fall 2008**Assignment 3**

Due at 2:00pm on Tuesday, October 28, 2008

[View Grading Details](#)**Deviations from the Ideal Gas Equation****Description:** Calculate the pressure of carbon dioxide gas using the ideal-gas and van der Waals equations, and find the percentage difference between them.

The derivation of the ideal gas equation employs two assumptions that are invalid for real gas molecules. First, the equation assumes that the molecules of the gas have no volume, which is not true for real molecules. Since the molecules will have some physical volume, the volume that the gas molecules occupy will be increased by the volume that the molecules occupy at rest. In addition, the equation ignores any interactions among the molecules. However, such interactions were first observed in the 19th century by J. D. van der Waals. He realized that, because of the intermolecular forces in the gas, there is a small but measurable attraction among the molecules, which will reduce the pressure of the gas on the walls of the container. To correct for these two deviations from an ideal gas, the *van der Waals equation* gives

$$\left(p + \frac{an^2}{V^2}\right)(V - nb) = nRT.$$

where a and b are empirical constants, which are different for different gasses.

For carbon dioxide gas (CO_2), the constants in the van der Waals equation are $a = 0.364 \text{ J} \cdot \text{m}^3/\text{mol}^2$ and $b = 4.27 \times 10^{-5} \text{ m}^3/\text{mol}$.

Part A

If 1.00 mol of CO_2 gas at 350 K is confined to a volume of 400 cm^3 , find the pressure p_{ideal} of the gas using the ideal gas equation.

Hint A.1 How to approach the problem

Use the ideal gas equation to calculate the pressure of the carbon dioxide. Be careful to use the correct units in your calculations.

Express your answer numerically in pascals.ANSWER: **Part B**

Find the pressure p_{vdW} of the gas using the van der Waals equation.

Hint B.1 Using the van der Waals equation**Express your answer numerically in pascals.**ANSWER: **Part C**

What is the percentage difference of the van der Waals result from the ideal gas equation result?

Hint C.1 Percentage difference

The fractional difference of x from y is given as $|x - y|/y$. Don't forget to convert your answer to a percentage difference from a fractional difference.

Express your answer as a percentage.ANSWER:

Note that the van der Waals equation gives a lower pressure than the ideal gas equation.

The gas is kept at the same temperature as it expands to a volume of 4000 cm^3 .

Part D

Find the pressure p_{ideal} of the gas using the ideal gas equation in this case.

Express your answer numerically in pascals.

ANSWER: $p_{\text{ideal}} = 7.27 \cdot 10^5 \text{ Pa}$

Part E

Find the pressure p_{vdW} of the gas at this new volume using the van der Waals equation.

Express your answer numerically in pascals.

ANSWER: $p_{\text{vdW}} = 7.12 \cdot 10^5 \text{ Pa}$

Part F

What is the percentage difference of the van der Waals result from the ideal gas equation result in this case?

Express your answer as a percentage.

ANSWER: 2.06 %

Note that the van der Waals equation gives a lower pressure than the ideal gas equation once again. The difference is less, however, because the ratio n/V decreases as V increases (keeping n constant). For small values of the ratio, the average distance between the molecules is large, so the corrections in the van der Waals equation become insignificant, and the equation reduces to the ideal gas equation for sufficiently small values of n/V .

Kinetic Energy of Hydrogen and Oxygen Gas Conceptual Question

Description: Conceptual questions dealing with total translational kinetic energy and root-mean-square speed of gas molecules where rms and total translational kinetic energy in one situation are given. (conceptual)

The rms (root-mean-square) speed of a diatomic hydrogen molecule at 50°C is 2000 m/s . Note that 1.0 mol of diatomic hydrogen at 50°C has a total translational kinetic energy of 4000 J .

