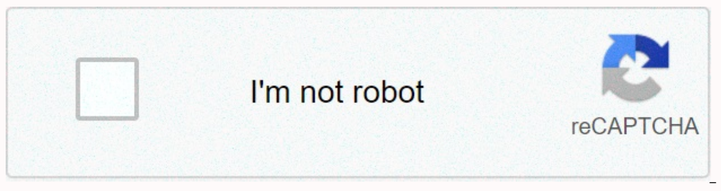

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Physical and chemical properties worksheet answers

At the end of this section you will be able to: Identify properties and changes in matter as physical or chemical Identify properties of matter as extensive or intense The properties that allow us to distinguish one substance from another called properties. A physical property is a characteristic of matter that is not associated with a change in its chemical composition. Familiar examples of physical properties are density, color, hardness, melting and boiling points, and electrical conductivity. We can observe certain physical characteristics, such as density and color, without changing the physical state of the observed matter. Other physical properties, such as the melting temperature of iron or the freezing temperature of the water, can only be observed because matter undergoes a physical change. A physical change is a change in the state or properties of matter without any accompanying change in its chemical composition (the identities of the substances included in the matter). We observe a physical change when wax melts, when sugar dissolves in coffee, and when steam condenses into liquid water (Figure 1). Other examples of physical changes include magnetizing and demagtiizing metals (made with common antitheft safety tags) and grinding solids into powders (which can sometimes cause noticeable color changes). In each of these examples there is a change in the physical state, shape or properties of the substance, but no change in its chemical composition. Figure 1. (a) Wax undergoes a physical change when solid wax is heated to form liquid wax. (b) Steam condensing inside a cooking pot is a physical change, as water vapor changes to liquid water. (credit a: change of work by 95jb14/Wikimedia Commons; credit b: change of work by mjneuby/Flickr) The change of one type of matter to another type (or the inability to change) is a chemical property. Examples of chemical properties are flammability, toxicity, acidity, reactivity (many types), and combustion heat. Iron, for example, combines with oxygen in the presence of water to form rust; chromium does not oxidize (Figure 2). Nitroglycerin is very dangerous because it explodes easily; neon poses almost no danger because it is very unactive. Figure 2. a One of the chemical properties of iron is that it rusts; (b) one of the chemical properties of chromium is that it does not. (credit a: change of work by Tony Hisgett; credit b: change of work of Atoma/Wikimedia Commons) To identify a chemical property, we are looking for a chemical change. A chemical change always produces one or more types of matter that differ from the case present before the change. The formation of rust is a chemical change because rust is a different type of matter than iron, oxygen and water that exists before rust is formed. The explosion of is a chemical change because the gases produced are very different kinds of matter from the original substance. Other examples of chemical changes are reactions performed in a lab (such as copper reacts with nitric acid), all forms of burning (burning), and food cooked, digested, or rotting (Figure 3). Figure 3. (a) copper and nitric acid undergo a chemical change to form copper nitrate and brown, gaseous nitrogen dioxide; (b) During the combustion of a match, cellulose in the match and oxygen from the air undergo a chemical change to form carbon dioxide and water vapour. (c) Cooking red meat causes a number of chemical changes, including oxidation of iron in myoglobin resulting in the familiar red-to-brown color change. (d) A banana that turns brown is a chemical change in the formation of new, darker (and less tasty) substances. (credit b: change of work by Jeff Turner; credit c: change of work by Gloria Cabada-Leman; credit d: change of work by Roberto Verzo) Properties of matter fall into one of two categories. If the property depends on the amount of matter present, it is an extensive property. The mass and volume of a substance are examples of extensive properties; for example, a gallon of milk has a greater mass and volume than a cup of milk. The value of a large property is directly proportional to the amount of matter in question. If the property of a sample of matter does not depend on the amount of matter present, it is an intense property. Temperature is an example of an intense property. If the gallon and cup of milk are each at 20 °C (room temperature), when combined, the temperature remains at 20 °C. As another example, consider the distinct but related properties of heat and temperature. A drop of hot cooking oil sprinkled on the arm causes short, less discomfort, while a pot of hot oil produces severe burns. Both drop and pot with oil are at the same temperature (an intense property), but the pot clearly contains much more heat (extensive property). You may have seen the symbol shown in Figure 4 on containers of chemicals in a laboratory or workplace. Sometimes called a fire diamond or danger diamond, this chemical