

41. (a) $pH = pK_a + \log \left[\frac{\text{salt}}{\text{acid}} \right]$
 $= 9.30 + \log \left[\frac{0.2}{0.1} \right] = 9.30 + 0.3010 = 9.6.$

42. (a) $pH = pK_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$
 $pH = -\log(1.8 \times 10^{-5}) + \log \frac{[10]}{[100]}$
 $= -\log 1.8 + 5 + \log 10^{-1}$
 $= -0.2553 + 5 - 1 = 3.7447 \text{ or } 4$

43. (b) 20 ml. of 0.1 $NHCl = \frac{0.1}{1000} \times 20 \text{ g eq.} = 2 \times 10^{-3} \text{ g eq.}$
 $20 \text{ ml. of } 0.001 KOH = \frac{0.001}{1000} \times 20 \text{ g meq.}$
 $= 2 \times 10^{-5} \text{ g eq.}$
 $\therefore HCl \text{ left unneutralised} = 2(10^{-3} - 10^{-5})$
 $= 2 \times 10^{-3}(1 - 0.01) = 2 \times 0.99 \times 10^{-3} = 1.98 \times 10^{-3} \text{ g eq.}$

Volume of solution = 40 ml.

$$\therefore [HCl] = \frac{1.98 \times 10^{-3}}{40} \times 1000 M = 4.95 \times 10^{-2}$$

ESTD: 2005

 $\therefore pH = 2 - \log 4.95 = 2 - 0.7 = 1.3.$

44. (d) > 7

Explanation (Step-by-Step & Easy):

1. Find moles of NaOH (strong base):

Moles of NaOH = N × V = 0.1 × 10 mL = 0.001 mol

2. Find moles of H_2SO_4 (diprotic strong acid):

H_2SO_4 gives 2 H^+ ions, so effective normality = $2 \times 0.05 = 0.1 \text{ N}$

Moles of H_2SO_4 = $0.05 \times 10 \text{ mL} = 0.0005 \text{ mol acid}$



But it gives double H^+ , so total $H^+ =$

$$0.0005 \times 2 = 0.001 \text{ mol } H^+$$

3. Compare Base and Acid:

$NaOH$ gives 0.001 mol OH^-

H_2SO_4 gives 0.001 mol H^+

They exactly neutralize each other

→ Solution becomes neutral (but total volume becomes 20 mL → dilution effect)

4. Final Result:

After neutralization, no extra H^+ or OH^- remains, but the solution contains Na_2SO_4 salt, which is a salt of strong acid + strong base → neutral salt.

So $pH \approx 7$, but it may be slightly basic due to dilution and ionic nature.

45. (b) $10^{-7} M NaOH$ means $[OH^-] = 10^{-7}$; $pOH = 7$ $pH = 14 - 7 = 7$

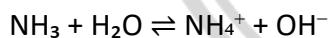
46. (a) $[H^+] = c \times \alpha = 0.1 \times \frac{30}{100} = 0.03 M$

47. (a) 11.27

Explanation (Word-Friendly):

Ammonia (NH_3) is a weak base.

It ionizes in water as:



We use the formula:

$$pOH = \frac{1}{2} [pK_b - \log C]$$

For NH_3 :

$$K_b = 1.8 \times 10^{-5} \rightarrow pK_b = 4.74$$

$$C = 0.1 M$$

Step-by-Step:

$$pOH = \frac{1}{2} [pK_b - \log C]$$

$$pOH = \frac{1}{2} [4.74 - \log(0.1)]$$

$$pOH = \frac{1}{2} [4.74 - (-1)]$$

$$pOH = \frac{1}{2} [4.74 + 1] = \frac{1}{2} \times 5.74 = 2.87$$

$$pH = 14 - pOH = 14 - 2.87 = 11.13 \approx 11.27$$

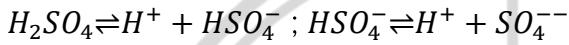


48. (a) The pH of buffer solution never changed.

49. (c) $[H^+] = \frac{10^{-14}}{10^{-1}} = 10^{-13} \text{ mol/litre}$ $pH = 13$.

50. (a) $pH = -\log[H^+]$; $7.4 = -\log[H^+]$; $[H^+] = 4 \times 10^{-8} M$

51. (a) The pH of $0.1 M HCl = 1$ Ionization of H_2SO_4 takes place in two steps.



52. (c) $1N NaOH$ solution have highest pH

$$[OH^-] = 1; pOH = 0; pH + pOH = 14$$

$$pH = 14 - 0 = 14$$

53. (c) $H_2O \rightleftharpoons [H^+][OH^-]$



$$\text{Total } [H^+] = [H^+]_{H_2O} + [H^+]_{HCl} = 10^{-7} + 10^{-8}$$

$$= 10^{-7}[1 + 10^{-1}]$$

$$[H^+] = 10^{-7} \times \frac{11}{10}$$

$$pH = -\log[H^+] = -\log(10^{-7} + \frac{11}{10}); pH = 6.958$$

54. (c) $pK_a = -\log K_a$, $pK_b = -\log K_b$

$$pH = -\frac{1}{2}[\log K_a + \log K_b - \log K_w]$$

$$= -\frac{1}{2}[-5 + \log(1 \times 10^{-14}) - (-5)]$$



$$= -\frac{1}{2}[-5 - 14 + 5] = -\frac{1}{2}(-14) = 7$$

55. (d) BaO , CaO and Na_2O are shows more than 7 pH because of their basic nature.

56. (a) $MgCl_2 + 2H_2O \rightleftharpoons Mg(OH)_2 + 2HCl$

57. (c) H_2SO_4 ionized in two step.

58. (b) $pH = pK_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$

$$5.8 = 4.8 + \log \frac{[\text{Salt}]}{[\text{Acid}]} \text{ or } \log \frac{[\text{Salt}]}{[\text{Acid}]} = 1.0$$

$$\frac{[\text{Salt}]}{[\text{Acid}]} = \text{antilog } 1.0 = 10$$

$$\therefore \frac{[\text{Acid}]}{[\text{Salt}]} = \frac{1}{10} = 0.1$$

59. (b) It contains replaceable H atom.

60. (c) (i) 20 ml of 0.5 N HCl

$0.5N \Rightarrow 1000\text{ml}$ 0.5 mole HCl is present in 20 ml

$$= \frac{20 \times 0.5}{1000} = 1.0 \times 10^{-2}$$

(ii) 35 ml of 0.1 N $NaOH$

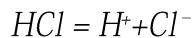
$0.1N \Rightarrow 1000\text{ml}$ of 0.1 mole $NaOH$ is 35 ml

$$= \frac{35 \times 0.1}{1000} = 0.35 \times 10^{-2}$$

Total = 20 + 35 = 55 ml.

$$\Rightarrow (1.0 - 0.35) 10^{-2} = 0.65 \times 10^{-2} \text{ mole } HCl$$





$$\Rightarrow [HCl] = [H^+] + [Cl^-]$$

55 ml contains 0.65×10^{-2} mole of H^+ ions

$$1000\text{ml} - \frac{0.65 \times 10^{-2} \times 10^3}{55} = \frac{6.5}{55}$$

$$\begin{aligned} pH &= -\log[H^+] = -\log(6.5/55) \\ &= \log 55 - \log 6.5 = 0.92 \end{aligned}$$

Due to acidic nature of solutions the colour of phenolphthalein becomes pink.

