What is the difference between homogeneous and heterogeneous mixture class 9

Learning Objectives Explain the difference between a pure substance and a mixture. Explain the difference between an element and a compound. Explain the difference between a homogeneous mixture and a heterogeneous mixture. One useful way of organizing our understanding of matter is to think of a hierarchy that extends down from the most general and complex to the simplest and most fundamental (Figure \(\PageIndex{1}\)). Matter can be classified into two broad categories: pure substances and mixtures. A pure substance is a form of matter that has a constant composition (meaning that it is the same everywhere) and properties that are constant throughout the sample (meaning that there is only one set of properties such as melting point, color, boiling point, etc. throughout the matter). A material composed of two or more substances is a mixture. Elements and compounds are both examples of pure substances. A substance that cannot be broken down into chemically simpler components is an element. Aluminum, which is used in soda cans, is an element. A substance that can be broken down into chemically simpler components (because it has more than one element) is a compound. For example, water is a compound composed of the elements hydrogen and oxygen. Today, there are about 118 elements in the known universe. In contrast, scientists have identified tens of millions of different compounds to date. Figure \(\PageIndex{1}\): Relationships between the Types of Matter and the Methods Used to Separate Mixtures Ordinary table salt is called sodium chloride. It is considered a substance because it has a uniform and definite composition. All samples of sodium chloride are chemically identical. Water is also a pure substance. Salt easily dissolves in water, but salt water cannot be classified as a substance because its composition can vary. You may dissolve a small amount of salt or a large amount into a given amount of water. A mixture is a physical blend of two or more components, each of which retains its own identity and properties in the mixture. Only the form of the salt is changed when it is dissolved into water. It retains its composition and properties. A homogeneous mixture is a mixture in which the composition is uniform throughout the mixture. The salt water described above is homogeneous because the dissolved salt is evenly distributed throughout the entire salt water sample. Often it is easy to confuse a homogeneous mixture with a pure substance because they are both uniform. The difference is that the composition of the substance is always the same. The amount of salt in the salt water can vary from one sample to another. All solutions are considered homogeneous because the dissolved material is present in the same amount throughout the solution. A heterogeneous mixture is a mixture in which the composition is not uniform throughout the mixture. Vegetable soup is a heterogeneous mixture. Any given spoonful of soup will contain varying amounts of the different vegetables and other components of the soup. Phase A phase is any part of a sample that has a uniform composition and properties. By definition, a pure substance or a homogeneous mixture consists of a single phase. A heterogeneous mixture consists of two or more phases. When oil and water are combined, they do not mix evenly, but instead form two separate layers. Each of the layers is called a phase. Example \(\PageIndex{1}\) Identify each substance as a compound, an element, a heterogeneous mixture, or a homogeneous mixture (solution). filtered tea freshly squeezed orange juice a compact disc aluminum oxide, a white powder that contains a 2:3 ratio of aluminum and oxygen atoms selenium Given: a chemical substance Asked for: its classification Strategy: Decide whether a substance is chemically pure. If it is pure, the substance is either an element or a compound. If a substance can be separated into its elements, it is a compound. If a substance is not chemically pure, it is either a heterogeneous mixture or a homogeneous mixture. If its composition is uniform throughout, it is a homogeneous mixture. Solution A) Tea is a solution of compounds in water, so it is not chemically pure. It is usually separated from tea leaves by filtration. B) Because the composition of the solution is uniform throughout, it is a homogeneous mixture. A) Orange juice contains particles of solid (pulp) as well as liquid; it is not chemically pure. B) Because its composition is not uniform throughout, orange juice is a heterogeneous mixture. A) A compact disc is a solid material that contains more than one element, with regions of different compositions visible along its edge. Hence, a compact disc is not chemically pure. B) The regions of different composition indicate that a compact disc is a heterogeneous mixture. A) Aluminum oxide is a single, chemically pure compound. A) Selenium is one of the known elements. Exercise \(\PageIndex{1}\) Identify each substance as a compound, an element, a