danger diamond provides valuable information that briefly sums up the various dangers of being aware of when working with a particular substance. Figure 4. The National Fire Protection Agency (NFPA) hazard diamond summarizes the major risks of a chemical substance. The National Fire Protection Agency (NFPA) 704 Hazard Identification System was developed by the NFPA to provide safety information on certain substances. The system details flammability, reactivity, health, and other dangers. Within the overall diamond symbol, the top (red) diamond indicates the fire risk level (flashpoint temperature range). The blue (left) diamond health risk level. The yellow (right) diamond describes the risk of reactivity, such as how easily the substance will undergo detonation or a violent chemical change. The white (bottom) diamond points out particular dangers, such as whether it is an oxidizer (which causes the substance to burn in the absence of air /oxygen), undergoes an unusual or dangerous reaction with water, is corrosive, acidic, alkaline, a biological hazard, radioactive, and so on. Each hazard is rated on a scale of 0 to 4, with 0 is no danger and 4 is extremely dangerous. While many elements differ dramatically in their chemical and physical properties, some elements have similar properties. We can identify sets of elements that exhibit common behaviors. For example, many elements lead heat and electricity well, while others are bad conductors. These properties can be used to sort the elements into three classes: metals (elements that conduct good), nonmetals (elements that conduct poorly), and metalloids (elements that have properties of both metals and nonmetals). The periodic table is a system of elements that place elements with similar characteristics close to each other (Figure 4). You will learn more about the periodic table as you continue your study of chemistry. Figure 4. The periodic table shows how elements can be grouped by certain similar properties. Note the background color denotes whether an element is a metal, metalloid, or non-metal, while the element symbol color indicates whether it is a solid, liquid, or gas. All substances have distinct physical and chemical properties, and can undergo physical or chemical changes. Physical properties, such as hardness and boiling point, and physical changes, such as melting or freezing, do not imply a change in the composition of matter. Chemical properties, such flammability and acidity, and chemical changes, such as roasting, involve the production of matter that is different from that found in advance. Measurable properties fall into one of two categories. Extensive properties depend on the amount of matter present, such as the mass of gold. Intense properties do not depend on the amount of matter present, such as the density of gold. Heating is an example of an extensive property, and the temperature is an example of an intense property. Chemistry Chapter exercises Classify the six underlined properties in the following paragraph as chemical or physical: Fluoride is a pale yellow gas that reacts with most substances. The free element melts at −220 °C and boils at −188 °C. Finely divided metals burn in fluoride with a light flame. Nineteen grams of fluoride will react with 1.0 grams of hydrogen. Classify each of the following changes as physical or chemical: (a) condensation of steam (b) burning of gasoline (c) acidification of milk (d) dissolution of sugar in water (e) melting of gold Class of the following changes as physical or chemical: (a) coal burning (b) ice melting (c) mixture of chocolate syrup with milk (d) explosion of a firecracker (e) excitation of a screwdriver The volume of a sample of oxygen gas changed from 10 mL to 11 mL as the temperature changed. Is this a chemical or physical change? A 2.0-liter volume of hydrogen combined with 1.0 liters of oxygen gas to produce 2.0 liters of water vapor. Is oxygen undergoing chemical or physical change? Explain the difference between extensive properties and intense properties. Identify the following properties as either extensive or intense. (a) volume (b) temperature (c) humidity (d) heat (e) boiling point The density of a substance (d) is an intense characteristic defined as the ratio of its mass (m) to its volume (V). [latex]\text{density}= \frac{\text{mass}}{\text{volume}}[/latex] [latex]\text{d} = \frac{\text{m}}{\text{V}}[/latex] Given that mass and volume are both extensive properties, explain why their relationship, density, is intense. chemical change change produces a different type of matter from the original type of matter chemical property behavior that is related to the change of one type of matter to another type of matter involving the property of a substance that depends on the amount of the substance intense property of a substance that is independent of the amount of the substance physical change in the state or properties of matter that does not involve a change in its chemical composition physical property that is characteristic of matter that is not associated with any change in its chemical composition