<u>Chapter 1 matter and change worksheet answers</u>





## Chapter 1 matter and change worksheet answers

By the end of this section, you will be able to: to express concentrations of solution components using the fraction of Mole and the Molality describe the effect of soluto concentration on various solution properties (steam pressure, boiling point, point freezing and osmotic pressure) perform calculations using the mathematical equations that describe these various collective effects describe the distillation process and its practical applications to explain the process of osmosis and describe how industrially and in nature the properties of a solution is different from those of pure solute or solvent. Many solution properties depend on the chemical identity of the solute. Compared to pure water, a hydrogen chloride solution is more acid, a solution of solute species, regardless of their identities. These colligative properties include lowering steam pressure, boiling point elevation, freezing point depression and osmotic pressure. This small set of properties is of fundamental importance for many natural phenomena and technological applications, as will be described in this form. Several groups commonly used to express the concentrations of the solution components have been introduced into a previous chapter of this text, each by providing some advantages for use in different applications. For example, molarity (m) is a convenient unit to use in stoochiometric calculations, since it is defined in terms of molar quantity of solute species: [latex] m = frac {text {mol; solute} } {text {l; solution}} [/ LATEX] Because the volumes of solution vary with temperature, molar concentrations of a solute and solvent species will be different at different temperatures, due to the contraction / expansion of the solution. More appropriate for calculations involving many colligative properties are a mole-based concentration units whose values do not depend on temperature. Two of these units are a hamlet (introduced in the previous chapter on the gases) and Molality. The Mole, X, of a component is the ratio of its molar quantity to the total number of mass of all the components of the solution: [LATEX] X \_ {text {A}} = fraction and the previous chapter on the gases and Molality. {text {mol; A}} {Text {TOTAL; OFF calculated using only mass masses and molar quantities, they do not vary with temperature and, therefore, they are more suitable for applications that require concentrations From the temperature, including several colligative properties, as described in this chapter module. chapter. Fraction of the mole and molalitá The antifreeze in most automotive radiators is a mixture of equal volumes of glycol and ethylene water, with minor quantities of other additives that prevent corrosion. What are the (a) Talpa fraction and (b) ethylene glycol mola, C2H4 (OH) 2, in a solution prepared by 2.22 Å £ - 103 g of ethylene glycol and 2.00 Åf-103 g of water (about 2 l glycol and 2 l of water)? Solution (a) The fraction of the ethylene glycol mole can be calculated by first of all deriving to molar quantities of both members of the solution and therefore replace these amounts in the definition of the unit. [Latex] text {mol; C} \_2 text {h}  $4 (t text {oh}) _ 2 {62.07; text {g; C} _ 2 text {h} _ 4 (t text {oh}) _ 2 = 35.8; text {mol; C} _ 2 text {h} _ 4 (t text {oh}) _ 2 [/ latex] [latex] text {mol; h} _ 2 text {o} = 2000; text {g}; Time; frac {1; text {mol; h} _ 2 text {o}} = 11.1; text {mol; h} _ 2 text {or} = 11.1; text {mol; h} _ 2 text {or} [/ latex] [latex] x _ {text {etilen; glycol}} = frac {1; text {mol; h} _ 2 text {o} = 2000; text {g; h} _ 2 text {o} = 11.1; text {mol; h} _ 2 text {or} [/ latex] [latex] x _ {text {etilen; glycol}} = frac {1; text {mol; h} _ 2 text {o} = 2000; text {g; h} _ 2 text {o} = 11.1; text {mol; h} _ 2 text {or} ] = 11.1; text {mol; h} _ 2 text {or} ] = 11.1; text {mol; h} _ 2 text {o} ] = 11.1; text {mol; h} _ 2 text {or} ] = 11.1; text {mol; h} _ 2 text {o} ] = 11.1; text {mol;$ {35.8; text {mol; C} \_2 text {h} \_4 (text {oh}) \_2} {(35.8; + 11.1); text {mol; Total}} = 0.763 [/ LATEX] Note that the fraction of mole is a property without size, being the relationship between properties with identical units (moles). (b) To find the molalitÃ, we must know the mole of the solute and the mass of the solvent (in kg). First, use the Data Mass of ethylene glycol and its molar mass to find soluto moles: [LATEX] 2220; text {g; C} 2 text {h} 4 (\t text {oh}) 2; (. text {mol; C} 2 text {h} 4 (\t text {oh}) 2; (. text {mol; C} 2 text {h} 4 ( definition: [LATEX] Begin {array} {R @ {{} = {}} } text {molyality} & frac {text} {Solute text {kg; solvent} [1em]} text {molalitÃ} & frac {35.8; text {mol; C} \_2 text {h} \_4 (text {oh}) \_2} {2; text {kg; h} \_2 text {or}} [n] text {molalitÃ} and 17.9; m end {array} [/ LATEX] Check your learning What are the fraction of the mole and solam of a mole and solaw of a solution that contains 0.850 g of ammonia, NH3, dissolved in 125 g of water? Conversion of the mole fraction and molerals concentrations calculate the fraction of the solution from a concentration unit to another is accomplished first by comparing the two unit . In this case, both units have the same numerator (moles of soluto) but different denominators. The MOLAL concentration provided can be written as: [LATEX] Frac {3.0; text {mol; NACL}} {1.0; text {mol; deriving the molar quantity of the water corresponding to 1.0 kg [latex] 1.0; text {kg; h} \_2 text {o}; (\ tBrak {1000; g}) = = And then replacing these molar amounts in the definition by hamlet. [Says] Begin {array] # x \_ {text {h} \_2 text {o}; h} \_2 text {o}} {text {mol; h} \_2 text {o}; h} \_2 text {o}; h] = And then replacing these molar amounts in the definition by hamlet. [Says] Begin {array] # x \_ {text {h} \_2 text {o}; h} \_2 text {o}; h] = And then replacing these molar amounts in the definition by hamlet. [Says] Begin {array] # x \_ {text {h} \_2 text {o}; h] = And then replacing these molar amounts in the definition by hamlet. [Says] Begin {array] # x \_ {text {h} \_2 text {o}; h] = And then replacing these molar amounts in the definition by hamlet. 