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where it is more concentrated to less concentrated, filtration uses a hydrostatic pressure gradient to push the fluid—and the solutes within it—from a higher pressure area to a lower pressure area. The most common unit of concentration is molarity, which is also the most useful for calculations involving the stoichiometry of reactions in solution. 0.182 M, d. 0.489 mol of NiSO4 in 600 mL of solution 1.045 mol of magnesium bromide in 500 mL of solution 0.146 mol of glucose in 800 mL of solution 0.479 mol of CaCl2 in 700 mL of solution What is the concentration of each species present in the following aqueous solutions? As meals are eaten, this triggers a rise in blood glucose that is counteracted by the secretion of insulin. Solutions of known concentration can be prepared either by dissolving a known mass of solute in a solvent and diluting to a desired final volume or by diluting the appropriate volume of a more concentrated solution (a stock solution) to the desired final volume. This hormone then travels to the distal tubules or collecting ducts of the kidneys, causing fluid to be retained and urine output to be reduced. Note that the volume of the solvent is not specified. The equivalent value of (NH4)2Cr2O7 can then be calculated by dividing 1.43 M by 4.29 M, yielding 0.333 equivalents. An effector is any organ or tissue that receives information from the integrating center and acts to bring about the changes needed to maintain homeostasis. The cell membrane provides a barrier around the cell, separating its internal components from the extracellular environment. For example, the hypothalamus can change the body's temperature set point, such as raising it during a fever to help fight an infection. Solutes are soluble or insoluble, meaning they dissolve or do not dissolve in a particular solvent. Both internal and external events can induce negative feedback mechanisms. Important physiological electrolytes include Na+, K+, Ca2+, Mg2+, and Cl−. (Gaseous solutes already have their constituent particles separated, but the concept of being surrounded by solvent particles still applies.) This process is called solvation and is illustrated in Figure 7.2. When the solvent is water, the word hydration, rather than solvation, is used. Water also can move freely across the cell membrane of all cells, either through protein channels or by slipping between the lipid tails of the membrane itself. 0.324 mol of K2MoO4 in 250 mL of solution 0.528 mol of potassium formate in 300 mL of solution 0.477 mol of KClO3 in 900 mL of solution 0.378 mol of potassium iodide in 750 mL of solution What is the molar concentration of each solution? Retrieved on Dec 31st, 2018 from Kahn Academy (2019) Homeostasis. Disease is any failure of normal physiological function that leads to negative symptoms. 93.57 g d. In order to deal with these climatic conditions, humans have developed physiologic and cultural modes of adaptation. Quantitatively, the concentration of a solution describes the quantity of a solute that is contained in a particular quantity of that solution. It also denotes 1/100th (from L. Osmotic pressure is a measure of the tendency of water to move into one solution from another by osmosis. Concentrations of these contaminants are typically very low in treated and natural waters, and their levels cannot exceed relatively low concentration thresholds without causing adverse effects on health and wildlife. When a molecule has multiple different effects on the body, these multiple effects are called pleiotropic effects. Heat is mainly produced by the liver and muscle contractions. 150 mL of a 0.769 M solution a. For more dilute solutions, parts per million (106 ppm) and parts per billion (109; ppb) are used. Available at: Open Textbooks for Hong Kong. If the concentrations were different, say one was given in Molarity and the other in percent or one was in Molarity and the other was in Millimolarity, one of the terms would need to be converted so that they match. That way, the units will cancel out and leave you with units of volume, in this case. Molecules (or ions) will spread/diffuse from where they are more concentrated to where they are less concentrated until they are equally distributed in that space. In addition, the density of water is 1.0 g/mL or 1.0 mg/0.001 mL which makes the conversion between the two units easier. This produces the active component, Thrombin IIa which has multiple effects. First, it cleaves the protein Fibrinogen to produce Fibrin. Another example is a spoonful of sugar placed in a cup of tea. 1.40 L of a 0.334 M solution or 1.10 L of a 0.420 M solution 25.0 mL of a 0.134 M solution or 10.0 mL of a 0.295 M solution 250 mL of a 0.489 M solution or 150 mL of a 0.769 M solution Complete the following table for 500 mL of solution. The sodium-potassium pump is found in many cell (plasma) membranes. Solutes that dissolve into individual neutral molecules without dissociation do not impart additional electrical conductivity to their solutions and are called nonelectrolytes. Molarity, defined as the number of moles of solute per liter of solution, is a common concentration unit in the chemistry laboratory. The control of this necessary but potentially toxic substance is an important part of many aspects of human health and disease. Because of this property, soluble ionic compounds are referred to as electrolytes. 