SOLIDS LIQUIDS AND GASES BASICS pdf

1: www.enganchecubano.com: Matter: Liquids

Gases, liquids and solids are all made up of atoms, molecules, and/or ions, but the behaviors of these particles differ in the three phases. The following figure illustrates the microscopic differences.

Millions and millions of these tiny objects fit together to form larger things like animals and planets and cars. Matter includes the water we drink, the air we breathe, and the chair we are sitting on. States or Phases Matter usually exists in one of three states or phases: The chair you are sitting on is a solid, the water you drink is liquid, and the air you breathe is a gas. Water, for example, is always made up of two hydrogen atoms and one oxygen atom. However, it can take the state of liquid, solid ice , and gas steam. Matter changes state when more energy gets added to it. Energy is often added in the form of heat or pressure. Water Solid water is called ice. This is water with the lowest energy and temperature. Liquid water is just called water. As ice heats up it will change phases to liquid water. Liquid molecules are looser and can move about easily. Gas water is called steam or vapor. When water boils it will turn to vapor. These molecules are hotter, looser, and moving faster than the liquid molecules. They are more spread apart and can be compressed or squished. One is called plasma. Plasma occurs at very high temperatures and can be found in stars and lightning bolts. Plasma is like gas, but the molecules have lost some electrons and become ions. Another state has the fancy name Bose-Einstein condensates. This state can occur at super low temperatures. Fun Facts about Solids, Liquids, Gases Gases are often invisible and assume the shape and volume of their container. The air we breathe is made up of different gases, but it is mostly nitrogen and oxygen. We can see through some solids like glass. When liquid gasoline is burned in a car, it turns into various gases which go into the air from the exhaust pipe. Fire is a mixture of hot gases. Plasma is by far the most abundant state of matter in the universe because stars are mostly plasma. Activities Take a ten question quiz about this page.

2: States of Matter - Atomic Bonding | Interaction Potential | Dipole - PhET Interactive Simulations

Naming examples of solids, liquids, and gases is a common homework assignment because it makes you think about phase changes and the states of matter. Examples of Solids Solids are a form of matter that has a definite shape and volume.

Solids can be hard like a rock, soft like fur, a big rock like an asteroid, or small rocks like grains of sand. A rock will always look like a rock unless something happens to it. The same goes for a diamond. Solids can hold their shape because their molecules are tightly packed together. You might ask, "Is baby power a solid? Even when you grind a solid into powder, you will see tiny pieces of that solid under a microscope. Liquids will flow and fill up any shape of container. Solids like to hold their shape. In the same way that a large solid holds its shape, the atoms inside of a solid are not allowed to move around too much. Atoms and molecules in liquids and gases are bouncing and floating around, free to move where they want. The molecules in a solid are stuck in a specific structure or arrangement of atoms. The atoms still vibrate and the electrons fly around in their orbitals, but the entire atom will not change its position. Solid Mixtures Solids can be made of many things. They can have pure elements or a variety of compounds inside. When you have a solid with more than one type of compound, it is called a mixture. Most rocks are mixtures of many different compounds. Concrete is a good example of a man-made solid mixture. Granite is a mixture you might find when you hike around a national park. Granite is made of little pieces of quartz, mica, and other particles. Because all of the little pieces are spread through the rock in an uneven way, scientists call it a heterogeneous mixture. Heterogeneous mixtures have different concentrations of compounds in different areas of the mixture. For example, there might be a lot of quartz and very little feldspar in one part of the granite, but only a few inches away those amounts might flip. Crystals On the other end of the spectrum is something called a crystal. A crystal is a form of solid where the atoms are arranged is a very specific order. Crystals are often pure substances and not all substances can form crystals because it is a very delicate process. The atoms are arranged in a regular repeating pattern called a crystal lattice. Table salt NaCl is a great example of a crystal you can find around your house. The sodium Na and chlorine Cl atoms arrange themselves in a specific pattern to form the cubic salt crystals. Allotropes A diamond is another good example of a crystal. Diamonds are a crystal form of pure carbon C. The carbon atoms of a diamond are connected in a very compact and structured way. The carbon atoms found in graphite in pencils have a different crystalline arrangement. According to the Mohs hardness scale, diamonds are very hard with a value of 10 while graphite is very soft with a value of 1. The two different structures of carbon atoms tetrahedron versus hexagon are called allotropes.