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As described in the chapter on liquids and solids, the pressure of the balance steam of a liquid is the pressure exerted by its gaseous phase when occurring vaporization and condensation with parity of speed: latex] Text {liquid} {LEFTRIGHTHARPOONS }; Text {gas} [/ LATEX The dissolution of a non-volatile substance in a volatile liquid causes a lowering of the pressure of the liquid vapor. This phenomenon can be rationalized considering the effect of the soluto molecules added on the vaporize, solvent molecules must be present on the surface of the solution. The presence of solute decreases the surface available to solvent molecules and thus reduces the solvent vaporization rate is not influenced by the presence of solute, the net result is that the vaporization-condensation balance is reached with less solvent molecules in the steam phase (ie, at a lower steam pressure ) (Figure 1.) While this kinetic interpretation is useful, it does not refer to different important aspects of the colligative nature of the steam lower. A more rigorous explanation concerns the owner of entropy, topic of discussion in a subsequent chapter of text on thermodynamics. To understand the lowering of the vapor pressure of a liquid, it is sufficient to note that the greater entropy of a solution compared to its separate solvent and its solution serves to effectively stabilize the solvent molecules and to hinder their vaporization. A lower steam pressure result and a correspondingly higher boiling point as described in the next section of this module. Figure 1. The presence of non-volatile solutes lowers the pressure of a solution preventing the evaporation of solvent molecules. The relationship between the vapor pressures of the components of and the concentrations of such component of an ideal solution is equal to the vapour pressure of the pure component multiplied by its mole fraction in the solution  $[latex]P_{\det{A}} = X_{\det{A}}P_{\det{A}} = X_{dA}P_{dA} =$ Remembering that the total pressure of a gas mixture is equal to the sum of the partial pressures for all its components (Dalton's law of partial pressures), the total vapour The pressure exerted by a solution containing the components I [LATEX] P {\ TEXT {Solution}} = \ Sum \ Limits {i} \; P\_i = \ Sum \ Limits {i} \; x\_ip\_i ^ {\ Limits {i} \; x\_ip\_i ^ { non-volatile substance is one whose vapour pressure is negligible ( $PAc A^{\circ} Ac 0$ ), so the vapour pressure over a solution containing only non-volatile solids is due only to the solvent} = X \_ {\text {solvent}} = X \_ {\text {solvent}} + Circ} [/ Latex] Calculation of a vapour pressure Calculate the vapour pressure of an ideal solution containing 92.1 g of glycerin, c3h5 (oh) 3 and 184.4 G of ethanol, c 2h5oh, at 40°C. The vapour pressure of pure ethanol is 0.178 atm at 40 ŰC. Glycerin is essentially non-volatile at this temperature. Solution Since the solvent is the only volatile component of this solution, its vapour pressure can be calculated by raoult's law as: [latex] p  $\{ \text{solution} \} = x \{ \text{solvent} \} p \{ \text{Circ} \} (\text{Latex}] \text{First, calculate the molar quantities of each component of the solution using the mass data provided. [Latex] 92.1 \; \rule [0.5ex] {5.5em} \text {g \; c} 3 \text {h} _5 (\text {oh}) _3 \; \time \; \frac {1 \; \text {mol \; c} _3 \text {mol \$  $\{h\}_{5} (\text{text \{oh\}}_{3} = 1.00 \ \text{text \{oh\}}_{3} = 1.00 \ \text{text$ text {oh}} {46.069 \; \rule [0.25ex] {3.75em} } {0.1ex} \hspace {-3.75em} \text {oh}} = 4.000 \; \text {mol}} = 4.000 \; \tex  $(1.00 \ \text{text} \{\text{mol}\}\} \{ (1.00 \ \text{text} \{\text{mol}\}\} + \ \text{text} \{\text{mol}\}\} = 0.800 \ \text{text} \{\text{mol}\}\} = 0.800 \ \text{text} \{\text{mol}\}\} = 0.800 \ \text{text} \{\text{mol}\}\} = 0.142 \ \text{text} \{\text{mol}\}\} = 0.142$ volatile soluts, it is waiting for the boiling point of the solution to be subsequently increased. compared to pure solvent, a solution, therefore, will do ita higher temperature to reach a certain steam voltage, including a temperature equivalent to that of the surrounding atmosphere. The increase in the boiling point observed when the non-volatile solute is dissolved in a solvent, ΢Tb, is called an elevation of the boiling point and is directly proportional to the molar concentration, or constant beiling point of concentration (molality) of all sulute species. The elevation constants of the boiling point are characteristic properties that depend on the identity of the solvent. kb values for different solvents are listed in Table 2. solvent boiling point (°C to 1 atm) kf (Cmâ¢1) water 100,0 0.512 0.0 1,86 hydrogen acetate 118,1 3,07 16,6 3,9 benzene 80,1 2,53 5.5 5,12 chloroform 61,26 3,63 â ¢63 the extent to which the steam voltage of a solvent is lowered and the boiling point is elevated depends on the total number of solvent, not by the mass or size or chemical identity of the particles. a water solution of 1 m of sucrose (342 g/mol) and a water solution of 1 m of sucrose (342 g/mol) and a water solution of 1 m of ethylene glycol (62 g/mol) present the same boiling point of a solution contains a molecule of sulute particles (molecules) for a kilogram of solvent. calculation of the boiling point of a solution what is the boiling point of a solution of the boiling point of a solution of 0.33 m of a non-volatile solute in the benzene? to solve the molility