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Part 2- Adding Base to Weak Acid 12.5ml 0.100M NaOH to 50.0ml 0.100M HC2H3O2 Moles HAC-50.0 0.0 ml x 0.100M⁵.00mmoles OH⁻ 12.5ml x 0.100M¹.25mmol Set up an ice box using mmol. (Note only the arrow to one side, use moles) HAC - AH - H2O 15.00mmol 1.25mmol ----- C-1.25mmol-1.25mmol-1.25mmol 1.25m E3.75mmol 0.125mmol Because when we balance we have acid and its horse base. We've made a buffer and we can use the Henderson-Hasselbalch equation. pKa-log Ka-log 1.8x10⁻⁵pKa⁴.74 You don't need to convert mmol as into Molarity because the equation only requires ratio. The ratio of mmol is the same as the ratio of molarities. pH-4.74=log 1.25mmol/3.75mmol pH-4.26 Titration is a controlled chemical reaction between two different solutions. The titting of weak acid with a strong base involves direct transmission of protons from weak acid to ion of hydroxide. The reaction of weak acid, acetic acid, with a strong base, NaOH, can be seen below. In reaction, acid and base react in a one-to-one ratio. In this reaction, C₂H₄O₂ (aq) (AHS-) (right C₂H₃O₂)⁻² (aq) (H₂O) (l) (1) in this reaction the drill is used to control one solution to another. The solution injected from the buret is called titrant. The solution to which the titrant is added is called analytic. In the credits of weak acid with a strong base of titre is a strong basis, and analytic - weak acid. In order to fully understand this type of, a reaction, a titrov curve and a type of problem with the caption will be introduced. Figure (PageIndex{1}): Titrations include the addition of a caption from buret to analytic. The drawing is used with the permission of J.A. A freir. The titulate curve is a graph of the volume of the credit, or in our case the volume of a strong base, pulled against the pH. There are several characteristics that are visible in all curves titled by weak acid with a strong base. These features are below. The initial pH (before adding any strong base) is higher or less acidic than the titulated strong acid There is a dramatic increase in pH at the beginning of the tited. This is because the aion of weak acid becomes a common ion, which reduces acid ionization. After a sharp increase in the beginning of the titing curve changes only gradually. This is because the decision acts as a buffer. This will continue until the base overcomes the capacity of the buffers. In the middle of this gradual curve there is a semi neutralization. At the moment, the concentration of weak acid is equal to the concentration of its conjugation base. That's why it's a good place. This point is called semi-neutralization because half of the acid has been neutralized. At the moment of pH equivalence more than 7, because all acid (HA) has been transformed into its conjugation base by adding NaOH, and now the balance moves back to HA and produces hydroxide, that is: A - H₂O rightleftharpoons AH OH The steep part of the curve to the point of equivalence is short. This usually only occurs before pH is about 10. Below is an image of a curve credited with weak acid with a strong base. All the characteristics described above can be seen in it{2}. The drawing is used with the permission of J.A. Freyre under Creative Commons Attributions-Share Alike 2.5 Generic When solving the problem of titting with weak acid and a strong base there are certain values that you want to achieve. These include the initial pH, pH after adding a small amount of base, pH at semi neutralization, pH at the equivalence point, and finally pH after adding excess base. This data will provide sufficient information about the caption. Here's an example of