SOLIDS LIQUIDS AND GASES BASICS pdf

3: Solids Drying: Basics and Applications - Chemical Engineering | Page 1

Atoms and molecules in liquids and gases are bouncing and floating around, free to move where they want. The molecules in a solid are stuck in a specific structure or arrangement of atoms. The molecules in a solid are stuck in a specific structure or arrangement of atoms.

This state has a definite volume. This state has no definite shape. This state allows the individual particles to move about while remaining in contact. This statement describes either the liquid state or the gas state. This statement describes the liquid state. This state has individual particles in a fixed position with regard to each other. This state has individual particles far apart from each other in space. This state has a definite shape. Water, the Most Important Liquid Earth is the only known body in our solar system that has liquid water existing freely on its surface. That is a good thing because life on Earth would not be possible without the presence of liquid water. Water has several properties that make it a unique substance among substances. It is an excellent solvent; it dissolves many other substances and allows those substances to react when in solution. In fact, water is sometimes called the universal solvent because of this ability. Though a liquid at normal temperatures, water molecules experience a relatively strong intermolecular interaction that allows them to maintain the liquid phase at higher temperatures than expected. Unlike most substances, the solid form of water is less dense than its liquid form, which allows ice to float on water. In colder weather, lakes and rivers freeze from the top, allowing animals and plants to continue to live underneath. Water also requires an unusually large amount of energy to change temperature. Thus, water changes its temperature slowly as heat is added or removed. This has a major impact on weather, as storm systems like hurricanes can be impacted by the amount of heat that ocean water can store. Key Takeaway Solids and liquids are phases that have their own unique properties. Concept Review Exercise How do the strengths of intermolecular interactions in solids and liquids differ? Answer Solids have stronger intermolecular interactions than liquids do. Exercises What are the general properties of solids? What are the general properties of liquids What are the general properties of gases? What phase or phases have a definite volume? What phase or phases do not have a definite volume? Name a common substance that forms a crystal in its solid state. Name a common substance that forms an amorphous solid in its solid state. Are substances with strong intermolecular interactions likely to be solids at higher or lower temperatures? Are substances with weak intermolecular interactions likely to be liquids at higher or lower temperatures? State two similarities between the solid and liquid states. State two differences between the solid and liquid states. Answers hard, specific volume and shape, high density, cannot be compressed variable volume and shape, low density, compressible sodium chloride answers will vary At higher temperatures, their intermolecular interactions are strong enough to hold the particles in place.

4: State of matter - Wikipedia

Watch different types of molecules form a solid, liquid, or gas. Add or remove heat and watch the phase change. Change the temperature or volume of a container and see a pressure-temperature diagram respond in real time. Relate the interaction potential to the forces between molecules.

Solids are objects you can hold and maintain their shape. Gases are floating around you or trapped in bubbles. Liquids are found between the solid and gas states. Examples of liquids at room temperature include water H2O , blood, and even honey. If you have different types of molecules dissolved in a liquid, it is called a solution. Honey is a solution of sugar, water, and other molecules. Liquids fill the shape of any container they are in. If you pour water in a cup, it will fill up the bottom of the cup first and then fill the rest. If you freeze that cup of water, the ice will be in the shape of the cup. The top of a liquid will usually have a flat surface. That flat surface is the result of gravity pulling on the liquid molecules. If you put an ice cube solid into the cup, it will sit there and not change shape. As the cube warms and melts, the liquid water will fill the bottom of the cup and have a flat surface on top. Pushing on a Liquid Another trait of liquids is that they are difficult to compress. When you compress something, you take a certain amount of material and force it into a smaller space or volume. You force the atoms closer together. Most solids are very difficult to compress while gases are easier. Liquids are in the middle, but tend to be difficult to compress because the molecules are already close together. It takes a lot of force. Many shock absorbers found in cars and trucks have compressed liquids, such as oils, in sealed tubes. Without shocks, there would be a very rough ride for the driver and a lot of stress on the structure of the car. The shocks counter the extremes of the up and down motion by acting as a dampening device. Molecules Sticking Together Intermolecular forces are found in all substances. Some of the forces bring molecules together while others push them apart. Solids are locked together and you have to force them apart. Gases bounce everywhere and spread out. Many liquids want to stick together because of cohesive sticky forces that pull the molecules together. When you place a drop of water on a piece of glass, you will see it stay together as a drop. Cohesive forces keep the drop from spreading out. Cohesive forces also keep water molecules together if there is a drip on your faucet. The water sticks together until it is too heavy. It drips when the weight of the water drop overcomes the cohesive forces holding it all together. Evaporation occurs when individual liquid molecules gain enough energy to escape the system and become a gas. The extra energy allows individual molecules to overcome the intermolecular forces within the liquid.