Part A

Diatomic oxygen has a molar mass 16 times that of diatomic hydrogen. The root-mean-square speed v_{rms} for diatomic oxygen at 50°C is:

Hint A.1 Definition of root-mean-square speed

Each particle in a gas sample has a different velocity and hence a different kinetic energy. The average velocity of these particles is zero, because each particle is equally likely to have a positive or negative velocity in any direction. However, the average of the *squared* speeds can be determined from the definition of temperature:

$$\langle K \rangle = \frac{1}{2} m \langle v^2 \rangle = \frac{3}{2} kT.$$

This can be rearranged to show that

$$\langle v^2 \rangle = \frac{3kT}{m}.$$

The square root of this quantity is referred to as the root-mean-square, or rms, speed:

$$v_{\text{rms}} = \sqrt{\frac{3kT}{m}}.$$

Choose the correct value of v_{rms} .

- ANSWER:
- (16)(2000 m/s) = 32000 m/s
 - (4)(2000 m/s) = 8000 m/s
 - 2000 m/s
 - $\left(\frac{1}{4}\right)$ (2000 m/s) = 500 m/s
 - $\left(\frac{1}{16}\right)$ (2000 m/s) = 125 m/s
 - none of the above

Part B

The total translational kinetic energy of 1.0 mole of diatomic oxygen at 50°C is:

Hint B.1 Definition of average and total kinetic energy

Each particle in a gas sample has a different velocity and hence a different kinetic energy. The average kinetic energy of the particles in the gas, however, is defined to be directly proportional to the temperature of the gas. This temperature must be expressed on the absolute, or Kelvin, scale:

$$\langle K \rangle = \frac{1}{2} m \langle v^2 \rangle = \frac{3}{2} kT.$$

The total kinetic energy is then the product of the average kinetic energy and the number of molecules in the gas.

Choose the correct total translational kinetic energy.

- ANSWER:
- (16)(4000 J) = 64000 J
 - (4)(4000 J) = 16000 J
 - 4000 J
 - $\left(\frac{1}{4}\right)$ (4000 J) = 1000 J
 - $\left(\frac{1}{16}\right)$ (4000 J) = 150 J
 - none of the above

Part C

The temperature of the diatomic hydrogen gas sample is increased to 100 °C. The root-mean-square speed v_{rms} for diatomic hydrogen at 100 °C is:

Choose the correct v_{rms} .

- ANSWER:
- (2)(2000 m/s) = 4000 m/s
 - $(\sqrt{2})(2000 \text{ m/s}) = 2800 \text{ m/s}$
 - 2000 m/s
 - $\left(\frac{1}{\sqrt{2}}\right)$ (2000 m/s) = 1400 m/s
 - $\left(\frac{1}{2}\right)$ (2000 m/s) = 1000 m/s
 - none of the above

Storing Ammonia

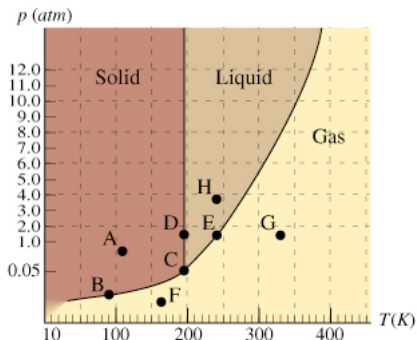
Description: Interpret a phase diagram for ammonia using phase change terminology. Use phase diagram for determining proper storage.

Ammonia (NH_3) is a colorless, pungent gas at standard pressure and temperature. It is a natural metabolic byproduct, usually getting released in respiration, sweat, and urine. However, because ammonia is caustic, exposure to large quantities of it can cause illness and even death. Despite its inherent dangers, ammonia is environmentally friendly in small quantities and has many applications in our economy. It can be used as a fertilizer, as a source of hydrogen gas for welding, as a refrigerant, in the production of nitric acid and sodium carbonate, in metallurgy, and in the infamous smelling salts used to revive unconscious people. Ammonia today can be mass produced inexpensively in chemical refineries.