heterogeneous mixture, or a homogeneous mixture (solution). white wine mercury ranch-style salad dressing table sugar (sucrose) Answer a: homogeneous mixture (solution) Answer b: element Answer c: heterogeneous mixture Answer d: compound Example \(\PageIndex{2}\) How would a chemist categorize each example of matter? saltwater soil water oxygen Solution Saltwater acts as if it were a single substance even though it contains two substances—salt and water. Saltwater is a homogeneous mixture, or a solution. Soil is composed of small pieces of a variety of materials, so it is a heterogeneous mixture. Water is a substance. More specifically, because water is composed of hydrogen and oxygen, it is a compound. Oxygen, a substance, is an element. Exercise \(\PageIndex{2}\) How would a chemist categorize each example of matter? Answer a: a homogeneous mixture (solution), assuming it is filtered coffee Answer b: element Answer c: heterogeneous mixture Matter can be classified into two broad categories: pure substances and mixtures. A pure substance is a form of matter that has a constant composition and properties that are constant throughout the sample. Mixtures are physical combinations of two or more elements and/or compounds. Mixtures can be classified as homogeneous or heterogeneous. Elements and compounds are both examples of pure substances. Compounds are substances that are made up of more than one type of atom. Elements are the simplest substances made up of only one type of atom. Vocabulary Element: a substance that is made up of only one type of atom. Compound:a substance that is made up of more than one type of atom bonded together. Mixture: a combination of two or more elements or compounds which have not reacted to bond together; each part in the mixture retains its own properties. Substance formed when two or more constituents are physically combined together For other uses, see Mixture (disambiguation). In chemistry, a mixture is a material made up of two or more different substances which are not chemically combined.[1] A mixture is the physical combination of two or more substances in which the identities are retained and are mixed in the form of solutions, suspensions and colloids.[2][3] Mixtures are one product of mechanically blending or mixing chemical substances such as elements and compounds, without chemical bonding or other chemical change, so that each ingredient substance retains its own chemical properties and makeup.[4] Despite the fact that there are no chemical changes to its constituents, the physical properties of a mixture, such as its melting point, may differ from those of the components. Some mixtures can be separated into their components by using physical (mechanical or thermal) means. Azeotropes are one kind of mixture that usually poses considerable difficulties regarding the separation processes required to obtain their constituents (physical or chemical processes or, even a blend of them).[5][6][7] Characteristics of mixtures Mixtures can be characterized by being separable by mechanical means e.g. heat, filtration, gravitational sorting, centrifugation etc.[8] Mixtures can be either homogeneous or heterogeneous': a mixture in which constituents are distributed uniformly is called homogeneous, such as salt in water, otherwise it is called heterogeneous, such as sand in water. One example of a mixture is air. Air is a homogeneous mixture of the gaseous substances nitrogen, oxygen, and smaller amounts of other substances. Salt, sugar, and many other substances dissolve in water to form homogeneous mixtures. A homogeneous mixture in which there is both a solute and solvent present is also a solution. Mixtures can have any amounts of ingredients. Mixtures are unlike chemical compounds, because: The substances in a mixture can be separated using physical methods such as filtration, freezing, and distillation. There is little or no energy change when a mixture forms (see Enthalpy of mixing). Mixtures have variable compositions, while compounds have a fixed, definite formula. When mixed, individual substances keep their properties in a mixture, while if they form a compound their properties can change.[9] The following table shows the main properties of the three families of mixtures and examples of the three types of mixture. Mixtures Table Dispersion medium (mixture phase) Dissolved or dispersed phase Solution Colloid Suspension (coarse dispersion) Gas Gas Gas mixture: air (oxygen and other gases in nitrogen) None None Liquid None Liquid aerosol:[10] fog, mist, vapor, hair sprays Spray Solid None Solid aerosol:[10] smoke, ice cloud, air particulates Dust Liquid Gas Solution: oxygen in water Liquid foam: whipped cream, shaving cream Sea foam, beer head Liquid Solution: alcoholic beverages Emulsion: milk, mayonnaise, hand cream Vinaigrette Solid Solution: sugar in water Liquid sol: pigmented ink, blood Suspension: mud (soil, clay or silt particles are suspended in water), chalk powder suspended in water Solid Gas Solution: hydrogen in metals Solid foam: aerogel, styrofoam, pumice Foam: dry sponge Liquid Solution: amalgam (mercury in gold), hexane in paraffin wax Gel: agar, gelatin, silicagel, opal Wet sponge Solid Solution: alloys, plasticizers in plastics Solid sol: cranberry glass Clay, silt, sand, gravel, granite Homogeneous and heterogeneous mixtures In chemistry, if the volume of a homogeneous suspension is divided in half, the same amount of material is suspended in both halves of the substance. An example of a homogeneous mixture is air. In physical chemistry and materials science this refers to substances and mixtures which are in a single phase. This is in contrast to a substance that is heterogeneous.