5: States of Matter: Basics - Atoms | Molecules | States of Matter - PhET Interactive Simulations

Solids, liquids and gases are known as states of matter. Before we look at why things are called solids, liquids or gases, we need to know more about matter. Water is the only common substance that is naturally found as a solid, liquid or gas.

Basics and Applications By Dilip M. April 1, Adjustment and control of moisture levels in solid materials through drying is a critical process in the manufacture of many types of chemical products. As a unit operation, drying solid materials is one of the most common and important in the chemical process industries CPI , since it is used in practically every plant and facility that manufactures or handles solid materials, in the form of powders and granules. The effectiveness of drying processes can have a large impact on product quality and process efficiency in the CPI. For example, in the pharmaceutical industry, where drying normally occurs as a batch process, drying is a key manufacturing step. The drying process can impact subsequent manufacturing steps, including tableting or encapsulation and can influence critical quality attributes of the final dosage form. Apart from the obvious requirement of drying solids for a subsequent operation, drying may also be carried out to improve handling characteristics, as in bulk powder filling and other operations involving powder flow; and to stabilize moisture-sensitive materials, such as pharmaceuticals. This article provides basic information on the sometimes complicated heat- and mass-transfer processes that are important in drying, and discusses several technologies used to accomplish the task. Mechanism of drying Drying may be defined as the vaporization and removal of water or other liquids from a solution, suspension, or other solid-liquid mixture to form a dry solid. It is a complicated process that involves simultaneous heat and mass transfer, accompanied by physicochemical transformations. Drying occurs as a result of the vaporization of liquid by supplying heat to wet feedstock, granules, filter cakes and so on. Based on the mechanism of heat transfer that is employed, drying is categorized into direct convection , indirect or contact conduction , radiant radiation and dielectric or microwave radio frequency drying. Heat transfer and mass transfer are critical aspects in drying processes. Heat is transferred to the product to evaporate liquid, and mass is transferred as a vapor into the surrounding gas. The drying rate is determined by the set of factors that affect heat and mass transfer. Solids drying is generally understood to follow two distinct drying zones, known as the constant-rate period and the falling-rate period. The two zones are demarcated by a break point called the critical moisture content. In a typical graph of moisture content versus drying rate and moisture content versus time Figure 1 , section AB represents the constant-rate period. In that zone, moisture is considered to be evaporating from a saturated surface at a rate governed by diffusion from the surface through the stationary air film that is in contact with it. This period depends on the air temperature, humidity and speed of moisture to the surface, which in turn determine the temperature of the saturated surface. During the constant rate period, liquid must be transported to the surface at a rate sufficient to maintain saturation. Segment AB of the graph represents the constant-rate drying period, while segment BC is the falling-rate period At the end of the constant rate period, point B, Figure 1 , a break in the drying curve occurs. This point is called the critical moisture content, and a linear fall in the drying rate occurs with further drying. This section, segment BC, is called the first falling-rate period. As drying proceeds, moisture reaches the surface at a decreasing rate and the mechanism that controls its transfer will influence the rate of drying. Since the surface is no longer saturated, it will tend to rise above the wet bulb temperature. This section, represented by segment CD in Figure 1 is called the second falling-rate period, and is controlled by vapor diffusion. Movement of liquid may occur by diffusion under the concentration gradient created by the depletion of water at the surface. The gradient can be caused by evaporation, or as a result of capillary forces, or through a cycle of vaporization and condensation, or by osmotic effects. The capacity of the air gas stream to absorb and carry away moisture determines the drying rate and establishes the duration of the drying cycle. The two elements essential to this process are inlet air temperature and air flowrate. The higher the temperature of the drying air, the greater its vapor holding capacity. Since the temperature of the wet granules in a hot gas depends on the rate of evaporation, the key to analyzing the drying process is psychrometry, defined as the study of the relationships between the material and energy balances of water vapor and air mixture. Drying endpoint There are a number of approaches to determine the end of the drying process. The most common one is to construct a drying curve by taking samples during different stages of drying cycle against the drying time and establish a drying curve. When the drying is complete, the product temperature will start to increase, indicating the completion of drying at a specific, desired product-moisture content. Karl Fischer titration and loss on drying LOD moisture analyzers are also routinely used in batch processes. The water vapor sorption isotherms are measured using a gravimetric moisture-sorption apparatus with vacuum-drying capability. For measuring moisture content in grain, wood, food, textiles, pulp, paper, chemicals, mortar, soil, coffee, jute, tobacco, rice and concrete, electrical-resistance-type meters are used. This type of instrument operates on the principle of electrical resistance, which varies minutely in accordance with the moisture content of the item measured. Dielectric moisture meters are also used. They rely on surface contact with a flat plate electrode that does not penetrate the product. For measuring moisture content in paper rolls or stacks of paper, advanced methods include the use of the radio frequency RF capacitance method. This type of instrument measures the loss, or change, in RF dielectric constant, which is affected by the presence or absence of moisture. Types of dryers Adiabatic dryers are the type where the solids are dried by direct contact with gases, usually forced air. With these dryers, moisture is on the surface of the solid. Non-adiabatic dryers involve situations where a dryer does not use heated air or other gases to provide the energy required for the drying process Dryer classification can also be based on the mechanisms of heat transfer as follows: With adiabatic dryers, solid materials can be exposed to the heated gases via various methods, including the following: Heat transfer to the product is predominantly by conduction through the metal wall and the impeller. Therefore, these units are also called conductive dryers. Table 1 compares direct and indirect dryers, while Table 2 shows the classification of dryers based on various criteria. Classification of Dryers [5] Criterion.