To safely produce and store ammonia, its physical and thermodynamic properties must be understood. Physically, ammonia is a strong base that reacts with acids and metals. The thermodynamic properties describing the phases of ammonia (solid, liquid, and gas) and the transitions between the phases are just as important. The relationship of these phases to pressure and temperature is quantitatively described by ammonia's pT phase diagram. Note that, in this diagram, the pressure axis is not to scale.

From the diagram, the melting temperature, boiling temperature, and other quantities can be determined for any pressure. The pressure and temperature range for each of the phases is shown by its own unique area of the graph. The lines bounding each of the phases on the diagram represent the temperatures and pressures at which two states can coexist.

For this problem, any section of curve on the diagram can be named using two letters on the boundary in alphabetical order. Other points not lying on the boundary can also be used to help identify various thermodynamic processes.



Part A

On the phase diagram, which section of curve represents the pressure and temperature values at which ammonia will boil?

Part A.1 Describe boiling in terms of phase changes

Boiling is the transition from one phase to another with both phases existing together. The phases and direction of change involved in boiling are _____ to _____.

Express your answer as two words separated by commas. Choose from the following list: gas, liquid, or solid.

ANSWER: liquid gas

Express your answer as two letters in alphabetical order that lie on a section of the appropriate curve.

ANSWER: boiling curve = CE

Part B

The line between which two points would describe a process of liquid ammonia boiling completely away?

Express the answer as two letters representing the endpoints of the line in order so that going from the first letter to the second letter would show a process of boiling. Be careful to put the letters in the correct order.

ANSWER: HG

Part C

On the phase diagram, which section of curve represents the pressure and temperature values at which ammonia will sublime?

Part C.1 Describe the process of sublimation

The phases and direction of change for sublimation are _____ to _____.

Express your answer as two words separated by a comma. Choose from the following list: gas, liquid, or solid.

ANSWER: solid gas

Express the answer as two letters in alphabetical order that lie on a section of the appropriate curve.

ANSWER: sublimation curve = BC

Part D

The line between which two points would describe a process of sublimation for ammonia?

Express your answer with two letters ordered in the direction of sublimation. Be careful to put the letters in the correct order.

ANSWER: AF

The heat added to a substance undergoing sublimation must be equal to the heat of fusion plus the heat of vaporization.

Part E

On the phase diagram, which section of curve represents the pressure and temperature values at which ammonia will melt?

Express the answer as two letters in alphabetical order that lie on a section of the appropriate curve.

ANSWER: melting curve = CD

Part F

The line between which two points would describe the process of complete melting of ammonia?

Express your answer as two letters ordered in the direction of melting. Be careful to put the letters in the correct order.

ANSWER: AH

Part G

One of the most important points on a phase diagram is the triple point, where gas, liquid, and solid phases all can exist at once. What are the coordinates (T_{triple} , P_{triple}) of the triple point of ammonia in the diagram?

Part G.1 Determine the letter name for the triple point

Given that the triple point is the pressure and temperature at which all three phases can coexist, what is the letter name for the triple point of ammonia?

Express the answer as a single letter.

ANSWER: triple point = C

Express your answer as an ordered pair. Determine the temperature to the nearest 5 K and the pressure to one significant digit.

ANSWER: $T_{\text{triple}}, P_{\text{triple}} = 195 \ 0.05$

Temperature scales were originally based upon the melting and boiling points of a substance, but these values vary with pressure as seen in the phase diagram of ammonia. So if one did not control and measure the pressure precisely, the measurement used to calibrate the temperature scale would be inaccurate.

To circumvent this problem, modern temperature scales are based on the triple point of water. The triple point temperature of water is 0.01°C at 0.006 atm . The three phases of water will not coexist at any other temperature, regardless of the pressure, so the temperature can be calibrated without an additional pressure measurement. The triple points of mercury and other substances are also used as standards for calibrating thermometers.

