NORTH CAMPUS
64, Shastri Nagar,
Ajmer (Rajasthan)
Ph. 2 62 52 92

RACE PRAC-SHEET

An IIT / PMT / MBA / CA / IAS Foundation

IJSO | Talent Search | M-Sc-Astro Olympiad | IIT / PMT Foundation

SOUTH CAMPUS
C plus
409/28, Nr. P. O. Bhajan Ganj,
Petrol Pump No-9, Ajmer
Ph. 2 66 52 91

ANSWER KEY & SOLUTIONS

(ACIDS, BASES & SALTS (Theories of Acids & Bases, pH, pOH, Kw)

1. Here we are given that

$[H_3O^+] = 1.3 \times 10^{-5}$

$pH = -\log [H_3O^+] = -\log (1.3 \times 10^{-5})$

$= -(\log 1.3 + \log 10^{-5})$

$= -0.1139 + 5 = 4.8861$

$= \mathbf{4.89}$

As pH is less than 7, the black coffee is *acidic*.

2. Concentration of HNO_3 solution = 0.63 g per 100 ml (*Given*)

$= 6.3 \text{ g per litre} = \frac{6 \cdot 3}{63} \text{ moles/litre}$

$= 10^{-1}$ M

($\because$ Mol. wt. of $HNO_3 = 63$)

Now, HNO_3 completely ionizes as

$HNO_3 + H_2O \longrightarrow H_3O^+ + NO_3^-$

$\therefore [H_3O^+] = [HNO_3]$

$= 10^{-1}$ M

$\therefore \quad pH = -\log [H_3O^+]$

$= -\log 10^{-1} = \mathbf{1}$

3. $N_1V_1 = N_2V_2$, $25 \times 1 / 100 = N_2 \times 500$

or $N_2 = 5 \times 10^{-4}$ N

$[H^+] = [HCl] = 5 \times 10^{-4}$ M

$pH = -\log (5 \times 10^{-4})$

$= 4 - \log 5 = 4 - 0 \cdot 6990 = 3 \cdot 301.$

4. *(i) Calculation of molarity :*

Weight of NaOH dissolved = 4.0 g/litre

Mol. wt. of NaOH = 40

$\therefore$ Molarity of the solution

$= \frac{\text{Strength in g/ litre}}{\text{Mol. wt.}}$

$= \frac{4 \cdot 0}{40} = 0 \cdot 1$ M

(ii) Calculation of the OH^- ion conc.

NaOH completely ionizes as

$NaOH \longrightarrow Na^+ + OH^-$

$\therefore [OH^-] = [NaOH] = 0.1 \text{ M} = 10^{-1}$ M

(iii) Calculation of pH :

We know that

$[H_3O^+] [OH^-] = K_w = 1.0 \times 10^{-14}$

$\therefore [H_3O^+] = \frac{K_w}{[OH^-]} = \frac{1 \cdot 0 \times 10^{-14}}{10^{-1}}$

$= 10^{-13}$ M

$\therefore \quad pH = -\log [H_3O^+]$

$= -\log 10^{-13} = \mathbf{13}.$

5. $pH = 3$ means $[H^+] = 10^{-3}$ M and $pH = 5$ means $[H^+] = 10^{-5}$ M. On mixing equal volumes, in the final solution,

$$[H^+] = (10^{-3} + 10^{-5})/2$$
$$= \frac{10^{-3}(1 + 10^{-2})}{2}$$
$$= \frac{1 \cdot 01 \times 10^{-3}}{2} = 0 \cdot 505 \times 10^{-3} \text{ M}$$
$$= 5 \cdot 05 \times 10^{-4} \text{ M}$$
$$\therefore \ pH = -\log(5 \cdot 05 \times 10^{-4}) = 4 - 0 \cdot 7033$$
$$\approx 3 \cdot 3$$

6. $pH = 4$ means $[H^+] = 10^{-4}$ M and $pH = 10$ means $[H^+] = 10^{-10}$ M or $[OH^-] = 10^{-4}$ M. Thus they will exactly neutralise each other and pH of the resulting solution will be = 7.

7. 100 cm³ of solution with $pH = 3$ contains H^+

$$= \frac{10^{-3}}{1000} \times 100 = 10^{-4} \text{ mole}$$

400 cm³ of solution with $pH = 4$ contains

$$H^+ = \frac{10^{-4}}{1000} \times 400$$
$$= 4 \times 10^{-5} \text{ mole}$$
$$\text{Total } H^+ = 10^{-4} + 4 \times 10^{-5}$$
$$= 10^{-4}(1 + 0 \cdot 4) = 1 \cdot 4 \times 10^{4}$$
$$\text{Total volume} = 500 \text{ cm}^3$$
$$\therefore \ [H^+] = \frac{1 \cdot 4 \times 10^{-4}}{500} \times 1000 \text{ M}$$
$$= 2 \cdot 8 \times 10^{-4} \text{ M}$$
$$pH = -\log(2 \cdot 8 \times 10^{-4})$$
$$= 4 - 0 \cdot 4472$$
$$\approx \mathbf{3 \cdot 55}$$

8. (*a*) $pH = 7$.

(*b*) M/10 HCl left unneutralized = 10 ml of M/10

Total volume = 100 ml.

$$\therefore \quad 10 \times \frac{M}{10} = 100 \times ?\ M$$
$$\therefore \quad [HCl] = \frac{1}{100} = 10^{-2} \text{ M}. \ pH = 2$$

(*c*) solution is basic, pH will be > 7.

(*d*) 75 ml M/5 HCl = 15 millimoles, 25 ml of M/5 NaOH = 5 millimoles. HCl left unneutralised = 10 millimoles. Volume = 100 ml.

$$\therefore \quad [HCl] = \frac{10}{100} = 0 \cdot 1 \text{ M}$$
$$pH = -\log(0 \cdot 1) = 1.$$

9. 75 ml of (M/5) HCl + 25 ml of (M/5) NaOH

10. $0 \cdot 001$ M KOH means $[OH^-] = 10^{-3}$.

Hence $[H_3O^+] = 10^{-11}$.

11. pH = 7

12. Ag^+ ion is a Lewis acid. CH_4 is neither Lewis acid nor Lewis base.

13. $NH_2^- + H^+ = NH_3$.

14. Higher the $[H^+]$, lower is the pH.
1 M H_2SO_4 has highest $[H^+]$.

15. pH = 7 at the end point is only for strong acid with strong base.