6: Kids science: Solid, Liquid, Gas

Basics of Solids, Liquids and Gases Back to Physics Grade 9/10 Solids, Liquids and Gases. With some exceptions, you can generally classify everyday things as either a solid, liquid or gas.

The definition of a solid appears obvious; a solid is generally thought of as being hard and firm. Upon inspection, however, the definition becomes less straightforward. A cube of butter, for example, is hard after being stored in a refrigerator and is clearly a solid. After remaining on theâ€¦ Solids exhibit certain characteristics that distinguish them from liquids and gases. All solids have, for example, the ability to resist forces applied either perpendicular or parallel to a surface i. Such properties depend on the properties of the atoms that form the solid, on the way those atoms are arranged, and on the forces between them. Solids are generally divided into three broad classesâ€”crystalline, noncrystalline amorphous , and quasicrystalline. Crystalline solids have a very high degree of order in a periodic atomic arrangement. Practically all metals and many other minerals, such as common table salt sodium chloride , belong to this class. Noncrystalline solids are those in which atoms and molecules are not organized in a definite lattice pattern. They include glasses, plastics, and gels. Quasicrystalline solids display novel symmetries in which the atoms are arranged in quasiperiodic fashionâ€”i. They exhibit symmetries, such as fivefold symmetry , that are forbidden in ordinary crystals. Quasicrystal structures are common in alloys in which aluminum is combined with another metal , such as iron , cobalt, or nickel. Some molecules may exist in the liquid crystal state, which is intermediate to the crystalline solid and liquid states. Liquid crystals flow like liquids yet display a certain degree of the symmetry characteristic of crystalline solids. Four principal types of atomic bonds are found in crystalline solids: Metals and their alloys are characterized in the main by their high electrical and thermal conductivity , which arise from the migration of free electrons; free electrons also influence how the atoms bond. Ionic crystals are aggregates of charged ions. These salts commonly exhibit ionic conductivity, which increases with temperature. Covalent crystals are hard, frequently brittle materials such as diamond , silicon , and silicon carbide. In the simpler, monatomic types e. Molecular crystals are substances that have relatively weak intermolecular binding, such as Dry Ice solidified carbon dioxide , solid forms of the rare gases e. Various alloys, salts, covalent crystals, and molecular crystals that are good electrical insulators at low temperature become conductors at elevated temperatures, conductivity increasing rapidly with temperature. Materials of this type are called semiconductors. Their electrical conductivity is generally low when compared with that of such metals as copper, silver, or aluminum see semiconductor. Learn More in these related Britannica articles:

7: NinetyEast | Basics of Solids, Liquids and Gases

Heat, cool and compress atoms and molecules and watch as they change between solid, liquid and gas phases. Describe characteristics of three states of matter: solid, liquid and gas. Predict how varying the temperature or pressure changes the behavior of particles. Compare particles in the three.