Part H

At one atmosphere of pressure and temperatures above -33.3°C , ammonia exists as a gas. For transportation, ammonia is stored as a liquid under its own vapor pressure. This means that the liquid and gas phases exist simultaneously. If a container of ammonia is transported in a temperature-controlled truck that is maintained at no greater than 330 K , what maximum pressure p must the sides of the container be able to withstand?

Hint H.1 How to approach the problem

Because the liquid and vapor forms both exist in the container, find the point on the graph where the given temperature intersects the curve representing the phase change of liquid to gas.

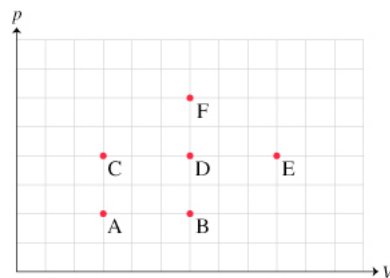
Express the answer numerically in atmospheres to one significant figure.

ANSWER:

Ideal Gas Law and Internal Energy Pressure vs. Volume Graph Ranking Task

Description: Conceptual question on ideal gas law and energy for a p vs. V graph. (ranking task)

Six thermodynamic states of the same monatomic ideal gas sample are represented in the figure.



Part A

Rank these states on the basis of the temperature of the gas sample in each state.

Hint A.1 The ideal gas law

An ideal gas sample of pressure p , volume V , temperature T , and number of molecules N must obey the relationship

$$pV = Nk_B T,$$

where k_B is Boltzmann's constant.

Hint A.2 Determining temperature

Since the same gas sample is involved in each state, the number of particles in the gas does not change. Therefore,

$$pV = Nk_B T$$

implies $T \propto pV$ (T is directly proportional to the product pV). Conceptually, this should make sense. To maintain a high pressure in a large volume requires very rapidly moving (very hot) particles.

Rank from largest to smallest. To rank items as equivalent, overlap them.

ANSWER:

[View](#)

Part B

Rank the states on the basis of the average kinetic energy of the atoms in the gas sample at each state.

Hint B.1 Definition of average kinetic energy

Each particle in the gas sample has a different velocity and hence a different kinetic energy. The average kinetic energy of the particles in the gas K_{avg} , however, can be easily determined and is directly proportional to the temperature of the gas T :

$$K_{\text{avg}} = \frac{3}{2}k_{\text{B}}T,$$

where k_{B} is Boltzmann's constant. By this definition, temperature is a macroscopic way of measuring the microscopic average kinetic energy of gas particles.

Rank from largest to smallest. To rank items as equivalent, overlap them.

ANSWER:

[View](#)

Temperature is a macroscopic quantity proportional to the average kinetic energy of the atoms in the gas.

Part C

Rank the states on the basis of the internal energy of the gas sample at each state.

Hint C.1 Definition of internal energy

The internal energy of a gas U is the sum of the kinetic and potential energies of all of its constituents. In the standard ideal gas model, we assume that the gas particles do not have any potential energy, so the internal energy is just the sum of all of the individual kinetic energies. Thus, knowing the relationship for the average kinetic energy K_{avg} allows us to write a relationship for the internal energy of an ideal monatomic gas of N particles as

$$U = N(K_{\text{avg}}).$$

Therefore,

$$U = \frac{3}{2}Nk_{\text{B}}T.$$

where T is the temperature of the gas and k_{B} is Boltzmann's constant. Thus, the temperature, average kinetic energy, and total internal energy of an ideal gas are all directly proportional to one another.

Rank from largest to smallest. To rank items as equivalent, overlap them.

ANSWER:

[View](#)

Internal energy is a measure of the total energy contained in the gas. The total energy is the average energy per atom multiplied by the number of atoms. Since temperature is proportional to the average energy per atom, it is also proportional to the total energy in the gas.