to solve the problem in two steps. calculates the change of the boiling point. [latex]{\Delta}T\_{\text{b}} = K\_{(text{b}} = 0.83);^{(circ}\text{C}]/latex] add the extraction of the boiling solvent compared to the pure point. [latex]\text{ebollition}; temperature} = 0.83);^{(circ}\text{C}]/latex] add the extraction of the boiling solvent compared to the pure point. [latex]\text{ebollition}; temperature} = 0.83);^{(circ}\text{C}]/latex] add the extraction of the boiling solvent compared to the pure point. [latex]\text{ebollition}; temperature} = 0.83);^{(circ}\text{C}]/latex] add the extraction of the boiling solvent compared to the pure point. [latex]\text{ebollition}; temperature} = 0.83);^{(circ}\text{C}]/latex] add the extraction of the boiling solvent compared to the pure point. [latex]\text{ebollition}; temperature} = 0.83);^{(circ}\text{C}]/latex] add the extraction of the boiling solvent compared to the pure point. [latex]\text{ebollition}; temperature} = 0.83);^{(circ}\text{C}]/latex] add the extraction of the boiling solvent compared to the pure point. [latex]\text{ebollition}; temperature} = 0.83);^{(circ}\text{C}]/latex] add the extraction of the boiling solvent compared to the pure point. [latex]\text{ebollition}; temperature} = 0.83);^{(circ}\text{E}]/latex] add the extraction of the boiling solvent compared to the pure point. [latex]\text{ebollition}; temperature} = 0.83);^{(circ}\text{E}]/latex] add the extraction of the boiling solvent compared to the pure point. [latex]\text{E}]/latex] add the extraction of the boiling solvent compared to the pure point. [latex]/latex] add the extraction of the boiling solvent compared to the pure point. [latex]/latex] add the extraction of the boiling solvent compared to the pure point. [latex]/latex] add the extraction of the boiling solvent compared to the pure point. [latex]/latex] add the extraction of the boiling solvent compared to the pure point. [latex]/latex] add the extracting the pure point. [latex]/latex] add the extraction of 80.1\;
^{\circ}\text{C four steps. convert from grams to i2 jets using the molar mass of i2 into the unit conversion factor. result: 0.363 mol determining the molarity between boiling point change and molar concentration to determine how much the boiling point changes. Result: 1.65°C Determine the new boiling point from the boiling point of the pure solvent and change. Result: 62.91°C Check each result as Check your learning What is the boiling point of a solution of 1.0 g of glycerin, c3h5 (oh) 3, in 47.8 g of water? Hire an ideal solution. Distillation is a technique to separate the components of mixtures widely applied both in the laboratory and in industrial settings. It is used to refine oil, to isolate fermentation products and to purify water. This separation technique involves the controlled heating of an example mixture to selectively vaporize, condense and collect one or more components of interest. A typical apparatus for laboratory-scale distillation is shown in Figure 2. Figure 2. A typical laboratory distillation unit is shown in (A) a photograph and (b) a schematic diagram of the work of a ¬ A vifileman82a / Wikimedia Commons; Credit B: Modification of the work of a ¬ / Wikimedia Commons) Petroleum refineries use large-scale fractional distillation to separate the components of crude oil. Crude oil is heated to high temperatures at the base of a high fractionation column, vaporizing many of the components that rise up inside the column. As the vaporized components reach sufficiently cold areas during their ascent, they condense and are collected The liquids collected are simpler mixtures of hydrocarbons and other petroleum compounds that are of appropriate composition for various applications (e.g. diesel fuel, kerosene, gasoline), as shown in Figure 3. Figu at lower temperatures than pure liquids. This phenomenon is exploited in a - Åde-glaining schemes that use salt (Figure 4), calcium chloride or urea to melt ice on roads and sidewalks, and in the use of ethylene glycol as a - Åntifreeze in automotive radiators us. Seawater freezes at a lower temperature than fresh water, and so the Arctic and Antarctic oceans remain questionable even at temperatures below 0°C (as do the body fluids of fish and other cold-blooded marine animals living in these oceans). Figure 4. Red salt (NACL), calcium chloride (cacl2) or a mixture of the two are used to melt ice. (Credit: Modified work by Eddie Welker) The decrease in the freezing point of a dilute solution compared to that of the pure solvent, is called the freezing point depression and is directly proportional to the moral concentration of the solute [latex] {\ Letx {f}} = k\_{\ text {f}} = k\_{\ text {f}} = k\_{\ text {f}} = k\_{\ text {f}} Just like the boiling point elevation constants, these are characteristic properties whose values depend on the chemical identity of the solvent. The KF values for different solvents are listed in Table 2. Calculation of the freezing point of a solution of the freezing point of the solvent. Example 2? Solution Use the freezing point depression equation to solve the molality to solve the problem in two steps. Calculate the change in the freezing point. [latex]{\text{f} = K\_{\text{f}} = K\_{\text{f}} = K\_{\text{f}} = K\_{(\text{f})} = 5.12, ^{(\text{f})} = 5.12, ^{(\text{f}) freezing point of the solvent. [latex]\text{C} = 3.8;  ${\circ}\text{C} = <math>3.8$ ;  ${\circ}\text{C} = 3.8$ ;  ${\circ}\t$ often used to defrost roads and pavements, since a solution of any of these salts will have a freezing point below 0°C, the freezing point below 0°C, the freezing point of pure water. Group 2 metal salts are often mixed with the cheaper and more readily available sodium chloride (the "rock salt") for road use, as they tend to be slightly less corrosive than NaCl, and provide greater