The boiling point of a substance is the temperature that separates a liquid and a gas. What accounts for this variability? Why do some substances become liquids at very low temperatures, while others require very high temperatures before they become liquids? It all depends on the strength of the intermolecular interactions A force of attraction between different molecules. Although ionic compounds are not composed of discrete molecules, we will still use the term intermolecular to include interactions between the ions in such compounds. Substances that experience strong intermolecular interactions require higher temperatures to become liquids and, finally, gases. Substances that experience weak intermolecular interactions do not need much energy as measured by temperature to become liquids and gases and will exhibit these phases at lower temperatures. Substances with the highest melting and boiling points have covalent network bonding A type of interaction in which all the atoms in a sample are covalently bonded to other atoms.. This type of intermolecular interaction is actually a covalent bond. In these substances, all the atoms in a sample are covalently bonded to other atoms; in effect, the entire sample is essentially one large molecule. Many of these substances are solid over a large temperature range because it takes a lot of energy to disrupt all the covalent bonds at once. One example of a substance that shows covalent network bonding is diamond Figure 8. The strongest force between any two particles is the ionic bond, in which two ions of opposing charge are attracted to each other. Thus, ionic interactions An attraction due to ions of opposite charges. Substances that contain ionic interactions are relatively strongly held together, so these substances typically have high melting and boiling points. Sodium chloride Figure 8. Many substances that experience covalent bonding exist as discrete molecules. In many molecules, the electrons that are shared in a covalent bond are not shared equally between the two atoms in the bond. Typically, one of the atoms attracts the electrons more strongly than the other, leading to an unequal sharing of electrons in the bond. This idea is illustrated in Figure 8. The fluorine atom attracts the electrons in the bond more than the hydrogen atom does. The result is an unequal distribution of electrons in the bond, favoring the fluorine side of the covalent bond. A covalent bond that has an unequal sharing of electrons is called a polar covalent bond A covalent bond that has an unequal sharing of electrons.. A covalent bond that has an equal sharing of electrons, as in a covalent bond with the same atom on each side, is called a nonpolar covalent bond A covalent bond that has an equal sharing of electrons.. A molecule with a net unequal distribution of electrons in its covalent bonds is a polar A molecule with a net unequal distribution of electrons in its covalent bonds. HF is an example of a polar molecule. Because the fluorine atom has nine protons in its nucleus, it attracts the negatively charged electrons in the bond more than the hydrogen atom does with its one proton in its nucleus. Thus, electrons are more strongly attracted to the fluorine atom, leading to an imbalance in the electron distribution between the atoms. Such a bond is called a polar covalent bond. The charge separation in a polar covalent bond is not as extreme as is found in ionic compounds, but there is a related result: This type of intermolecular interaction is called a dipole-dipole interaction An attraction between polar molecules.. Many molecules with polar covalent bonds experience dipole-dipole interactions. The covalent bonds in some molecules are oriented in space in such a way that the bonds in the molecules cancel each other out. The individual bonds are polar, but the overall molecule is not polar; rather, the molecule is nonpolar. Such molecules experience little or no dipole-dipole interactions. As a result, such molecules experience little or no dipole-dipole interaction. Because of this strong interaction, hydrogen bonding A particularly strong type of dipole-dipole interaction caused by a hydrogen atom being bonded to a very electronegative element. The physical properties of water, which has two Oâ€”H bonds, are strongly affected by the presence of hydrogen bonding between water molecules. Finally, there are forces between all molecules that are caused by electrons being in different places in a molecule at any one time, which sets up a temporary separation of charge that disappears almost as soon as it appears. These are very weak intermolecular interactions and are called dispersion forces or London forces A force caused by the instantaneous imbalance of electrons about a molecule.. An alternate name is London dispersion forces. Molecules that experience no other type of intermolecular interaction will at least experience dispersion forces. Substances that experience only dispersion forces are typically soft in the solid phase and have relatively low melting points. Because dispersion forces are caused by the instantaneous distribution of electrons in a molecule, larger molecules with a large number of electrons can experience substantial dispersion forces. Examples include waxes, which are long hydrocarbon chains that are solids at room temperature because the molecules have so many electrons. The resulting dispersion forces between these molecules make them assume the solid phase at normal temperatures. The phase that a substance adopts depends on the type and magnitude of the intermolecular interactions the particles of a substance experience. If the intermolecular interactions are relatively strong, then a large amount of energyâ€”in terms of temperatureâ€”is necessary for a substance to change phases. If the intermolecular interactions are weak, a low temperature is all that is necessary to move a substance out of the solid phase. Example 1 What intermolecular forces besides dispersion forces, if any, exist in each substance? Are any of these substances solids at room temperature? Because ionic interactions are strong, it might be expected that potassium chloride is a solid at room temperature. Ethanol has a hydrogen atom attached to an oxygen atom, so it would experience hydrogen bonding. If the hydrogen bonding is strong enough, ethanol might be a solid at room temperature, but it is difficult to know for certain. Ethanol is actually a liquid at room temperature. Elemental bromine has two bromine atoms covalently bonded to each other. Because the atoms on either side of the covalent bond are the same, the electrons in the covalent bond are shared equally, and the bond is a nonpolar covalent bond. Thus, diatomic bromine does not have any intermolecular forces other than dispersion forces. It is unlikely to be a solid at room temperature unless the dispersion forces are strong enough. Bromine is a liquid at room temperature. Skill-Building Exercise What intermolecular forces besides dispersion forces, if any, exist in each substance?

