PHYSICAL / INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 19

Total Marks : 31

Max. Time : 35 min.

Topic : Ionic Equilibrium

Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.4 to Q.7	(4 marks, 5 min.)	[16, 20]
Comprehension ('–1' negative marking) Q.8 to Q.9	(3 marks, 3 min.)	[6, 6]

1. A weak acid HA after treatment with 12 ml of 0.1 M strong base BOH has a pH of 5 . At the end point, the volume of same base required is 27 ml . K_a of acid is :

(A) 1.8×10^{-5} (B) 8×10^{-6} (C) 1.8×10^{-6} (D) 8.2×10^{-5}

2. **(a)** Which of the following indicators is best suited in the titration of a weak acid versus a strong base ?

(A) phenolpthalein (8.3 – 10.0) (B) methyl orange (3.1 – 4.4)

(C) methyl red (4.2 – 6.3) (D) litmus (4.5 – 8.3)

(b) Which of the following indicators is best suited in the titration of a weak base versus a strong acid ?

(A) phenolphthalein (8.3 – 10.0) (B) phenol red (6.8 – 8.4)

(C) methyl organe (3.1 – 4.4) (D) litmus (4.5 – 8.3)

3. **(a)** The best indicator for the detection of end point in titration of a weak acid & a strong base is:

(A) methyl orange (pH 3 to 4) (B) methyl red (pH 5 to 6)

(C) bromothymol blue (pH 6 to 7.5) (D) phenolphthalein (pH 8 to 9.6)

(b) For the acid H_2X, $pK_1 = 4$ and $pK_2 = 10$. Which of the following indicators(with their ranges provided) is most suitable for the titration $H_2X + OH^- \rightarrow HX^- + H_2O$?

(A) Methyl orange (3.1 to 4.4) (B) Bromocresol green (3.8 to 5.4)

(C) p-nitrophenol (5.6 to 7.6) (D) Phenolphthalein (8 to 9.6)

4. 0.1 M CH_3COOH solution is titrated against 0.05 N NaOH solution. Calculate pH at $1/4^{th}$ and $3/4^{th}$ neutralization of acid. The pH for 0.1 M CH_3COOH is 3 .

5. 25 ml of 0.1 mol/litre aqueous pyridine ($K_b = 1.6 \times 10^{-9}$ mol/litre) is titrated with 0.1 mol/litre hydrochloric acid. Calculate pH at equivalence point (neutralization point) and after 30 cm^3 hydrochloric acid have been added .

6. The equivalent point in a titration of 40 ml of a solution of a weak monoprotic acid occurs when 32 ml of a 0.1 M NaOH solution has been added . The pH of the solution is 5.75 after the addition of 20 ml of NaOH solution. What is K_a of the acid. [antilog(0.45) = 2.8]

7. A solution of weak acid HA was titrated with NaOH, the end point is obtained by the addition of 36 ml of 0.1 N NaOH. Now 18 ml of 0.1 N HCl was added to titrated solution. The pH was found to be 4.5. Calculate K_a for the acid HA .

8. **Comprehension # (Q.(i) to Q.(iii))**

Read the following paragraph carefully and answer the following questions based on it : (Q.(i) to Q.(iii))

A solution capable of maintaining its pH relatively constant, when either excess acid or excess base is added, is said to be buffered. While it is not usually considered a buffered solution, a concentrated solution (10^{-2} M and higher) of a strong acid or strong base is buffered against large changes in pH when acids or bases are added.

Buffered solutions are usually those containing a weak acid and a salt of that weak acid or a weak base and the salt of that weak base. For example a solution containing HAC and NaAC resists large changes in pH when acid or alkali is added.

For a buffer solution Buffer capacity is defined as the number of moles of a strong acid or a strong base that causes 1L of the buffer to undergo a 1 unit change in pH. Buffer capacity is maximum when the molar ratio of the two components is unity and the buffer solution is considered good.