freezing point depression as they dissociate to produce three particles per unit of formula, rather than two particles like sodium chloride. The chloride. Since these ionic compounds tend to accelerate metal corrosion, it would not be a wise choice to use as an antifreeze for your car's radiator or to defrost an aircraft before takeoff. Covalent compounds such as ethylene or propylene glycol are often used for these applications. The glycols used in the radiator fluid not only lower the freezing point, making the liquid useful in both winter and summer. Heated glycols are often sprayed on the surface of aircraft before take-off in bad winter weather to remove ice that has already formed and prevent the formation of more ice, which is particularly dangerous if it forms on the aircraft's control surfaces (Figure 5). Figure 5. The freezing point vacuum is used to remove ice from (a) track and (b) aircraft control surfaces. The colligative effects on vapour pressure, boiling point and freezing point described in the previous paragraph are appropriately summarised by comparing the phase diagrams of a pure liquid and a solution derived from it. Phase diagrams for water and an aqueous solution are shown in Figure 6. Figure 6 vapour curve for the solution is below the corresponding curve for the solvent, which The reduction of the vapor voltage,  $\tilde{A}$ žåžp, resulting from the dissolution is observed at a temperature higher than that of the pure solvent, reflecting the elevation of the boiling point, Ažâžtb, associated with the presence of non-volatile solute. The The curve for the solution are identical. This is the case with many solutions that include liquid solvents and non-volatile solvents. Just like for vaporization, when such a solution is frozen, it is actually only the solvent molecules that undergo the transition from liquid to solid, forming pure solid solvent that excludes sister species. The solid and gaseous phases, therefore, are only solvent compounds, and thus the transitions between these phases are not subject to collanistic effects. A number of natural and synthetic materials exhibit selective permeation, which means that only molecules or ions of a certain size, shape, polarity, charge and so on, are able to pass through (permeating) the material. Biological cell membranes provide elegant examples of selective permeation in nature, while the dialysis tube used to remove metabolic waste from the blood is a simpler technological example. Regardless of how they may be manufactured, these materials are generally referred to as semi-permeable membranes. Consider the apparatus shown in Figure 7, where samples of pure solvent and solution are separated by a membrane which only solvent molecules can permeate. Solvent molecules spread across the membrane in both directions. Because the solvent side of the solution at a faster rate than in the opposite direction. The result is a net transfer of solvent molecules from the pure solvent to the solution. Diffusion-guided transfer of solvent molecules from a sample with a low (or zero) concentration of solute to a sample with a higher concentration of solute. When osmosis is performed in an apparatus as shown in Figure 7, the volume of the solution increases as it becomes diluted by the accumulation, increases as it becomes diluted by the accumulation of solvent. This causes an increase in the level of the solution, increasing the hydrostatic pressure (due to the weight of the column of the solution in the tube) and resulting in a faster transfer of solvent molecules to the pure solvent side. When the pressure reaches a value that produces a reverse transfer rate of the solvent stops. This pressure is called the osmotic pressure (ÃC) of the solution. The osmotic pressure of a diluted solution is related to its pure molarity, m and temperature T, according to the equation [lattice] \ it {{ PI}} = MRT [/ Latex] where R is the universal gas constant. Calculation of glucose in water that is used for intravenous infusionBody temperature, 37 degrees Celsius? Solution We can find osmotic pressure, 
$\tilde{A}\check{z}$ , using the formula  $\tilde{A}\check{z}$  = MRT, where t is on the Kelvin scale (310 K) and the value of R is expressed in the appropriate units (0.08 206 l atm / mol k). [latex] begin {array} {r @ {} = {}} l { {more} } & mrt [0.5em] & 0.03; text {mol / 1}; Times; 0.08 206; text {l END {Array} [/ LATEX] Osmotic pressure (ATM) A solution with a volume of 0.750 l containing 5.0 g of methanol, CH3OH, in water at 37 Å, A ° C? If a solution is inserted into a device like that shown in Figure 8, applying a greater pressure of the solution, the osmosis will be reversed and the solvent molecules are pushed from the solution in pure solvent. This reverse osmosis technique is used for the large-scale desalination of sea water and, on a reduced scale, for the production of high purity tap drinking water. Figure 8. Applying a greater pressure of the solution to reverse the osmosis. The solvent molecules of the solution are placed in pure solvent. In the osmosis process, the diffusion serves to move water through a semipermeable membrane from a less concentrated solution to a more concentrated. Osmotic pressure is the quantity of pressure that must be applied to the most concentrated solution to terminate the osmosis. If greater pressure is applied, the water will pass from the most concentrated solution to a less concentrated (plus pure). This is called reverse osmosis. Reverse osmosis (RO) is used to purify water in many applications, from desalination plants in coastal cities to water purification machines in grocery stores (Figure 9) and to osmosis domestic units Inverse smaller. rescue shelves. Our military forces have a variety of RO units powered by a generator that can be transported in vehicles