Acids and Bases-Topic 19 (AHL)

(Note: Some of these questions are from paper when caculators were allowed.)

30. 98/26. Benzene, C_6H_6, boils at 80°C and methylbenzene, C_7H_8, boils at 111°C. Which of these substances has the greater enthalpy of vaporisation (ΔH_{vap}) and which will have the higher mole fraction in the vapour during the fractional distillation of an equimolar mixture?

	Greater ΔH_{vap}	**Higher mole fraction in vapour**
A.	benzene	benzene
B.	methylbenzene	benzene
C.	benzene	methylbenzene
D.	methylbenzene	methylbenzene

H 95-37. Only one of the following substances cannot function as a Lewis acid or a Lewis base. Identify that substance on the basis of its structure.

A. NH_4^+ B. NH_2^- C. NH_3 D. BF_3

H 95-40. Equal concentrations of ammonia and ammonium chloride were mixed to give an aqueous buffer solution with a pH = 9.3 . Which one of the following actions would not reduce the pH of this solution to 9.0?

A. Adding some solid ammonium chloride
B. Adding some concentrated hydrochloric acid
C. Diluting the solution with distilled water
D. Boiling briefly to evaporate some of the ammonia

H 95-41. The number of moles of a solid weak organic acid is to be determined by titrating a solid sample with 0.1280 M sodium hydroxide solution. Which one of the following will always give results that are too high?

A. The solid acid is dissolved in 75 cm^3 of water rather than in 50 cm^3 of water.
B. The wet buret is not rinsed with the standard NaOH solution.
C. Methyl orange (pKa 3.4) is used as indicator instead of phenolphthalein (pKa 9.4)
D. A concentration of 0.1208 M is used for the base in the calculations.

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11. 95/38. A student determined the concentration of a solution of hydrochloric acid by an acid-base titration. When a 45.0 cm^3 sample of the acid was titrated to a phenolphthalein endpoint, 36.0 cm^3 of 0.15 M KOH was required. What was the molarity of the hydrochloric acid solution?

A. 0.30 B. 0.24 C. 0.12 D. 0.060

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14. 94/39. Which one of the following species can function as both an acid and a base, according to the Bronsted-Lowry definition?

A. HS^- B. S^{2-} C. NH_4^+ D. Al^{3+}

15. 94/40. All of the following reactions are examples of acid-base reactions **except**

A. $Al(OH)_3(s) + 3H^+(aq) \rightarrow Al^{3+}(aq) + 3H_2O(l)$
B. $Al(OH)_3(s) + OH^-(aq) \rightarrow Al(OH)_4^-(aq)$
C. $2KO_2(s) + 2H_2O(l) \rightarrow 2KOH(s) + H_2O_2(l) + O_2(g)$
D. $POCl_3(l) + 3H_2O(l) \rightarrow H_3PO_4(aq) + 3H^+(aq) + 3Cl^-(aq)$

16. 94/42. Mixing equal volumes of the following solutions will produce a sodium hydrogen carbonate-sodium carbonate buffer in all cases **except**

A. 1.0 M Na_2CO_3 and 1.0 M $NaHCO_3$ B. 2.0 M $NaHCO_3$ and 1.0 M NaOH
C. 2.0 M Na_2CO_3 and 1.0 M HCl D. 2.0 M Na_2CO_3 and 1.0 M NaOH

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H 93-42. Which substance, when dissolved in water, will undergo hydrolysis to form a basic solution?

A. $NaCH_3COO$ B. NH_4Cl C. $NaNO_3$ D. $BaSO_4$

H 93-43. All of the following mixtures will result in the formation of buffer solutions when dissolved in 1.00 dm^3 of water **EXCEPT**

A. 0.20 mol of $NaHCO_3$ and 0.10 mol of Na_2CO_3
B. 0.20 mol of CH_3COOH and 0.10 mol of HCl
C. 0.20 mol of NH_3 and 0.10 mol of NH_4Cl
D. 0.20 mol of NH_3 and 0.10 mol of HCl

17. 93/40. If 35.00 cm^3 of a sodium hydroxide solution NaOH(aq), are required for the neutralisation of a 50.00 cm^3 sample of 0.2000 M sulphuric acid solution, H_2SO_4(aq), which was diluted to 75.00 cm^3, what is the molarity of the sodium hydroxide solution?

A. 1.714 M B. 0.5714 M C. 0.4285 M D. 0.2857 M

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C. 0.20 mol of NH_3 and 0.10 mol of NH_4Cl D. 0.20 mol of NH_3 and 0.10 mol of HCl

G 93-29. If a solution has a pH of 7.40, the molar hydroxide ion concentration is

A. 6.6 B. 2.5×10^{-7} C. 4.0×10^{-8} D. 1.3×10^{-15}

A 92-31. Which one of the following is the strongest acid?