8: Solids, Liquids, and Gases

Solids, liquids and gases The particle theory is used to explain the properties of solids, liquids and gases. The strength of bonds between particles is different in all three states.

Dilute solutions Dilute solutions Measured quantity: In adsorption, the measurable quantity is always a so called adsorption excess or Gibbs adsorption , whereas most theories of adsorption deal with adsorbed amount called just adsorption value or absolute adsorption - see below. However, in some cases - namely for gas or dilute solute adsorption - we may simplify considerations and assume that the measured quantity excess is the same as adsorbed amount. This assumption seems quite straightforward for gas adsorption, but it is not obvious for dilute solute adsorption. Basics of gas adsorption: First, lets consider gas adsorption: Measured quantity is surface excess - practically equal to true adsorption, a. It is due to typically low concentrations of gases in gas phase use Ideal Gas Law: In order to compare densities of surface and gas phase one may use densities of gas phase and adsorbed i. For ideal both phases - no lateral interactions, homogeneous surface: Monolayer part of multilayer adsorption of vapour gas below critical point: The most often used model is BET equation with quite simple multilayer factor. Basics of liquid adsorption: In the following it is assumed for simplicity, that the molecular sizes and molecular volumes are identical or similar. Otherwise the sum of nis may not be constant and equal to nms as it is implied below. In such a case, though the total occupied surface area is constant, the no. For adsorption in smaller pores, where the adsorption space has constant volume, the preferred way to deal with the problem may be using volume fractions instead of molar fractions. Now, lets look at binary liquid adsorption: The model picture click to enlarge shows an example of concentration profile C x of component "i" vs. The shaded area corresponds to the adsorption excess. For any multicomponent system we always have by definition: For ideal both phases - no lateral interactions, homogeneous surface - the composition of a surface phase for a binary liquid system in contact with solid surface is given by a classic Everett isotherm equation being a simple analogue of Langmuir equation , where the components are interchangeable i. Everett isotherm By simple rearrangement we get: This equation may be easily transformed into several linear forms, analogues of Langmuir or BET linear plots 2nd eq. Everett linear plot and Analogously, by simple rearrangement of original Everett eqn. We may use similarity of form of general integral equations for appropriately formulated isotherm for liquids and gases to find, that in such a case it is enough to replace gas pressure "p" by ratio of molar fractions in binary mixture to obtain respective isotherm for liquid adsorption. Then energy of gas adsorption E is replaced by the difference of adsorption energies of components "1" and "2" and distribution function of adsorption energy E is replaced by distribution of energy differences. I Basics of dilute solute adsorption: We may try to simplify respective equations for liquid mixtures by changing molar fractions to molar concentrations, most often used to express solute concentration in dilute solutions: Then, after substitution of x12l and x1s into the Everett equation we get a good approximation identical in form with the Langmuir isotherm for gas adsorption:

SOLIDS LIQUIDS AND GASES BASICS pdf

9: Water determination in solids, liquids, and gases in the chemical industry | Metrohm

Phases BASICS: SOLIDS, LIQUIDS, and GASES (and aqueous too) These charts must be in your head. Work at it. solid Particles are strongly attracted to each other, other than some vibration there is.