in remote places. Figure 9. Reverse osmosis systems for drinking water purification of Willard's work J. Lathrop) Examples of osmosis are obvious in many biological systems because the cells are surrounded by semipermeable membranes. Carrots and celery becomes soft because they lost water can be rendered crispy putting them in the water. loses water for osmosis and absorbs a little salt to become a cucumber. Osmosis can also hit animal cells. Soluble solutions are particularly When solutions are particularly When solutions are injected into the body. The solutions injected into the body. into the organism must have the same osmotic blood pressure of the blood serum, ie must be isotonic with with serum. If a less concentrated solution, is injected in sufficient quantities to dilute the blood serum, the water from the diluted serum passes to the blood cells for osmosis, making sure that the cells expand and break. This process is called hemolysis. When a more concentrated solution, a hypertonic solution is injected, the cells lose water to the most concentrated in Figure 10. Red blood cell membranes are permeable to water and (a) inflatable and possibly die in a process called Crenation. These effects are illustrated in Figure 10. Red blood cell membranes are permeable to water and (a) inflatable and possibly die in a process called Crenation. break into a hypotonic solution; (b) maintain normal volume and shape in an isotonic solution; and (c) screws and possibly die in a hypertonic solution; (b) maintain normal volume and shape in an isotonic solution; (b) maintain normal volume and shape in an isotonic solution; (c) screws and possibly die in a hypertonic solution; (c) screws and possibly die in a hypertonic solution; (b) maintain normal volume and shape in an isotonic solution; (c) screws and possibly die in a hypertonic solution; (c) screws and possible solution; (c) s solute concentration. As a result, we can use a measurement of one of these properties to determine the molar mass of the solute from measurements. Determination of a molar mass of the solute from measurements. Determination of a molar mass of the solute from measurement of the solute from measurements. compound? Solution that we can solve this problem using the following steps. It determines the change in the freezing point from the observed freezing point of the pure benzene (Table 2). [Latex] {\ delta} t {\ text {c}; - \; 2.32\; ^ \; 2.32\; 2.32\; ^ \; 2.32\; 2 Latex] Determines the harassment concentration by KF, the constant of the freezing point depression for benzene (Tabella 2) and  $\hat{I}$  "TF. [Latex] {\delta} t \_ {\text {f}} = k \_ {\text {f}} = k \_ {\text {f}} = k \_ {\text {f}} = 0.63m [/ Latex] \ text {f}} = k \_ {\text {f}} = k \_ {\text {f}} = 0.63m [/ Latex] {\delta} t \_ {\text {f}} = k \_ {\text {f}} = k \_ {\text {f}} = 0.63m [/ Latex] (text {f}) = 0.63m [/ Latex] (t harassment concentration and the solvent mass used to achieve the solution. [Latex] \ text {mol}; solute} +  $fac \{0.62 \; text \{mol\}, solvent\}$ the solute and the number of moles in that mass. [Latex] \ Text {molar \; mass} = \ frac {4.00 \; \ text {g}} {0.034 \; \ text {mol}} = 1.2 \ times \; 10 ^ 2 \; \ text { G / MOL} [/ Latex] Check your learning A 35.7 G solution of a non-lettrolyte inG of chloroform has a boiling point of 64,5 ° C. What is the molar mass of this compound? Determination of a non-lettrolyte inG of chloroform has a boiling point of 64,5 ° C. What is the molar mass of this compound? Determination of a non-lettrolyte inG of chloroform has a boiling point of 64,5 ° C. What is the molar mass of this compound? Determination of a non-lettrolyte inG of chloroform has a boiling point of 64,5 ° C. What is the molar mass of this compound? Determination of a non-lettrolyte inG of chloroform has a boiling point of 64,5 ° C. What is the molar mass of this compound? Determination of a non-lettrolyte inG of chloroform has a boiling point of 64,5 ° C. What is the molar mass of this compound? Determination of a non-lettrolyte inG of chloroform has a boiling point of 64,5 ° C. What is the molar mass of this compound? Determination of a non-lettrolyte inG of chloroform has a boiling point of 64,5 ° C. What is the molar mass of this compound? Determination of a non-lettrolyte inG of chloroform has a boiling point of 64,5 ° C. What is the molar mass of this compound? Determination of a non-lettrolyte inG of chloroform has a boiling point of 64,5 ° C. What is the molar mass of this compound? Determination of a non-lettrolyte inG of chloroform has a boiling point of 64,5 ° C. What is the molar mass of this compound? Determination of a non-lettrolyte inG of chloroform has a boiling point of 64,5 ° C. What is the molar mass of this compound? Determination of a non-lettrolyte inG of chloroform has a boiling point of 64,5 ° C. What is the molar mass of this compound? molar mass by osmotic pressure 0.500 l sample of a watery solution containing 10,0 g hemoglobin has an osmotic pressure of 5,9 torr to 22 ° c. What is the molar
