DOWNLOAD PDF IDEAL GAS LAW NOTES

Chapter 1 : ideal gas law | CourseNotes

The ideal gas law is an ideal law. It operates under a number of assumptions. It operates under a number of assumptions. The two most important assumptions are that the molecules of an ideal gas do not occupy space and do not attract each other.

All of the gas laws rely on some basic assumptions that are made about gases, and together they constitute what it means for a gas to be in an ideal state. In an ideal state All gas particles are in constant, random motion. All collisions between gas particles are perfectly elastic meaning that the kinetic energy of the system is conserved. The volume of the gas molecules in a gas is negligible. Gases have no intermolecular attractive or repulsive forces. The average kinetic energy of the gas is directly proportional to its Kelvin temperature and is the same for all gases at a specified temperature. Only four measurable properties are used to describe a gas: The quantity amount of the gas is usually expressed in moles n. The temperature, T, of gases must always be converted to the Kelvin temperature scale the absolute temperature scale. The volume, V, of a gas is usually given in liters. Finally, the pressure, P, of a gas is usually expressed in atmospheres. Example Which of the following statements is not true of ideal gases? The volume occupied by gas particles is only significant at very low pressures. Gas molecules occupy an insignificant volume compared to the volume of the container that holds them. The particles of a gas move in random straight line paths until a collision occurs. The collisions that occur between gas particles are considered elastic. At a given temperature, all gas molecules within a sample possess the same average kinetic energy. Explanation In this example, choice 1 is incorrect. Choices 2, 3, 4, and 5 all describe an ideal gas. Choice 1 makes an incorrect assumption: The volume only becomes significant if gas particles collide often, increasing the chances that intermolecular forces will hold them together. Measuring the Pressure of a Gas Gas pressure is a gauge of the number and force of collisions between gas particles and the walls of the container that holds them. The SI unit for pressure is the pascal Pa , but other pressure terms include atmospheres atms , millimeters of mercury mmHg , and torr. The following is a list of all of the standard pressure in every unit for pressure. Memorize these for the exam so you can convert units where necessary:

Chapter 2 : Ideal gas equation: PV = nRT (video) | Khan Academy

Ideal Gas Law PV = nRT The moles of gas is no longer a constant, and is now represented by "n". There is also a gas constant, "R". Gas Laws Notes Author.

Gas Laws One of the most amazing things about gases is that, despite wide differences in chemical properties, all the gases more or less obey the gas laws. The gas laws deal with how gases behave with respect to pressure, volume, temperature, and amount. Pressure Gases are the only state of matter that can be compressed very tightly or expanded to fill a very large space. Pressure is force per unit area, calculated by dividing the force by the area on which the force acts. This is called atmospheric pressure. The units of pressure that are used are pascal Pa , standard atmosphere atm , and torr. It is normally used as a standard unit of pressure. The SI unit though, is the pascal. For laboratory work the atmosphere is very large. A more convient unit is the torr. A torr is the same unit as the mmHg millimeter of mercury. It is the pressure that is needed to raise a tube of mercury 1 millimeter. Another way to describing it is saying that their products are constant. When volume goes up, pressure goes down. From the equation above, this can be derived: This equation states that the product of the initial volume and pressure is equal to the product of the volume and pressure after a change in one of them under constant temperature. For example, if the initial volume was mL at a pressure of torr, when the volume is compressed to mL, what is the pressure? Plug in the values: The Temperature-Volume Law This law states that the volume of a given amount of gas held at constant pressure is directly proportional to the Kelvin temperature. V Same as before, a constant can be put in: Also same as before, initial and final volumes and temperatures under constant pressure can be calculated. The Pressure Temperature Law This law states that the pressure of a given amount of gas held at constant volume is directly proportional to the Kelvin temperature. P Same as before, a constant can be put in: The Volume Amount Law Amedeo Avogadro Gives the relationship between volume and amount when pressure and temperature are held constant. Remember amount is measured in moles. Also, since volume is one of the variables, that means the container holding the gas is flexible in some way and can expand or contract. If the amount of gas in a container is increased, the volume increases. If the amount of gas in a container is decreased, the volume decreases. V As before, a constant can be put in: The Combined Gas Law Now we can combine everything we have into one proportion: The volume of a given amount of gas is proportional to the ratio of its Kelvin temperature and its pressure. Same as before, a constant can be put in: The Ideal Gas Law The previous laws all assume that the gas being measured is an ideal gas, a gas that obeys them all exactly. But over a wide range of temperature, pressure, and volume, real gases deviate slightly from ideal. Since, according to Avogadro, the same volumes of gas contain the same number of moles, chemists could now determine the formulas of gaseous elements and their formula masses. The idea gas law is: The balloon used by Charles in his historic flight in was filled with about mole of H_2. If the outside temperature was 21 oC and the atmospheric pressure was mm Hg, what was the volume of the balloon?