this process. Find pH in each of the following points in the caption 25 ml 0.3 M HF with 0.3 M NaOH. Value (k_a) is 6.6 times 10⁻⁴ Initial pH After adding 10 ml 0.3 M NAOH After adding 12.50 ml 80.3 M NaOH After adding 25 ml 0.3 M NaOH After adding 26 ml 0.3 M NaOH Example (PageIndex{1}): Calculating the original pH Search for the original pH. SOLUTION Because HF is a weak acid, the use of the ICE table is required to find pH. The question gives us a concentration of HF. -HF - H₂O rightleftharpoons H₃O⁺ F⁻ onumber - HF H₂O H₃O⁺ F⁻ Initial 0.3 M - 0 M 0 M Change - X - X⁺ Equilibrium 0.3 - X - X X X M Writing information from the ICE table in the form of an equation gives in 6.6 times 10⁻⁴ (dfrac{x²}{0.3-x}) onumber' manipulating equation to get everything, that on one side, gives 0 - x {2} - 6.6 times 10⁻⁴x - 1.98 times 10⁻⁴ onumber (Now this information is connected to the square formula to give x dfrac{-6.6 times 10⁻⁴ ± sqrt(6.6 times 10⁻⁴)² - 4 (1) (-1) (-1) 1.98 times 1 410⁻⁴) {2} onumber - square formula gives that x²0.13745 and x⁻0.014405 However we can exclude x⁻0.014405 because there can be no negative concentrations. So to get pH we connect the H₃O concentration into the pH journal equation (0.013745) and get a pH 1.86 Example (PageIndex{2}): After adding 10 ml 0.3 M NAOX Find pH after adding 10 ml 0.3 M NaOH. SOLUTION The number of HF millimoles to be neutralized is 25 th (ml) mmol (HF) (mL-right) - 7.50 mmol HF onumber (number of millimoles OH₂ which will be added within 10 ml, - 10 th,ml) left (dfrac{-0.3, mmol), OH-H₁, mN on the right) - 3, mmol OH- onumber To calculate the pH with this addition of base we must use the table ICE (HF) H₂O (right-hand) H₃O⁺ F⁻ onumber H₂O H₂O F⁻ 7.5 mmol 0 mmol - 0 mmol Add 0 mmol 3 mmol - Change - 3 mmol -3 mmol - 3 mmol Equilibrium 4.5 mmol 0 mmol - 3 mmol However, it gives us only millimoles. To get concentration, we have to divide by the total volume. The total volume of 25 ml original solution HF plus 10 ml NaOH, which was added. Thus, the total volume is 25 ml 10 ml and 35 ml) Concentration of HF: dfrac 4.5, mmol, HF-35, ml. Concentration of MH F⁻: drf 3m, mole F-35, mN 0.0857; Since the acid and its conjugation base are in balance, we can try to use the Henderson-Hasselbalch equation. However, in order for this to work, the reaction must follow certain rules. The ratio of conjugation base to weak acid should be between 0.10 and 10. In addition, as the ratio of base conjugation and ka value and ratio of acid to ka value should exceed 100. In this problem, the Henderson-Hasselbalch equation can be applied because the F-to-HF ratio is 0.0857 x 0.1287. That's 0.10 to 10. The ratio of HF to ka is (frac{0.1287M}{6'6'}) and the F-to-ka ratio is (frac{0.0857M}{6.6 times 10^{-4}}) (pH-pk_a) (pH-magazine (6.6-times 10⁻⁴)) 1287) pH -3.00 Example (PageIndex{3}): After adding 12.50 ml 0.3 M NaOH Find pH after adding 12.50 ml 0.3 M NaOH. SOLUTION Millimoles OH-added in 12.50 ml: th (12.50 ml) 5 mmol 0 mmol - 0 mmol Add 0 mmol 3.75 mmol - Change -5 mmol 3.75 mmol -3.75 mmol - 3.75 mmol Equilibrium 3.75 mmol 0 mmol - 3.75 mmol To find concentrations we have to divide by total volume. This is the initial volume of HF, 25 ml, and the addition of NaOH, 12.50 ml. So the total volume is 25 ml and 12.50 ml and 37.50 ml Concentration HF: 0.1 MH) Concentration F⁻: (Dfraki 3.75m FX-37.50ml) We found a semi-acid point. We know this because the total amount of acid to be neutralized, 7.50 mmol, has been reduced to half its cost, 3.75 mmol. In the semi neutralization point, we can simplify the Henderson-Hasselbalch equation and use it. Since the number of conjugated bases and acids