mass of hemoglobin? Solution Here is a number of steps that can be used to solve the problem: convert osmotic pressure to atmospheres, then determine molar concentrationosmotic pressure. [Latex] {\ it {\ pi}} = \ frac {5.9 \; \ text {Torr} \; \ text {atm}} { 760 \; \ text {torr}} = 7.8 \; \ text {torr} } = 7.8 \; \ text times \; 10  $\{-4\}$  \; \ text {m} [/ latex] Determines the number of moles of haemoglobin in the solution. [Latex] \ Text {mole \; of \; hemoglobin} = \ frac {3.2 \; \ time \; 10  $\{-4\}$  \; \ text {mol}} } {0.1ex}} } {-3.5em} \ text {1 \; solution} \; \; \; \; \ times \; 10  $\{-4\}$  \; \ text {mole} \; of \; hemoglobin in the solution. [Latex] \ Text {mole \; of \; hemoglobin} = \ frac {3.2 \; \ time \; 10  $\{-4\}$  \; \ text {mole} \; of \; hemoglobin} = \ frac {3.2 \; \ time \; 10 [-4] \; \ text {mole} \; 10 [-4] \; \ text {mole} \; of \; hemoglobin \; \; \; \; \ times \; 10 [-4] \; \ text {mole} \; of \; hemoglobin \; \; \; \; \ times \; 10 [-4] \; \ text {mole} \; 10 [-4] \; 10 [-4] \; 10 [-4] \; 10 [-4] \; 10 [-4] \; 10 [-4] \; 10 [-4] \; 10 [-4] \; 10 [-4] \; 10 [-4] \; 10 [-40,500, Rule [0.5ex] {4.4em} (0.1ex} {-4}, text {mol} = 1.6 ; text {mol} = 1.6 ; text {mol} = 6.2 ; text mol} [/ in latex] Check your learning What is the molar mass of a protein if a solution of 0.02 g of the protein in 25.0 ml of solution has an osmotic pressure of 0.56 torr at 25ŰC? As noted above In this module, the colligative properties of a solution has an osmotic pressure of 0.56 torr at 25ŰC? electrolytes dissolved in 1 kilogram of solvent produces the same freezing point depression as 1 mole of any other non-electrolyte. However, 1 mole of any other non-electrolyte. However, 1 mole of solution. Each individual ionic produces the same effect on the freezing point as a single molecule. The freezing point of an electrolyte solution The concentration of ions in seawater is about the same as in a solution containing 4.2 g of nacl dissolved in 125 g of water. Suppose that each of the ions in the NACL solution (which is roughly the same effect on the freezing temperature of the solution (which is roughly temperature of the solution). equal to the freezing temperature of seawater). Solution we can solve this problem using the following set of steps. Convert grams to moles in the solution using the number of ion moles in 1 mole of NACL as the conversion factor (2 MOL IONS / 1 MOL NACL). Result: 0.14 MOL ions determine the molality of the ions in the solution by the number of ion molesters and the mass of the solvent, in kilograms. Result: 1.1 m Use direct proportionality the variation of the freezing point changes Result: 2.0 ° C Determine the new freezing point of pure solvent and change. Result: A '2.0 ° C Check each result as self-assessment. Check that your learning assumes that each ion in calcium chloride, CACL2, has the same effect on thepoint of 0,724 g of CaCl2 in 175 g of water. Assuming complete dissociation, a 1.0 m aqueous solution of NaCl contains 1.0 mole of ions (1.0 mol Na+ and 1.0 mol ClâÂ<sup>x</sup>) per kilogram of water, and the freezing point depression is expected to be [latex]{\Delta}T {\text{f} = 2.0\text{mol};ions/kg};water} \;\time\;1.86\;^{\text{C}};water/mol\;ion} = 3.7\; ^ {\circ}\text{C}[/latex]. Similar differences are observed for other ionic compounds, and differences between measured and expected colligative properties typically become more significant as solute concentrations increase. These observations suggest that sodium chloride ions (and other strong electrolytes) are not completely dissociated in solution. In order to take this into account and avoid the mistakes that accompany the total dissociation hypothesis, a parameter experimentally measured by the name of the German Nobel Prize in Chemistry Jacobus Henricus vanâ¦t Hoff is used. The vanâ¦t Hoff is used as the ratio between the solute particles in solution and the number of units of the formula dissolved: [latex] = \frac{\text{mole};di\;particles\;in\;solution}} {\text{mole};di\;particles\;in\;solution}, are given in Table 3. Electrolytic particles in solution i (expected) i (measured) HCl H+, Cl¢Â¤ 2 1.9 NaCl Na+, Cl¢Â¤ 2 1.9 MgSO4 Mg2+, SO42- 2 1.3 MgCl2 Mg2+, 2Cl3 Fe3+, 3Cl¢Â¤ 4 glucose C12H22O11 1 1.0 Table 3. Hoff Factors Expected and Observed for Different 0.050 m Aqueous Electrolyte Solutions In 1923, chemists Peter Debye and Erich HÅ1â4ckel proposed a theory to explain the apparent incomplete ionization of strong electrolytes. They suggested that although the interion attraction is greatly reduced by the dissolution of the ions and the insulating action of the polar solvent, it is not completely cancelled out. The residual attractiveness prevents the ions from behaving as fully independent particles (Figure 11). In some cases, a positive and negative ion can actually touch each other, giving a solvent unit called an ionic pair. Therefore, the activity, or effective concentration, of a particular type of ion is lower than that indicated by the effective concentration, of a particular type of ion is lower than that indicated by the effective concentration. less. Therefore, in highly diluted solutions, the actual concentrations of ions (their activities) are essentially equal to the actual concentrations. It should be noted that the factors of for table 3 electrolytes refer to solutions of 0.05 m, for which the value of i for NaCl is 1.9, in contrast to aFigure 11. The ions become more and more separated the more dilute the solution, and the residual interonic attractions become less. Properties of a solution that depend only on the concentration of solute particles are called colligative properties. These include changes in vapour pressure, boiling point and freezing concentration of soluble particles in a solution, not on the type of particles. The total concentration of soluble particles in a solution also determines its osmotic pressure that must be applied to the solution. The ionic compounds of pure solution also determines its osmotic pressure that must be applied to the solution. may not dissociate completely in solution due to activity effects, in which case the colligative effects observed may be less than expected. [latex]  $P_{\text{x}} = \text{x}_{\text{x}} \frac{1}{1} = \text{x}_{1} \frac{1}{1} = \frac{1}{1} \frac{1}{1} = \frac{1}{1} \frac{1}{1} \frac{1}{1} = \frac{1}{1} \frac{1}{1} \frac{1}{1} = \frac{1}{1} \frac{1}{1} \frac{1}{1} = \frac{1}{1} \frac{1}{1} \frac{1}{1} \frac{1}{1} = \frac{1}{1} \frac{$ chapter What is / do part of the macroscopic domain of solutions and which is/are part of the microscopic domain: boiling