The Speed of Nitrogen Molecules

Description: Determine the average speed, root mean square speed, and temperature of a sample of nitrogen gas from a histogram of molecule velocities. One applet based question also.

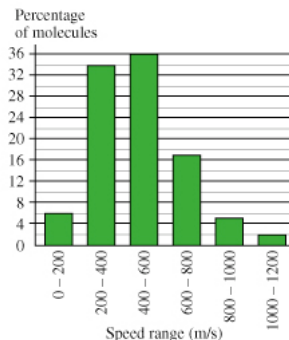
The *kinetic theory of gases* states that the kinetic energy of a gas is directly proportional to the temperature of the gas. A relationship between the microscopic properties of the gas molecules and the macroscopic properties of the gas can be derived using the following assumptions:

- The gas is composed of pointlike particles separated by comparatively large distances.
- The gas molecules are in continual random motion with collisions being perfectly elastic.
- The gas molecules exert no long-range forces on each other.

One of the most important microscopic properties of gas molecules is velocity. There are several different ways to describe statistically the average velocity of a molecule in a gas. The most obvious measure is the average velocity \vec{v}_{avg} . However, since the molecules in a gas are moving in random directions, the average velocity is approximately zero. Another measure of velocity is $(v^2)_{\text{avg}}$, the average squared velocity. Since the square of velocity is always positive, this measure does not average to zero

over the entire gas. A third measure is the root-mean-square (rms) speed, v_{rms} , equal to the square root of $(v^2)_{\text{avg}}$. The rms speed is a good approximation of the typical speed of the molecules in a gas.

This histogram shows a theoretical distribution of speeds of molecules in a sample of nitrogen (N_2) gas. In this problem, you'll use the histogram to compute properties of the gas.



Part A

What is the average speed v_{avg} of the molecules in the gas?

Hint A.1 How to use the histogram

The histogram shows the fraction of molecules that have speeds within each of a set of ranges. Each speed range is called a *bin*. Take the central speed value of each bin as an estimate of the speed of all the molecules in that bin. Compute the weighted average speed, using the percentage of molecules in a bin as the weighting factor for that bin.

Hint A.2 More on computing the average

To find the weighted average, take the average speed of the molecules in each "bin" (for example, the average speed of molecules in the 0-200 range is 100), and multiply that value by the fraction of molecules in that bin. Repeat this process for each bin, adding the results. This will give you the average speed of the molecules in the gas.

Express your answer numerically to three significant digits.

ANSWER: $v_{\text{avg}} = 474 \text{ m/s}$

Part B

Because the kinetic energy of a single molecule is related to its velocity squared, the best measure of the kinetic energy of the entire gas is obtained by computing the mean squared velocity, $(v^2)_{\text{avg}}$, or its square root v_{rms} . The quantity v_{rms} is more common than $(v^2)_{\text{avg}}$ because it has the dimensions of velocity instead of the less-familiar velocity-squared.

What is the rms speed v_{rms} of the molecules in the nitrogen gas?

Hint B.1 How to approach the problem

The rms speed of a system of molecules is the square root of the average of the squares of the velocities. Take the central speed value of each bin as an estimate of the speed of all the molecules in that bin. Compute the weighted average squared speed, using the percentage of molecules in a bin as the weighting factor for that bin. Then take the square root.

Part B.2 Find the mean square velocity

What is the mean square velocity $(v^2)_{\text{avg}}$ for the given distribution of molecules?

Hint B.2.a Understanding mean square velocity

The mean square velocity is given by $(v^2)_{\text{avg}} = (\sum v^2)/N$, where the sum is taken over all the molecules in the gas and N is the total number of molecules. If you take the central speed value of each bin as an estimate of the speed of all the molecules in that bin, this equation reduces to

$$(v^2)_{\text{avg}} = \frac{\sum_{\text{bins}} n_{\text{bin}} v^2}{N},$$

where the sum is now over the number of discrete bins and n_{bin} is the number of molecules (or equivalently the percentage of molecules) in a particular bin.