(i). The least change in pH on adding 0.01 mol of HCl to 1 litre of conc. HCl solutions will be in case of:

(A) 0.1 M HCl solution (B) 0.2 M HCl solution

(C) 0.3 M HCl solution (D) 0.4 M HCl solution

(ii). Which solution is not a buffer solution ?

(A) NaCN (2 mole) + HCl (1 mole) in 5 L (B) NaCN (1 mole) + HCl (1 mole) in 5L

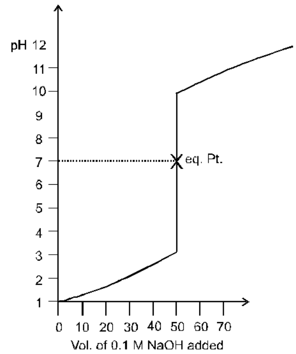
(C) NH_3 (2 mole) + HCl (1 mole) in 5 L (D) CH_3COOH (2 mole) + KOH (1 mole) in 5L

(iii). Which species has the lowest concentration in a solution prepared by mixing 0.1 mole each of HCN and NaCN in 1L solution ? K_a (HCN) = 10^{-10}.

(A) CN^- (B) HCN (C) H^+ (D) OH^-

9. **Comprehension # (Q.(i) to Q.(iii))**

50 ml 0.1 M HCl is titrated against V ml 0.1 M NaOH solution. Titration curve is as follows.



This suitable indicator for this titration can be selected on the following basis.

The steep section of the titration curve at the equivalence point must encompass an internal of pH values at least as large as the pH transition range of an indicator.

The pH transition range of the indicator should most concide with the steep portion of the titration curve.

Indicator	Colour change		pH transition range
	in acid form	in basic form	
Phenolphthalein	Colourless	Pink	8.3 to 10
Bromomethyl blue	Orange	Blue	6.0 to 8.0
Methyl orange	Red	Yellow	3.1 to 4.5

(i). Which of the following indicator can be used for this titration ?

(A) phenophthalein (B) Bromomethyl blue (C) Methyl orange (D) All of these

(ii). 50 ml of 0.1 M HCl is titrated with 0.1 M NaOH. At pH = 3, vol of NaOH used is (approximately) :

(A) 49 ml (B) 50 ml (C) 45 ml (D) 41 ml

(iii). 100 ml of 0.1 M NaOH is titrated with 100 ml of 0.05 M H_2SO_4. The pH of the solution is (For H_2SO_4, $Ka_1 = \infty$, $Ka_2 = 10^{-2}$, log 5 = 0.7, log 2 = 0.3).

(A) 7 (B) 7.2 (C) 7.4 (D) None

Answer Key

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1.	(B)	**2.**	**(a)** (A) **(b)** (C)	**3.**	**(a)** (D) **(b)** (C)	**4.**	4.52, 5.48.
5.	3.25	**6.**	2.95×10^{-6}	**7.**	3.162×10^{-5}	**8.**	**(i)** (D) **(ii)** (B) **(iii)** (C)
9.	**(i)** (D) **(ii)** (A) **(iii)** (B)						

Hints & Solutions

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8. **(i)** The conc. of HCl is highest in this case.
(ii) This is actually a solution of weak acid HCN with salt NaCl (having spectator ions only)
(iii) $[H^+] = 10^{-10}$ M from Hendersen equation.

9. **(iii)**

	$NaOH + H_2SO_4 \longrightarrow$		$NaHSO_4 + H_2O$
initial m mole	10	5	0
reaction	5	0	5

$NaOH + NaHSO_4 \longrightarrow$		$Na_2SO_4 + H_2O$
5	5	0
0	0	5

$$pH = 7 + \frac{1}{2}\left[2 + \log\frac{5}{200}\right] = 7 + \frac{1}{2}\left[2 + \log 5 - \log 200\right] = 7 + \frac{1}{2}\left[2 + 0.7 - 0.3 - 2\right] = \mathbf{7.2.}$$