point elevation, Henry's law, hydrogen bonding, ion-dipole attraction, molarity, non-electrolyte, non-stoichiometric compound, osmosis, solvated ion? What is the microscopic domain of solutions and which is/are part of the macroscopic domain: boiling point elevation, Henry's law, hydrogen bonding, ion-dipole attraction, molarity, non-electrolyte, non-stoichiometric compound, osmosis, solvated ion? Figure 7 in Chapter 11.3 Solubility? Sketch a qualitative graph of the pressure versus time for water and a solution of potassium nitrate, an electrolyte and a solution of glycerin (C3H5 (OH) 3), a non-electrolyte, both boil at 100.3 ŰC. What other physical properties of the two solutions are identical? What are the mole fractions of H3PO4 and water in a solution of 14.5 g of Water? (a) Highlight the steps needed to answer the question. (b) Answer the question. What are the mole fractions of H3PO4 in 125 g of Water? (a) Highlight the steps needed to answer the question. (b) Answer the question. What are the mole fractions of H3PO4 in 125 g of Water? (a) Highlight the steps needed to answer the question. Highlight the steps needed to answer the question. (b) Answer the question. Calculate the mole fraction of each solvent: (a) 583 g of H2SO4 in 1.50 kg of waterâa sodium chloride solution for intravenous injection (c) 46.85 g of tails Calculate the mole fraction of each solvent: (a) 0,710 kg of sodium carbonate (soda wash), Na2CO3, in 10.0 kg of water âa mixture used to make an instant packet of ice (c) g of Cl2 in 125 g of CH2Cl2 (d) 0.372 g histamine, C5H9N, in 125 g of NH4NO3 in 275 g of water âa mixture used to make an instant packet of ice (c) g of Cl2 in 125 g of CH2Cl2 (d) 0.372 g histamine, C5H9N, in 125 g of CH2Cl3 (d) 0.372 g histamine, C5H9N, in 125 g histamine, C5H9N, in 12 fractions of methanol, CH3OH, ethanol, C2H5OH and water in a solution composed of 40% methanol, 40% ethanol and 20% water by mass. (Suppose the data is good at two significant digits.) What is the difference between a 1 m solution and a 1 m solution? What is the molality of phosphoric acid, H3PO4, in a solution of 14.5 g of H3PO4 in 125 g of water? (a) Describe the measures needed to respond to the question. (b) Answer the question. (b) Answer the question. (b) Answer the question. (c) Answer the question (c) Answer the question. (c) Answer the question (c) An H2SO4 in 1,50 kg water (b)
0,86 g NaCl in 1,00 Å 102 g water (c) 46,85 g codeine, C18H21NO3, 125,5 g ethanol, C2H5OH (d) 25 g I2 in 125 g Calculate the molality of each of the following solutions: a) 0,710 kg of sodium carbonate (d) Na2CO3, in 10,0 kg of water, a saturated solution at 0°C (b) 125 g of NH4NO3 in 275 g of water "a mixture used to make a packing is (c) 25 g of Cl2 in 125 g of dichloromethane, CH2Cl2 (d) 0.372 g of histamine, C5H9N, in 125 g of chloroform, CHCl3 The concentration of glucose, C6H12O6, in the intestinal fluid is [latex]\frac{75};\text{mg}{100};\text{g}[/latex]. What is the molality of the solution? A solution of 13,0% by mass of K2CO3 has a density of 1,09 g/cm3. Calculate the molality of the solution. Why does 1 mol of sodium chloride depresses the freezing point of 1 kg of water almost twice as much as 1 mol of glycerin? What is the boiling point of a solution of 115,0 g of sucrose, C12H22O11, in 350,0 g of water? (a) Describe the steps required to answer the question (b) Answer the question What is the boiling point of a solution of 9.04 g of I2 in 75.5 g of benzene, assuming that I2 is not volatile? (a) Describe the measures needed to respond to the question. (b) Answer the question. (b) Answer the question. (c) Answer the question of 115,0 g of sucrose, C12H22O11, in 350,0 g of water, which freezes at 0,0°C when pure? (a) Describe the measures needed to respond to the question. (b) Answer the following question. What is the freezing point of a solution of 9.04 g of 12 in 75.5 g of benzene? (a) Describe the measures needed to answer the following question. What is the osmotic pressure of an aqueous solution of 1.64 g Ca (NO3) 2 in water at 25°C? The volume of the solution is 275 mL. (a) Describe the measures needed to answer the question. (b) Answer the question. (b) Answer the question. What is the molar mass of a 5.00 g molÂ×1) at 18°C if 100.0 mL of the solution contains 0.103 g insulin? (a) the measures necessary to answer the question. (b) Answer the question. solution of a compound in 25.00 g of carbon tetrachloride (bp 76.8 °C; Kb = 5.02 °C/m) boiling at 81.5 °C at 1 atm? (a) Describe the measures needed to respond to the question. (b) Solve the problem. A sample of an organic compound (a non-electrolyte) weighing 1.35 g lowered the freezing point of 10.0 g benzene by 3.66 ŰC. Calculate the molar mass of the compound. A solution of 1.0 m HCl in benzene has a freezing point of 0.4 ŰC. Is HCl an electrolyte in benzene? Explain it to me. One solution contains 5,00 g of urea, CO (NH2) 2, a non-volatile compound, dissolved in 0,100 kg of water. If the vapour pressure of the solution? A sample of 12,0 g of a non-electrolyte is dissolved in 80,0 g of water. The solution freezes at 1.94°C. Calculate the molar mass of the substance. Arrange the following solutions in decreasing order of freezing points: 0,1 m Na3PO4, 0,1 m C2H5OH, 0,01 m CO2, 0,15 m NaCl and 0,2 m CaCl2. Calculate the boiling point elevation of 0,100 kg of water containing 0,010 mol NaCl, 0,020 mol Na2SO4 and 0,030 mol MgCl2, assuming complete dissociation of these electrolytes. How can an aqueous solution? A sulphur sample weighing 0.210 g was dissolved in 17.8 g of carbon sulphide, CS2 (Kb = 2.43 ŰC/m). If the boiling point rise was 0.107°C, what is the formula of a sulfur molecule in carbon disulfide? In an important experiment conducted many years ago, 5.6977 g of cadmium iodide in 44.69 g of water brought the boiling point to 