Express your answer numerically in meters squared per second squared to three significant figures.

ANSWER: $(v^2)_{\text{avg}} = 2.69 \cdot 10^5 \text{ m}^2/\text{s}^2$

Express your answer numerically to three significant digits.

ANSWER: $v_{\text{rms}} = 519 \text{ m/s}$

A speed of 519 m/s is comparable to that of a bullet shot from a handgun. In contrast, a Boeing 747 jet airliner has a maximum air speed of 270 m/s and the speed of sound in air is only about 330 m/s. The speed of sound in air must be slower than the average speed of the molecules because it is the movement of the molecules that transmits sound.

Part C

What is the temperature T of the sample of N_2 gas described in the histogram?

Hint C.1 How to approach the problem

Using the assumptions of kinematics, the ideal gas law, and the formula for kinetic energy, it can be shown that $v_{\text{rms}} = \sqrt{3RT/m_m}$, where R is the ideal gas constant, T is the temperature in kelvins, and m_m is the molar mass in kilograms.

Solve this equation for T . Use $R = 8.314 \text{ J/(K} \cdot \text{mol)}$.

Part C.2 Find the molar mass of N_2

To three significant figures, the weight of nitrogen is 14.0 g/mol . What is the molar mass m_m of the N_2 molecule?

Express your answer in grams per mole to three significant figures.

ANSWER: $m_m = 28.0 \text{ g/mol}$

Express your answer in degrees Celsius to three significant figures.

ANSWER: $T = 29.4 \text{ }^\circ\text{C}$

Part D

The histogram used in this problem is obviously only an approximation of the true distribution of velocities in a gas. In reality, the molecules span a continuous range of velocities. For a given temperature, the majority of the molecules have a speed near the average speed, with a few molecules traveling very fast or very slow. To good approximation, the speeds of molecules in a gas follow what is known as the Maxwell-Boltzmann distribution. This [applet](#) allows you to see the curves for the Maxwell-Boltzmann distribution at many different temperatures. It also lets you move a small interval around on the histogram to highlight all of the molecules within the speed range of that part of the histogram.

Which of the following describes the qualitative behavior of the Maxwell-Boltzmann distribution as temperature increases? You will have to press the "reset" button on the applet before you can change the temperature using the thermometer on the right side.

- ANSWER:
- The peak moves to the right, while the distribution becomes more spread out.
 - The peak moves to the right, while the distribution becomes less spread out.
 - The peak moves to the left, while the distribution becomes more spread out.
 - The peak moves to the left, while the distribution becomes less spread out.

At the higher temperatures, the peak of the curve shifts to the right, indicating a higher average velocity. The peaks of the higher temperature curves are also broader, indicating that a greater percentage of molecules are traveling at a higher velocity than in the low-temperature case.

Problem 18.43

Description: (a) From the van der Waals equation of state, find the critical temperature and pressure. [Hint: Use the fact that the P versus V curve has an inflection point at the critical point so that the first and second derivatives are zero.]... (b) ... (c)...

Part A

From the van der Waals equation of state, find the critical temperature and pressure. [Hint: Use the fact that the P versus V curve has an inflection point at the critical point so that the first and second derivatives are zero.]

Express your answer in terms of the variables a , b , and appropriate constants.

ANSWER: $T_{cr} = \frac{8a}{27bR}$
 $\frac{8a}{27bkN_A}$

Part B

Express your answer in terms of the variables a and b .

ANSWER: $P_{cr} = \frac{a}{27b^2}$

Part C

Determine a and b for CO_2 from the measured values of $T_{cr} = 304 \text{ K}$ and $P_{cr} = 72.8 \text{ atm}$.