12.8 g of sodium hydrogen sulfate in 400 mL of solution 7.5 g of potassium hydrogen phosphate in 250 mL of solution 11.4 g of barium chloride in 350 mL of solution 4.3 g of tartaric acid (C4H6O6) in 250 mL of solution Give the concentration of each reactant in the following equations, assuming 20.0 g of each and a solution volume of 250 mL for each reactant. Similarly, solutions can also be made by mixing two compatible liquids together. Many ionic compounds are soluble in water, however, not all ionic compounds are soluble. Homogeneous mixtures can be further broken down into two classifications: Colloids and Solutions. Glucagon signaling activates the liver to begin breaking down the glycogen storage molecule into free glucose. The movement of water molecules is not itself regulated by cells, so it is important that cells are exposed to an environment in which the concentration of solutes outside of the cells (in the extracellular fluid) is equal to the concentration of solutes inside the cells (in the cytoplasm). The sensors, integrating center, and effectors are the basic components of every homeostatic response. Diluting a stock solution is preferred when making solutions of very weak concentrations, because the alternative method, weighing out tiny amounts of solute, can be difficult to carry out with a high degree of accuracy. To resolve this, a specialized carrier protein called the glucose transporter will transfer glucose molecules into the cell to facilitate its inward diffusion. BaCl2(aq) + Na2SO4(aq) → Ca(OH)2(aq) + H3PO4(aq) → Al(NO3)3(aq) + H2SO4(aq) → Pb(NO3)2(aq) + CuSO4(aq) → Al(CH3CO2)3(aq) + NaOH(aq) → An experiment required 200.0 mL of a 0.330 M solution of Na2CrO4. Answer a) NH3 is a weak base, which means that some of the molecules will accept a proton from water molecules causing them to dissociate into H+ and -OH ions. The H+ ion will associate with the NH3 to form NH4+. Thus this would look the most like beaker #2. In effect, the solute is drawing the water out of the cell. Supersaturated solutions are solutions that have dissolved solute beyond the normal saturation point. Endocytosis is a form of active transport in which a cell envelops extracellular materials using its cell membrane. Much of what we drink—for example, soda, coffee, tea, and milk are solutions. This Figure is adapted from: MPT-Matthew Many parameters are regulated within the body within a narrow homeostatic window to maintain proper functioning and balance within biological systems. In mild hypothermia there is shivering and mental confusion. In this section, we will cover the most common ways of presenting solution concentration. These include: Molarity and Parts Per Solutions. Anyone who has made instant coffee or lemonade knows that too much powder gives a strongly flavored, highly concentrated drink, whereas too little results in a dilute solution that may be hard to distinguish from water. Figure 8.10 Preparation of a Solution of Known Concentration by Diluting a Stock Solution. (2010). However, there are two NH4+ ions per formula unit, so the concentration of NH4+ ions is 2 × 1.43 M = 2.86 M. Dilute solutions may be expressed in milliequivalents (mEq)—for example, human blood plasma has a total concentration of about 150 mEq/L. Severe heart failure can be fatal. Channel proteins are less selective than carrier proteins, and usually mildly discriminate between their cargo based on size and charge. (Back to the Top) 8.2 Disease as a Homeostatic Imbalance What Is Disease? Find the concentration of each species by multiplying the number of each ion by the molarity of the solution. Core body temperature is maintained at a normal setpoint of 37°C. If the core temperature rises above (right hand side) or drops below (left hand side) the setpoint, internal biological responses are initiated to return the core temperature back to the setpoint range. For quantitative treatment of this type of solutions, we will devote a unit to gases. If a mouthwash has a phenol concentration of 1.5 g per 100 mL of solution, what is the molarity of phenol? Iron, a required component of hemoglobin, is endocytosed by red blood cells in this way. Figure 8.8: Preparation of a Solution of Known Concentration Using a Solid Solute. Why or why not? For example, the circulatory system uses filtration to move plasma and substances across the endothelial lining of capillaries and into surrounding tissues, supplying cells with the nutrients. If you live near a lake, a river, or an ocean, that body of water is not pure H2O but most probably a solution. For example, the EPA has identified the maximum safe level of fluoride ion in tap water to be 4 ppm. Silver, gold, and copper form many different alloys with unique colors and appearances. If 1 mol of NaCl and 1 mol of CaCl2 dissolve in a solution, there is 1 equiv Na, 2 equiv Ca, and 3 equiv Cl in that solution. Up to 10% of the volume in liver cells is in the form of glycogen. When making a percent solution, it is important to indicate what units are being used, so that others can also make the solution properly. There are many other solutes that must undergo facilitated diffusion to move into a cell, such as amino acids, or to move out of a cell, such as wastes. 