Chapter 3 : Ideal Gas Law | CourseNotes

An ideal gas is an idealized model of real gases; real gases follow ideal gas behavior if their density is low enough that the gas molecules don't interact much, and when they do interact they undergo elastic collisions, with no loss of kinetic energy.

The Kinetic Theory of Gases Avogadro constant The laws of classical thermodynamics do not show the direct dependence of the observed macroscopic variables on microscopic aspects of the motion of atoms and molecules. It is however clear that the pressure exerted by a gas is related to the linear momentum of the atoms and molecules, and that the temperature of the gas is related to the kinetic energy of the atoms and molecules. In relating the effects of the motion of atoms and molecules to macroscopic observables like pressure and temperature, we have to determine the number of molecules in the gas. This number is called the Avogadro constant, NA. The Ideal Gas Avogadro made the suggestion that all gases - under the same conditions of temperature and pressure - contain the same number of molecules. Reversely, if we take 1 mole samples of various gases, confine them in boxes of identical volume and hold them at the same temperature, we find that their measured pressures are nearly identical. Experiments showed that the gases obey the following relation the ideal gas law: R has the same value for all gases: The temperature of the gas must always be expressed in absolute units Kelvin. Using the ideal gas law we can calculate the work done by an ideal gas. Suppose a sample of n moles of an ideal gas is confined in an initial volume Vi. The gas expands by moving a piston. Its final volume is Vf. During the expansion the temperature T of the gas is kept constant this process is called isothermal expansion. The work done by the expanding gas is given by The ideal gas law provides us with a relation between the pressure and the volume Since T is kept constant, the work done can be calculated easily Note: What is the final pressure of the gas? The ideal gas law tells us that The initial state of the gas is specified by Vi, pi and Ti; the final state of the gas is specified by Vf, pf and Tf. We conclude that Thus The temperature T in this formula must be expressed in Kelvin: A Molecular View Let n moles of an ideal gas be confined to a cubical box of volume V. The molecules in the box move in all directions with varying speeds, colliding with each other and with the walls of the box. The molecule will collide with the right wall. The result of the collision is a reversal of the direction of the x-component of the momentum of the molecule: Molecule moving in box. The y and z components of the momentum of the molecule are left unchanged. The change in the momentum of the particle is therefore After the molecule is scattered of the right wall, it will collide with the left wall, and finally return to the right wall. The force exerted on the wall by this molecule can be calculated easily For n moles of gas, the corresponding force is equal to The pressure exerted by the gas is equal to the force per unit area, and therefore The term in parenthesis can be rewritten in terms of the average square velocity: Thus, we conclude that where M is the molecular weight of the gas. The disturbance is passed on from molecule to molecule by means of collisions; a sound wave can therefore never travel faster than the average speed of the molecules. When we measure the temperature of a gas, we are measuring the average translational kinetic energy of its molecules. Mean Free Path The motion of a molecule in a gas is complicated. Besides colliding with the walls of the confinement vessel, the molecules collide with each other. The mean free path l is the average distance traversed by a molecule between collisions. The mean free path of a molecule is related to its size; the larger its size the shorter its mean free path. Suppose the gas molecules are spherical and have a diameter d. Two gas molecules will collide if their centers are separated by less than 2d. During this time, the molecule travels a distance v. If we carry out the calculation correctly all molecules moving , the following relation is obtained for the mean free path: The relation derived between the macroscopic pressure and the microscopic aspects of molecular motion only depend on the average root-mean-square velocity of the molecules in the gas. Quit often we want more information than just the average root-mean-square velocity. For example, questions like what fraction of the molecules have a velocity larger than v0 can be important nuclear reaction cross sections increase dramatically with increasing velocity. The distribution is normalized, which means that The most probable speed, vp, is that velocity at which the speed distribution peaks. Assume for the moment that we are dealing with a monatomic gas. If the sample contains n moles of such a gas, it contains nNA molecules. The total internal energy of the gas is equal to We observe that the total internal energy of a gas is a function of only the gas temperature, and is independent of other variables such as the pressure and the density. For more complex molecules diatomic N2 etc. Molar Heat Capacity at Constant Volume Suppose we heat up n moles of gas while keeping its volume constant. Molar heat Capacity at Constant Pressure Suppose that, while heat is added to the system, the volume is changed such that the gas pressure does not change. Again, the change in the internal energy of the system is given by where Cp is the molar heat capacity at constant pressure. This can be achieved by either expanding the gas very quickly such that there is not time for the heat to flow or by very well insulating the system.