are equal, their ratio is one. We know that (log,1) and therefore the ratio of the conjugant base to acid will also be zero. The equation at the half-personalization point will be: (pH-pk_a) (pH)pk_a-journal (6.6 times 1) Example pH 3.18 (PageIndex{4}): After adding 25 ml 0.3 M. NaOH find pH after adding 25 ml NaOH. SOLUTION millimoles OH-added in 25 ml: HF H₂O H₃O⁺ F⁻ Initial 7.5 mmol 0 mmol - 0 mmol Add 0 mmol 7.5 mmol - 0 mmol Change -7.5 mmol -7.5 mmol - 7.5 mmol Balance 0 mmol 0 mmol - 7.5 mmol This is the point equivalent of titration. We know this because the acid and base are neutralized, and none of them are redundant. To find concentrations, we have to divide by total volume. This is the initial volume of HF, 25 ml, and the addition of NaOH, 25 ml. So to get the pH at the moment we need to understand that F-hydrolysis will be. The ICE table for this reaction should be built by the HF H₂O H₃O⁺ F⁻ Initial 0.15 M - 0 M 0 M Change - X - X⁺ Equilibrium X 0.15 - X - X M X M In this F- reaction acts as a basis. So we have to get the KB value, not the ka value. (k_b'b' (drq) k_a (k_a) (k_b) (6.6-4)) (k_b 1,515 times 10⁻¹¹) Now that we have a kb value, we can write an ICE table in the equation form of the equation (1,515 x 10⁻¹¹) dfrac{x²}{15-x)} to get all that on one hand gives (0' x²) - 1,515 (time 10⁻¹¹x -2.2727 times 10⁻¹²) Now this information is connected to a square formula to give q(x q-1.515 times 10⁻¹¹ (-1.5115 times 10⁻¹¹) - 4-1)-----2,2727 times 10⁻¹²) {2} square formula gives x 1,5075 times 10⁻⁶ and -1,5075 times 10⁻⁶. However, a negative value may be excluded because the concentrations cannot be zero. So to get pOH we plug the concentration of OH-in the pH-journal equation (1,5075 times 10⁻⁶) and get pOH-5.82. To get pH we minus pOH from 14. pH No14 - 5.82 pH 8.18 Example (PageIndex{5}): After adding 26 ml 0.3 M. NaOH Find pH after adding 26 ml NaOH. SOLUTION MILLIMOLEs OH-added in 26 ml: (26 ml) 7.8 mmol OH- neutralizes 7.50 mmol HCl. To find how much OH-will be in excess we subtract the amount of acid and hydroxide. mmol hydroxide over: 7.8 mmol - 7.50 mmol 0.3 mmol OH- To find the concentration of OH- we have to divide by the total volume. This is the initial volume of HF, 25 ml, and the addition of NaOH, 26 ml. Thus, the total volume is 25 ml 26 ml and 51 ml Concentration OH- is (dfrac{-0.3 mmol OH --51 ml 0.00588 M) pOH-journal (0.00588) 0.00588) 2.23 pH 14-2.23 pH 11.77 Example (PageIndex{6}): Equivalence Point When there is an equivalence point of 15 ml 0.15 M CH₃COOH with 0.1 M NaOH? A SOLUTION equivalence point occurs when equal acid moles react with equal mole base. CH₃COOH mmol: 15 ml CH₃COOH and Dfrac.15 mmol CH₃COOH 1 ml) 2.25 mmol CH₃COOH) We must find the amount of ml NaOH to give us the same mmol as CH₃COOH (2.25 mmol CH₃COOH and 0.1 M NAOHX Xml NaOH) X-22.5 ml is therefore the point of equivalence after adding 22.5 ml naoh Levi Links, Robert De. Akevo acid-basic equilibrium and titrates. New York: Oxford University Press Inc. 1991. Petrucci, Ralph H. General Chemistry: Principles - Modern Application, 9th edition. New Jersey: Pearson Prentice Hall. 2007. Outside of Exile Contributors Hyejung Sleep (UCD), Jessica Thornton (UCD) (UCD) weak acid strong base titration curve explanation. weak acid strong base titration curve buffer region. weak acid strong base titration curve equivalence point. weak acid strong base titration curve labeled. weak acid strong base titration curve calculations. weak acid strong base titration curve explained. weak acid strong base titration curve excel. weak acid strong base titration curve pdf

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