**More examples of Buffer calculations**

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| 0.15 mol L-1 NH3 and 0.50 mol L-1 NH4Cl make up a buffer solution. What is the pH of the buffer solution? Ka NH4+ = 5.8 x 10-10NH4+(aq) + H2O(l) ⇄ NH3(aq) + H3O+(aq)**Using Ka**Ka = [NH3][H3O+] [NH4+]5.8 x 10-10 = [0.15][H3O+] [0.50](5.8 x 10-10) (0.50) = [H3O+] 0.151.933 x 10-9 =[H3O+]pH = - log 1.933 x 10-9pH = 8.713***Answer: 8.71*****OR****alternative method using H-H equation**pKa = - log KapKa = - log (5.8 x 10-10)pKa =9.236pH = 9.236 + log 0.15 0.50pH = 9.236 + log 0.3pH = 9.236 + (-0.5228)pH = 8.713***Answer: 8.71*** | 5.78g of sodium ethanoate was added to 1 litre of 0.1 mol L-1 ethanoic acid. What is the pH of the buffer solution? Ka (CH3COOH) = 1.8 x 10-5 M(CH3COONa) = 82 g mol-1Assume that the added mass of sodiumethanoate does not change the total volume of solutionCH3COOH(aq) + H2O(l) ⇄ CH3COO-(aq) + H3O+(aq)n = m Mn (CH3COONa) = 5.78 82n (CH3COONa) = 0.07048 molC (CH3COONa) = n V C (CH3COONa) = 0.07048 = 0.07048 mol L-1 1**Using Ka**Ka = [CH3COO-][H3O+] [CH3COOH]1.8 x 10-5 =0.07048 [H3O+] 12.553 x 10-4 = [H3O+]pH = - log 2.553 x 10-4pH = 3.59***Answer: 3.59*****OR****alternative method using H-H equation**pKa = - log KapKa = - log (1.8 x 10-5 )pKa =4.744pH = 4.744 + log 0.07048 0.1pH = 4.744 + log 0.77048pH = 4.744 + 1.151pH = 3.59***Answer: 3.59*** | 2.64g of Na2HPO4.12H2O and 0.31g of NaH2PO4.2H2O made up a buffer solution with a volume of 1 litre. What is the pH of the buffer solution? Ka H2PO4- = 6.3 x 10-8M (Na2HPO4.12H2O) = 358 g mol-1M (NaH2PO4.2H2O) = 156 g mol-1H2PO4-(aq)+ H2O(l) ⇄ HPO42-(aq)+ H3O+(aq)

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| n = m M |
| n (Na2HPO4.12H2O) = 2.64 358n (Na2HPO4.12H2O) = 7.374 x 10-3 | n (NaH2PO4.2H2O) = 0.31 156n (NaH2PO4.2H2O) = 1.987 x 10-3 |
| C = n V |
| C (Na2HPO4.12H2O) = 7.374 x 10-3 1C = 7.37 x 10-3 mol L-1 | C (NaH2PO4.2H2O) = 1.987 x 10-3 1C = 1.99 x 10-3 mol L-1 |

**Using Ka**Ka = [HPO42][H3O+] [H2PO4-]6.3 x 10-8 =7.37 x 10-3 [H3O+] 1.99 x 10-31.703 x 10-8 = [H3O+]pH = - log 1.703 x 10-8pH = 7.768***Answer: 7.77*****OR****alternative method using H-H equation**pKa = - log KapKa = - log (6.3 x 10-8)pKa =7.2pH = 7.2 + log 7.37 x 10-3  1.99 x 10-3pH = 7.2 + log 3.703pH = 7.2 + 0.5686pH = 7.768***Answer: 7.77*** |
| 50mL of 0.15 mol L-1 Lactic acid (HLac) is mixed with 35mL of 0.25 mol L-1 Sodium lactate (Lac-)what is the pH of the buffer solution?Ka (HLac) = 1.38 x 10-4HLac(aq) + H2O(l) ⇄ Lac-(aq) + H3O+(aq)

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| final concentration = original concentration x original volume final volume |
| C (HLac) = 0.15 x 0.05 0.085C (HLac) = 0.0882 mol L-1 | C (Lac-) = 0.25 x 0.035 0.085C (Lac-) = 0.1029 mol L-1 |

**Using Ka**Ka = [Lac-][H3O+] [HLac]1.38 x 10-4 =0.1029 [H3O+] 0.08821.182 x 10-4 = [H3O+]pH = - log 1.182 x 10-4pH = 3.926***Answer: 3.93*****OR****alternative method using H-H equation**pKa = - log KapKa = - log (1.38 x 10-4)pKa =3.86pH = 3.86 + log 0.1029 0.0882pH = 3.86 + log 1.166pH = 3.86 + (0.0669)pH = 3.926***Answer: 3.93*** | Calculate the ratio of carbonic acid concentration to bicarbonate ion concentration buffer in the blood which maintains a pH of 7.4. Ka (H2CO3) = 4.3 x 10-7H2CO3(aq) + H2O (l) ⇄ HCO3-(aq) + H3O+(aq)pH = - log [H3O+]inverse log – 7.4 = [H3O+]3.98 x 10-8 = [H3O+]**Using Ka**Ka = [HCO3-][3.98 x 10-8 ] [H2CO3]4.3 x 10-7=[HCO3-][3.98 x 10-8 ] [H2CO3]4.3 x 10-7 = [HCO3-] 3.98 x 10-8 [H2CO3]10.8 = [HCO3-] [H2CO3]***Answer: [HCO3-] : [H2CO3] = 11 : 1*****OR****alternative method using H-H equation**pKa = - log KapKa = - log 4.3 x 10-7pKa = 6.3667.4 = 6.366 + log [HCO3-] [H2CO3]7.4 – 6.366 = log [HCO3-] [H2CO3]inverse log 1.033 = [HCO3-] [H2CO3]10.78 = [HCO3-] [H2CO3][HCO3-] : [H2CO3] = 11 : 1***Answer: [HCO3-] : [H2CO3] = 11 : 1*** | Calculate the concentration of C3H5O2- in a buffer solution which has a pH of 4.5 if the concentration of HC3H5O2 is 0.50 mol L-1Ka (HC3H5O2) = 1.34 x 10-5HC3H5O2 (aq) + H2O (l)⇄ C3H5O2- (aq) + H3O+ (aq) pH = - log [H3O+]inverse log – 4.5 = [H3O+]3.16 x 10-5 = [H3O+]**Using Ka**Ka = [C3H5O2-] [H3O+] [HC3H5O2]1.34 x 10-5=[C3H5O2-] 3.16 x 10-5 0.50(1.34 x 10-5) (0.50) = [C3H5O2-]  3.16 x 10-50.2120 = [C3H5O2-] ***Answer 0.212 mol L-1*****OR****alternative method using H-H equation**pKa = - log KapKa = - log (1.34 x 10-5)pKa = 4.8724.5 = 4.872 + log [C3H5O2-]  0.504.5 – 4.872 = log [C3H5O2-]  0.50-0.372 = log [C3H5O2-] 0.5inverse log (-0.372) = [C3H5O2-] 0.5(0.4246) (0.5) = [C3H5O2-]0.2120 = [C3H5O2-] ***Answer 0.212 mol L-1*** |

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