0.181°C. What does this suggest about the nature of a CdI2 solution? Lysozyme is an enzyme that breaks down cell walls. A 0.100-L sample of a lysozyme solution containing 0.0750 g of the enzyme has an osmotic pressure of 1.32 Š10ŢŤ3 atm at 25ŰC. What is the molar mass of lysozyme? The osmotic pressure of a solution containing 7.0 g of insulin per litre is 23 torr at 25°C. What is the molar mass of lysozyme? The osmotic pressure of a solution containing 7.0 g of insulin per litre is 23 torr at 25°C. What is the molar mass of lysozyme? The osmotic pressure of 1.32 Å 10ŢŤ3 atm at 37°C. What mass of glucose, C6H12O6, is needed to produce 1.00 L of aqueous solution for intravenous feeding if the solution must have the same osmotic pressure as blood at body temperature, 37°C? What is the freezing point of a dibromobenzene solution, C6H4Br2, in 0,250 kg of benzene, if the solution boils at 83,5 ŰC? What is the boiling point of a dibromobenzene solution, C6H4Br2, in 0,250 kg of benzene, if the solution boils at 83,5 ŰC? What is the freezing point of a dibromobenzene solution for intravenous feeding if the solution for intravenous feeding if the solution for intravenous feeding if the solution must have the same osmotic pressure as blood at body temperature, 37°C? What is the freezing point of a dibromobenzene solution for intravenous feeding if the solution feedin NaCl solution in water if the solution freezes at Ţ0.93 ŰC? Fructose sugar contains 40,0% C, 6,7% H and 53,3% O by mass. A solution of 11.7 g of fructose in 325 g of ethanol has a boiling point It is 78.35°C, and Kb for ethanol is 1.20°C/m. What is the molecular formula of fructose? The vapour pressure of methanol, CH3OH, is 94 torr at 20°C. The vapour pressure of ethanol, C2H5OH, is 44 torr at the same temperature. (a) Calculate the mole of methanol and ethanol and be a solution that behaves as an ideal solution. solution at 20 ° c. (c) calculate the fraction of the methanol mole and ethanol in the steam above the solution. The triple point of airless water is defined as 273,15 K. Why is it important that water be air-free? Meat can be classified as fresh (not frozen) even if it is preserved at â'1 â ° c. Why would meat not freeze at this temperature? An organic compound has a composition of 93,46% C and 6,54% h perssa. A solution of 0.090 g of this compound in 1,10 g of Campora melts at 158,4 ° C. The melting point of the solute? Show your calculations. A 9.41 G weight HGCL2 sample is dissolved in 32.75 g ethanol, c2h5oh (KB = 1,20 ° C / m). The elevation of the solution boiling point is 1,27 ° C. HGCL2 is an electrolyte in ethanol? Show your calculations. A salt is known to be an alkali metal fluoride. A rapid approximate determination of the freezes at about a'.4 ° C. What is the formula of salt? Show your calculations. elevation of the boiling point of a liquid by means of a means of a liquid by means of a constant depression of a suphurThrough a semi-permeable law of the solution is equal to the product of the mole fraction of the solution and the equilibrium vapour pressure in the semi-permeable membrane of the pure state a membrane that selectively allows the passage of certain vanA¢ ions or molecules a ¬¢ T Hoff Factor Factor the ratio between the number of dissolved formula unit grindings in the solution responds to the end of the chemistry of the exercises in Chapter 2. the strength of bonds between molecules as molecules as molecules and other regions where oil molecules and other regions where oil molecules are some regions. 4. both form homogeneous solutions; their elevations of the boiling point are the same, as they are their lowering of vapor pressures. also osmotic pressures and lowering of the freezing point are equal for both solutions. 6. (a) find the number of hno3 and h20 mols in 100 g of the solution. find the freezing point are equal for both solutions. 6. (b) the freezing point are equal for both solutions. mole is 0.378. the fraction of the h2o mole is 0,622. 8. (a) [latex] in a 1 m solution, the mole is contained exactly in 1 l of solution. in a 1 m solution, the mole is contained exactly in 1 l of solution. determine molaility. (b) 33,7 m 14. (a) 6.70 Å-10m; (b) 5.67 m; (c) 2.8 m; (d) 0.0358 m 16. 1,08 m 18. (a) determine the molar mass of sucrose; determine the number of moles and the mass of the solvent, determine the difference between the boiling point of water and the boiling point of the solution; determines the new boiling point. (b) 100.5 ° c 20. (a) determine the number of saccharosine piers in the solution; determine molaility; determine the difference between the freezing temperature of water and the freezing temperature of the solution; determine the number of piers of ca (no3) 2; determine the molarity de of ions, therefore the pressure(b) 2.67 ATM 24. (a) Determine the moleral concentration from the solute in the solute in the solute in the solute in the solute mass. (b) 2.1 Åf-102 g MolÅ ¢ '1 26. No. Pure benzene benzene at 5.5 °C, and therefore the observed freezing point of this solution is depressed by  $\Delta Tf = 5.5 - 0.4 = 5.1$  °C. The value calculated, assuming the no ionization of HCl, is  $\Delta Tf = (1.0 \text{ m})(5.14 \text{ °C/m}) = 5.1 \text{ °C}$ . The value calculated, assuming the no ionization of HCl, is  $\Delta Tf = (1.0 \text{ m})(5.14 \text{ °C/m}) = 5.1 \text{ °C}$ . The value calculated, assuming the no ionization of HCl, is  $\Delta Tf = (1.0 \text{ m})(5.14 \text{ °C/m}) = 5.1 \text{ °C}$ . C2H5OH: 18 torr; (c) CH3OH: 0.75; C2H5OH: 0.25 42. The ions and compounds present in the water in the beef lower the freezing point of the beef lower the freezing point of the beef under -1 °C. 44. [latex]{\beta} = K {\text{b}} the theoretical change: therefore no dissociation occurs. It happens

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