The four fundamental states Solid A crystalline solid: Brighter atoms are Sr and darker ones are Ti. Solid In a solid, constituent particles ions, atoms, or molecules are closely packed together. The forces between particles are so strong that the particles cannot move freely but can only vibrate. As a result, a solid has a stable, definite shape, and a definite volume. Solids can only change their shape by force, as when broken or cut. In crystalline solids , the particles atoms, molecules, or ions are packed in a regularly ordered, repeating pattern. There are various different crystal structures , and the same substance can have more than one structure or solid phase. Ice has fifteen known crystal structures, or fifteen solid phases, which exist at various temperatures and pressures. Solids can be transformed into liquids by melting, and liquids can be transformed into solids by freezing. Solids can also change directly into gases through the process of sublimation , and gases can likewise change directly into solids through deposition. Liquid Structure of a classical monatomic liquid. Atoms have many nearest neighbors in contact, yet no long-range order is present. Liquid A liquid is a nearly incompressible fluid that conforms to the shape of its container but retains a nearly constant volume independent of pressure. The volume is definite if the temperature and pressure are constant. When a solid is heated above its melting point , it becomes liquid, given that the pressure is higher than the triple point of the substance. Intermolecular or interatomic or interionic forces are still important, but the molecules have enough energy to move relative to each other and the structure is mobile. This means that the shape of a liquid is not definite but is determined by its container. The volume is usually greater than that of the corresponding solid, the best known exception being water, H2O. The highest temperature at which a given liquid can exist is its critical temperature. Gas molecules have very weak or no bonds at all. The molecules in "gas" can move freely and fast. Gas A gas is a compressible fluid. Not only will a gas conform to the shape of its container but it will also expand to fill the container. In a gas, the molecules have enough kinetic energy so that the effect of intermolecular forces is small or zero for an ideal gas , and the typical distance between neighboring molecules is much greater than the molecular size. A gas has no definite shape or volume, but occupies the entire container in which it is confined. A liquid may be converted to a gas by heating at constant pressure to the boiling point , or else by reducing the pressure at constant temperature. At temperatures below its critical temperature , a gas is also called a vapor , and can be liquefied by compression alone without cooling. A vapor can exist in equilibrium with a liquid or solid , in which case the gas pressure equals the vapor pressure of the liquid or solid. A supercritical fluid SCF is a gas whose temperature and pressure are above the critical temperature and critical pressure respectively. In this state, the distinction between liquid and gas disappears. A supercritical fluid has the physical properties of a gas, but its high density confers solvent properties in some cases, which leads to useful applications. For example, supercritical carbon dioxide is used to extract caffeine in the manufacture of decaffeinated coffee. This gives it the ability to conduct electricity. Plasma physics Like a gas, plasma does not have definite shape or volume. Unlike gases, plasmas are electrically conductive, produce magnetic fields and electric currents, and respond strongly to electromagnetic forces. Positively charged nuclei swim in a "sea" of freely-moving disassociated electrons, similar to the way such charges exist in conductive metal, where this electron "sea" allows matter in the plasma state to conduct electricity. A gas is usually converted to a plasma in one of two ways. Either from a huge voltage difference between two points, or by exposing it to extremely high temperatures. Heating matter to high temperatures causes electrons to leave the atoms, resulting in the presence of free electrons. This creates a so-called partially ionised plasma. At very high temperatures, such as those present in stars, it is assumed that essentially all electrons are "free", and that a very high-energy plasma is essentially bare nuclei swimming in a sea of electrons. This forms the so-called fully ionised plasma. The plasma state is often misunderstood, and although not freely existing under normal conditions on Earth, it is quite commonly generated by either lightning , electric sparks , fluorescent lights , neon lights or in plasma televisions. Phase transitions Main article: Phase transitions This diagram illustrates transitions between the four fundamental states of matter. A state of matter is also characterized by phase transitions. A phase transition indicates a change in structure and can be recognized by an abrupt change in properties. A distinct state of matter can be defined as any set of states distinguished from any other set of states by a phase transition. Water can be said to have several distinct solid states. Likewise, ferromagnetic states are demarcated by phase transitions and have distinctive properties. When the change of state occurs in stages the intermediate steps are called mesophases. Such