Chapter 4 : Gas laws - Wikipedia

ideal gas law Wait just a minute here In order to access these resources, you will need to sign in or register for the website (takes literally 1 minute!) and contribute 10 documents to the CourseNotes library.

Relativity Development of the Ideal Gas Law The pressure, volume, temperature, and amount of an ideal gas are related by one equation that was derived through the experimental work of several individuals, especially Robert Boyle, Jacques A. An ideal gas consists of identical, infinitesimally small particles that only interact occasionally like elastic billiard balls. The gases in the sun are not ideal gases due to the high temperature and pressures found there. The product of the pressure P and its corresponding volume V is a constant. Definition of a mole The proportionality constant of the previous equation is the same for all gases if the amount of gas is measured in moles rather in terms of mass. The number of moles n of gas is the ratio of the mass m and the molecular or atomic mass M expressed in grams per mole: The mole of pure substance contains a mass in grams equal to the molecular mass or atomic mass of the substance. If the temperature, pressure, and volume change for a given number of moles of gas, the formula is where unprimed variables refer to one set of conditions and the primed variables refer to another. Frequently, a set of conditions of the temperature, pressure, and volume of a gas are compared to standard temperature and pressure STP. Standard pressure is 1 atmosphere, and standard temperature is 0 degrees Celsius approximately degrees Kelvin. One mole of any gas at standard temperature and pressure STP occupies a standard volume of Consider a gas with the four following idealized characteristics: It is in thermal equilibrium with its container. The gas molecules collide elastically with other molecules and the walls of the vessel. The molecules are separated by distances that are large compared to their diameters. The net velocity of all the gas molecules must be zero so that, on the average, as many molecules are moving in one direction as in another. This model of a gas as a collection of molecules in constant motion undergoing elastic collisions according to Newtonian laws is the kinetic theory of gases. From Newtonian mechanics, the pressure on the wall P may be derived in terms of the average kinetic energy of the gas molecules: Using this formula and the ideal gas law, the relationship between temperature and average linear kinetic energy can be found: Temperature is a direct measure of the average molecular kinetic energy for an ideal gas. These results seem intuitively defensible. If the temperature rises, the gas molecules move at greater speeds. If the volume remains unchanged, the hotter molecules would be expected to hit the walls more often than cooler ones, resulting in an increase in pressure. These significant relationships link the motions of the gas molecules in the subatomic world to their characteristics observed in the macroscopic world.

Chapter 5 : Development of the Ideal Gas Law

If the Ideal Gas Law is correct, the above would apply under any set of conditions of P, V, n, and T, giving (where 1 represents the initial conditions and 2 represents the final.

Chapter 6 : The Kinetic Theory of Gases

Lecture 14 Chapter 19 Ideal Gas Law and Kinetic Theory of Gases Chapter 20 Entropy and the Second Law of Thermodynamics Now we to look at temperature.

Chapter 7 : SparkNotes: SAT Chemistry: The Gas Laws

The kinetic molecular theory describes IDEAL gases. Most gases approximate ideal gases and the model works great for most gases. Some REAL gases need adjustments.

Chapter 8 : Ideal gas - Wikipedia

4 For Introductory Chemistry, though, we will just deal with Ideal gases. Pressure is the sum of all the forces of all the gas molecules colliding with a surface. Gas particles are in constant random motion exerting pressure as they collide.