[11] A diagram representing at the microscopic level the differences between homogeneous mixtures, heterogeneous mixtures, compounds, and elements Solution A solution is a special type of homogeneous mixture where the ratio of solute to solvent remains the same throughout the solution and the particles are not visible with the naked eye, even if homogenized with multiple sources. In solutions, solutes will not settle out after any period of time and they can't be removed by physical methods, such as a filter or centrifuge.[12] As a homogeneous mixture, a solution has one phase (solid, liquid, or gas), although the phase of the solute and solvent may initially have been different (e.g., salt water). Gases Air can be more specifically described as a gaseous solution (oxygen and other gases dissolved in the major component, nitrogen). Since interactions between molecules play almost no role, dilute gases form trivial solutions. In part of the literature, they are not even classified as solutions. In gas, intermolecular space is the greatest—and intermolecular force of attraction is least. Some examples can be oxygen, hydrogen, or nitrogen.air can be more specifically described as a gases Distinguishing between mixture types Making a distinction between homogeneous and heterogeneous mixtures is a matter of the scale of sampling. On a coarse enough scale, any mixture can be said to be homogeneous, if the entire article is allowed to count as a "sample" of it. On a fine enough scale, any mixture can be said to be heterogeneous, because a sample could be as small as a single molecule. In practical terms, if the property of interest of the mixture is the same regardless of which sample of it is taken for the examination used, the mixture is homogeneous. Gy's sampling theory quantitatively defines the heterogeneity of a particle as:[13] h i = (c i − c batch) m i c batch m aver , {\displaystyle h_{i}={\frac {(c_{i}-c_{\text{batch}})m_{i}}{c_{\text{batch}}m_{\text{aver}}}},} where h i {\displaystyle h_{i}} , c i {\displaystyle c_{i}} , c batch {\displaystyle c_{\text{batch}}} , m i {\displaystyle m_{i}} , and m aver {\displaystyle m_{\text{aver}}} are respectively: the heterogeneity of the i {\displaystyle i} th particle of the population, the mass concentration of the property of interest in the i {\displaystyle i} th particle of the population, the mass concentration of the property of interest in the population, the mass of the i {\displaystyle i} th particle in the population, and the average mass of a particle in the population. During sampling of heterogeneous mixtures of particles, the variance of the sampling error is generally non-zero. Pierre Gy derived, from the Poisson sampling model, the following formula for the variance of the sampling error in the mass concentration in a sample: V = 1 (∑ i = 1 N q i m i) 2 ∑ i = 1 N q i (1 − q i) m i 2 (a i − ∑ j = 1 N q j a j m j ∑ j = 1 N q j m j) 2 , {\displaystyle V={\frac {1}{(\sum _{i=1}^{N}q_{i}m_{i})^{2}}}\sum _{i=1}^{N}q_{i}(1-q_{i})m_{i}^{2}\left(a_{i}-{\frac {\sum _{j=1}^{N}q_{j}a_{j}m_{j}}{\sum _{j=1}^{N}q_{j}m_{j}}}\right)^{2},} in which V is the variance of the sampling error, N is the number of particles in the population (before the sample was taken), q i is the probability of including the ith particle of the population in the sample (i.e. the first-order inclusion probability of the ith particle), m i is the mass of the ith particle of the population and a i is the mass concentration of the property of interest in the ith particle of the population. The above equation for the variance of the sampling error is an approximation based on a linearization of the mass concentration in a sample. In the theory of Gy, correct sampling is defined as a sampling scenario in which all particles have the same probability of being included in the sample. This implies that q i no longer depends on i, and can therefore be replaced by the symbol q. Gy's equation for the variance of the sampling error becomes: V = 1 − q q M batch 2 ∑ i = 1 N m i 2 (a i − a batch) 2 , {\displaystyle V={\frac {1-q}{qM_{\text{batch}}^{2}}}\sum _{i=1}^{N}m_{i}^{2}\left(a_{i}-a_{\text{batch}}\right)^{2},} where abatch is that concentration of the property of interest in the population from which the sample is to be drawn and Mbatch is the mass of the population from which the sample is to be drawn. 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