phases have been exploited by the introduction of liquid crystal technology. Near absolute zero , a substance exists as a solid. As heat is added to this substance it melts into a liquid at its melting point , boils into a gas at its boiling point , and if heated high enough would enter a plasma state in which the electrons are so energized that they leave their parent atoms. Forms of matter that are not composed of molecules and are organized by different forces can also be considered different states of matter. Superfluids like Fermionic condensate and the quarkâ€”gluon plasma are examples. In a chemical equation, the state of matter of the chemicals may be shown as s for solid, l for liquid, and g for gas. An aqueous solution is denoted aq. Matter in the plasma state is seldom used if at all in chemical equations, so there is no standard symbol to denote it. In the rare equations that plasma is used in plasma is symbolized as p. Non-classical states Main article: Glass Schematic representation of a random-network glassy form left and ordered crystalline lattice right of identical chemical composition. Glass is a non-crystalline or amorphous solid material that exhibits a glass transition when heated towards the liquid state. Glasses can be made of quite different classes of materials: Thermodynamically, a glass is in a metastable state with respect to its crystalline counterpart. The conversion rate, however, is practically zero. Crystals with some degree of disorder A plastic crystal is a molecular solid with long-range positional order but with constituent molecules retaining rotational freedom; in an orientational glass this degree of freedom is frozen in a quenched disordered state. Similarly, in a spin glass magnetic disorder is frozen. Liquid crystal states Main article: Liquid crystal Liquid crystal states have properties intermediate between mobile liquids and ordered solids. Generally, they are able to flow like a liquid, but exhibiting long-range order. Like a crystalline solid, but unlike a liquid, liquid crystals react to polarized light. Other types of liquid crystals are described in the main article on these states. Several types have technological importance, for example, in liquid crystal displays. Magnetically ordered Transition metal atoms often have magnetic moments due to the net spin of electrons that remain unpaired and do not form chemical bonds. In some solids the magnetic moments on different atoms are ordered and can form a ferromagnet, an antiferromagnet or a ferrimagnet. In a ferromagnet â€”for instance, solid iron â€”the magnetic moment on each atom is aligned in the same direction within a magnetic domain. If the domains are also aligned, the solid is a permanent magnet , which is magnetic even in the absence of an external magnetic field. An antiferromagnet has two networks of equal and opposite magnetic moments, which cancel each other out so that the net magnetization is zero. For example, in nickel II oxide NiO , half the nickel atoms have moments aligned in one direction and half in the opposite direction. In a ferrimagnet , the two networks of magnetic moments are opposite but unequal, so that cancellation is incomplete and there is a non-zero net magnetization. A quantum spin liquid QSL is a disordered state in a system of interacting quantum spins which preserves its disorder to very low temperatures, unlike other disordered states. It is not a liquid in physical sense, but a solid whose magnetic order is inherently disordered. The name "liquid" is due to an analogy with the molecular disorder in a conventional liquid. A QSL is neither a ferromagnet , where magnetic domains are parallel, nor an antiferromagnet , where the magnetic domains are antiparallel; instead, the magnetic domains are randomly oriented. This can be realized e. When cooling down and settling to a state, the domain must "choose" an orientation, but if the possible states are similar in energy, one will be chosen randomly. Consequently, despite strong short-range order, there is no long-range magnetic order. Copolymer SBS block copolymer in TEM Copolymers can undergo microphase separation to form a diverse array of periodic nanostructures, as shown in the example of the styrene-butadiene-styrene block copolymer shown at right. Microphase separation can be understood by analogy to the phase separation between oil and water. Due to chemical incompatibility between the blocks, block copolymers undergo a similar phase separation. However, because the blocks are covalently bonded to each other, they cannot demix macroscopically as water and oil can, and so instead the blocks form nanometer -sized structures. Depending on the relative lengths of each block and the overall block topology of the polymer, many morphologies can be obtained, each its own phase of matter. Ionic liquids also display microphase separation. The anion and cation are not necessarily compatible and would demix otherwise, but electric charge attraction prevents them from separating. Their anions and cations appear to diffuse within compartmentalized layers or micelles instead of freely as in a uniform liquid. Superfluid Close to absolute zero, some liquids form a second liquid state described as superfluid because it has zero viscosity or infinite fluidity; i. This was discovered in for helium , which forms a superfluid below the lambda temperature of 2.

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