A. Ascorbic acid, $K_a = 8.0 \times 10^{-5}$
B. Benzoic acid, $K_a = 6.5 \times 10^{-5}$
C. 2-hydroxybenzoic acid, $K_a = 1.1 \times 10^{-3}$
D. chloroethanoic acid, $K_a = 1.4 \times 10^{-3}$

G 92-30. The following pairs are mixtures of 0.1 M aqueous solution. Which pair would be a buffer solution?

A. HCl and NaCl B. HCl and $NaNO_3$
C. NH_3 and HCl D. NaOH and HCl

20. 92/44. If a 1M aqueous solution of ethanoic acid is compared with an equal volume of 1M aqueous hydrochloric acid, the hydrochloric acid

A. would have a higher pH value.
B. would require a larger volume of 1M sodium hydroxide for neutralization.
C. would have a higher molar concentration of hydronium ions.
D. would produce a solution with a higher pH value at the equivalence point when titrated with

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with 1M sodium hydroxide.

H 91-49. Which one of the following species cannot function as a Lewis acid?

A. H^- B. CH_3^+ C. Al^{3+} D. $AlCl_3$

H 91-50. Which one of the following compounds will produce a gas when added to an aqueous solution of sulphuric acid?

A. Aluminum nitrate B. Sodium carbonate
C. Iron(III) bromide D. Lead(II) ethanoate

G 91-22. Gaseous hydrogen chloride can be dissolved in water and in methylbenzene. The electrical conductivity of the water solution is much greater than that of the methylbenzene solution. Which of the following statements best accounts for this behaviour?

A. Pure water is a better conductor than methylbenzene.
B. Water is a better proton acceptor than methylbenzene.
C. Water and methylbenzene are immiscible.
D. Hydrogen chloride has a higher solubility in water than in methylbenzene.

G 91-25. The acid dissociation constant, $K_a(HS^-)$, is the equilibrium constant for the reaction (in aqueous solution)

A. $HS^- + H_2O \Leftrightarrow H_2S + OH^-$
B. $HS^- + H_3O^+ \Leftrightarrow H_2S + H_2O$
C. $HS^- + OH^- \Leftrightarrow S^{2-} + H_2O$
D. $HS^- + H_2O \Leftrightarrow H_3O^+ S^{2-}$

G 91-27. What is the pH of a solution in which $[OH^-] = 0.020$ M?

A. 12.00 B. 12.30 C. 12.60 D. 13.00

21. 91/37. Ethanedioic acid, oxalic acid, $H_2C_2O_4$, is a diprotic acid. Which one of the following species would be expected to have the lowest concentration in a 0.1 M solution of the acid?

A. $H_2C_2O_4$ B. H_3O^+ C. $HC_2O_4^-$ D. $C_2O_4^{2-}$

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23. 91/50. Which one of the following compounds will produce a gas when added to an aqueous solution of sulphuric acid?

A. Aluminum nitrate B. Sodium Carbonate C. Iron(III) bromide D. Lead(II) ethanoate

24. 90/26. How many mL of 0.500 M hydrochloric acid are needed to titrate completely 25.0 mL of 0.150 M barium hydroxide solution?

A. 7.5 mL B. 10.0 mL C. 12.5 mL D. 15.0 mL

The following information relates to questions 90/37 and 90/38. Ethanedioic acid (oxalic acid) is a diprotic acid, $H_2C_2O_4$, with $K_1 = 5.4x10^{-2}$ and $K_2 = 5.3x10^{-5}$.
A 0.15 M aqueous solution of $H_2C_2O_4$ is made up and has a pH of 1.17.

25. 90/37. What is the $[H_3O^+]$ concentration in this solution?

A. 0.15 M B. 0.090 M C. 0.082 M D. 0.068 M

26. 90/38. What is the $[HC_2O_4^-]$ concentration in this solution?

A. 0.090 M B. 0.082 M C. 0.068 M D. 0.056 M

27. 90/39. Which of the following 0.01 molar solutions is the most acidic?

A. Na_2CO_3 B. NaCN C. $Mg(NO_3)_2$ D. $FeCl_3$

28. 90/40. For a given weak acid, HA, the value of K_a

A. will change with the pH B. will change with the pOH
C. will change with temperature D. cannot be less than 10^{-7}

29. 90/41. The following 3 statements are about buffer solutions. Which is/are false?

I. A buffer solution could consist of equal concentrations of ammonia and ammonium sulphate.
II. A buffer solution could consist of equal concentrations of nitric acid and ammonium nitrate.
III. A buffer solution will change only slightly in pH upon the addition of strong acid or strong base.

A. I only B. II only C. III only D. I and II only

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