8.7 g of calcium bromide in 250 mL of solution 9.8 g of lithium sulfate in 300 mL of solution 12.4 g of sucrose (C12H22O11) in 750 mL of solution 14.2 g of iron(III) nitrate hexahydrate in 300 mL of solution What is the molar concentration of each solution? Often, the solubility in water is expressed in gram/100 mL. These are then expelled as urine. centesimus) as in centimeter and the monetary unit cent. Thus alcohols are nonelectrolytes B The only solute species in solution is therefore (CH3)2CHOH molecules, so [(CH3)2CHOH] = 3.7 M 3. 0.032 M In(NO3)3 A Indium nitrate is an ionic compound that contains In3+ ions and NO3− ions, so we expect it to behave like a strong electrolyte in aqueous solution B One formula unit of In(NO3)3 produces one In3+ ion and three NO3− ions, so a 0.032 M In(NO3)3 solution contains 0.032 M In3+ and 3 × 0.032 M = 0.096 M NO3−—that is, [In3+] = 0.032 M and [NO3−] = 0.096 M (Back to the Top) 8.8 Movement of Molecules Across the Membrane One of the great wonders of the cell membrane is its ability to regulate the concentration of substances inside the cell. The terms miscible and immiscible, instead of soluble and insoluble, are used for liquid solutes and solvents. In order to understand how substances move passively across a cell membrane, it is necessary to understand concentration gradients and diffusion. One useful classification of materials is polarity. All of us have a qualitative idea of what is meant by concentration. Like other ionic compounds, it is a strong electrolyte that dissociates in aqueous solution to give hydrated NH4+ and Cr2O72− ions. If we consider this this solution mathematically, we can see that for every ammonium dichromate molecule that dissolves, there will be three resulting ions that form (the two NH4+ ions and the one Cr2O72− ion). This can also be thought of on a larger molar scale. When 1 mole of (NH4)2Cr2O7 is dissolved, it results in 3 moles of ions (1 mol of Cr2O72− anions and 2 mol of NH4+ cations) within the solution (Figure 8.11). To discuss the relationship between the concentration of a solution and the resulting number of ions, the term equivalents is used. Many chemical reactions are carried out in solutions, and solutions are also closely related to our everyday lives. CH3CO2H NaCl Na2S Na3PO4 acetaldehyde Would you expect a 1.0 M solution of CaCl2 to be a better conductor of electricity than a 1.0 M solution of NaCl? (Water molecules are omitted from a molecular view of the solution for clarity.) When we carry out a chemical reaction using a solution of a salt such as ammonium dichromate, we need to know the concentration of each ion present in the solution. Therefore, if the cell needs sodium ions, all it has to do is open a passive sodium channel, as the concentration gradient of the sodium ions will drive them to diffuse into the cell. This figure has been modified from: EEOC and Wikimedia Commons. If the concentration of solutes of the cell matches that of the extracellular fluid, there will be no net movement of water into or out of the cell. An alternative way to define the concentration of a solution is molality, abbreviated m. As Na+ is reabsored, water is reabsorbed as well. This leads to high blood pressure and enlargement of the heart, which eventually becomes too stiff to pump blood effectively, resulting in heart failure. Figure is by: Shannan Muskopf from Biologycorner.com In between meals or during times of fasting, blood glucose levels begin to drop. This activates the pancreas to secrete a different hormone, called glucagon. Water is reabsorbed with the Na+ causing an increase in fluid retention and decreased urine output. When blood sugar levels become too high, insulin is released from the pancreas. All substances that move through the membrane do so by one of two general methods, which are categorized based on whether or not energy is required. The kidneys are responsible for regulating blood water levels, re-absorption of substances into the blood, maintenance of salt and ion levels in the blood, regulation of blood pH, and excretion of urea and other waste products. Acetic acid (CH3COOH), the compound in vinegar, is a weak electrolyte. Instead it will remain precipitated as a solid at the bottom of the solution. Thus, one can often tell that a solution is saturated if extra solute is present (this can exist as another phase, such as gas, liquid, or solid). Three Forms of Endocytosis.







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