ANSWER: $a = 0.365 \text{ N}\cdot\text{m}^4/\text{mol}^2$

Part D

ANSWER: $b = 4.28\cdot 10^{-5} \text{ m}^3/\text{mol}$

Problem 18.57

Description: In outer space the density of matter is about one atom per $(\text{cm})^3$, mainly hydrogen atoms, and the temperature is about 2.7 K . (a) Calculate the rms speed of these hydrogen atoms. (b) Calculate the pressure (in atmospheres).

In outer space the density of matter is about one atom per cm^3 , mainly hydrogen atoms, and the temperature is about 2.7 K .

Part A

Calculate the rms speed of these hydrogen atoms.

Express your answer using two significant figures.

ANSWER: $v_{\text{rms}} = 260 \text{ m/s}$

Part B

Calculate the pressure (in atmospheres).

Express your answer using two significant figures.

ANSWER: $P = 3.7\cdot 10^{-22} \text{ atm}$

Problem 18.59

Description: (a) Estimate the rms speed of an amino acid, whose molecular mass is 89 u , in a living cell at 37 degree(s) C . (b) What would be the rms speed of a protein of molecular mass $85,000 \text{ u}$ at 37 degree(s) C ?

Part A

Estimate the rms speed of an amino acid, whose molecular mass is 89 u , in a living cell at 37°C .

Express your answer using two significant figures.

ANSWER: $v_{\text{rms}} = 290 \text{ m/s}$

Part B

What would be the rms speed of a protein of molecular mass $85,000 \text{ u}$ at 37°C ?

Express your answer using two significant figures.

ANSWER: $v_{\text{rms}} = 9.5 \text{ m/s}$

Problem 18.65

Description: (a) Assuming a typical nitrogen or oxygen molecule is about 0.3 nm in diameter, what percent of the room you are sitting in is taken up by the volume of the molecules themselves?

Part A

Assuming a typical nitrogen or oxygen molecule is about 0.3 nm in diameter, what percent of the room you are sitting in is taken up by the volume of the molecules themselves?

ANSWER: $\approx 1\%$
 $\approx 0.1\%$
 $\approx 0.01\%$
 $\approx 0.001\%$

Question 18.23

Description: (a) At suitable temperatures and pressures, can ice be melted by applying pressure? (b) At suitable temperatures and pressures, can carbon dioxide be melted by applying pressure?

Part A

At suitable temperatures and pressures, can ice be melted by applying pressure?

ANSWER: yes
 no

Part B

At suitable temperatures and pressures, can carbon dioxide be melted by applying pressure?

ANSWER: yes
 no

Description: The escape speed from the Earth is 1.12×10^4 (m/s), so that a gas molecule travelling away from Earth near the outer boundary of the Earth's atmosphere would, at this speed, be able to escape from the Earth's

The escape speed from the Earth is 1.12×10^4 m/s, so that a gas molecule travelling away from Earth near the outer boundary of the Earth's atmosphere would, at this speed, be able to escape from the Earth's gravitational

Part A

At what temperature is the average speed of oxygen molecules equal to 1.12×10^4 m/s?

ANSWER: $T = 1.90 \cdot 10^5$ K

Part B

At what temperature is the average speed of helium atoms equal to 1.12×10^4 m/s?

ANSWER: $T = 2.37 \cdot 10^4$ K

 Part C

Can you explain why our atmosphere contains oxygen but not helium?

ANSWER: **Answer Key:**
 Because the "escape temperature" is so high for oxygen, very few oxygen molecules ever escape the atmosphere. But helium, with one-eighth

Question 18.17

Description: (a) Is it possible to boil water at room temperature (20 degree(s) C) without heating it? (b) Explain.

Part A

Is it possible to boil water at room temperature (20 °C) without heating it?

ANSWER: yes
 no

 Part B

Explain.

ANSWER: **Answer Key:**
 If you place the water and its container in a vessel that can be evacuated (depressurized), and pump the air out of the vessel, the water

| | |
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| Summary | 0 of 12 items complete (0% avg. score) 0 of 67 points |
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