CH40S Acid Base Review Key

① HZ -> Ka is largest ∴ more products (H^+'s)

② NOTES

③ NOTES

④ a) HBr – STRONG ACID
b) O^{2-} STRONG BASE
c) ClO_4^- – weak base
d) H_2O_2 – weak acid
e) SO_4^{2-} – strong base
f) OH^- – strong base

⑤ $NaHCO_3 + \underset{\text{STRONG ACID}}{HCl} \rightarrow NaCl + \underset{\text{weak acid}}{H_2CO_3}$

∴ Prod. favoured – strong acid more likely to donate H^+

⑥ $\underset{A}{\boxed{H_2S}} + \underset{B}{NH_3} \rightleftharpoons \underset{CA}{\boxed{NH_4^+}} + \underset{CB}{HS^-}$

H_2S is stronger acid, ∴ donates more H^+ ∴ rxn is product favoured.

⑦ NOTES

⑧ $H_2O + HBb \rightleftharpoons H_3O^+ + Bb^-$

a) add NaOH – OH^- reacts w H_3O^+ -> $[H_3O^+]$ ↓
rxn shifts right

b) add HCl -> H^+ increases $[H_3O^+]$, ∴ rxn shifts left

⑨ $H_2S + H_2O \rightleftharpoons H_3O^+ + HS^-$ $\quad K_a = \frac{[H_3O^+][HS^-]}{[H_2S]}$

0.5		0	0
$-x$		$+x$	$+x$
$0.5-x$		x	x

$K_a = 2.24 \times 10^{-7} M = [HS^-] = [H_3O^+]$

$[H_2S] = 0.499\,M$

$pH = 3.65$ $\quad$ % diss = 0.045%

⑩ $HX + H_2O \rightleftharpoons H_3O^+ + X^-$

0.750		0	0
-3.16×10^{-4}	X	$+3.16\times10^{-4}$	$+3.16\times10^{-4}$
0.749		3.16×10^{-4}	3.16×10^{-4}

$pH = 3.5$

$[H_3O] = 10^{-3.5} = 3.16\times10^{-4}\ M$

$K_a = \frac{(3.16\times10^{-4})^2}{0.749} = \boxed{1.33\times10^{-7}}$

⑪ $HClO_4 + H_2O \longrightarrow H_3O^+ + ClO_4^-$ (STRONG ACID)

$4\times10^{-3} \longrightarrow \boxed{4\times10^{-3}\ M}$

$pH = -\log 4\times10^{-3} = \boxed{2.39}$

⑫ $BOH \longrightarrow B^+ + OH^-$

$pH = 8.4$

$pOH = 14 - 8.6 = 5.4$

$[OH^-] = 10^{-5.4} = 3.98\times10^{-6}\ M$

$\% = \frac{[OH^-]}{[BOH]} \times 100$

$0.948 = \frac{3.98\times10^{-6}\ M}{[BOH]} \times 100$

$[BOH] = \boxed{4.2\times10^{-4}\ M}$

⑬ $2H_3PO_4 + 3Ca(OH)_2 \rightarrow Ca_3(PO_4)_2 + 6H_2O$

$(0.005\ \frac{mol}{L})(0.02L) = 1\times10^{-4}\ mol\ Ca(OH)_2 \times \frac{2}{3} = \frac{6.67\times10^{-5}\ mol\ H_3PO_4}{0.0025\ \frac{mol}{L}}$

$= \boxed{2.67\times10^{-2}\ L}$

⑭ $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

$\frac{2.5g}{40.01\ g/mol} = 0.062\ mol\ NaOH \times \frac{1}{2} = \frac{0.031\ mol\ H_2SO_4}{2.5\ mol/L} = \boxed{0.0125\ L}$

(15) $HA + NaOH \rightarrow NaA + H_2O$

$(0.15 \frac{mol}{L})(0.03L) = 0.0045 mol\ NaOH \times \frac{1}{1} = 0.0045 mol\ HA$

$\frac{0.900g}{0.0045 mol} = \boxed{200 g}$

(16) $[H_3O^+] = 10^{-4.6} = \boxed{2.51 \times 10^{-5} M}$

$[OH^-] = \frac{K_w}{[H_3O^+]} = \boxed{3.98 \times 10^{-10} M}$

(17) $0.15 \frac{mol}{L} \times \frac{0.06\%}{100} = \boxed{9 \times 10^{-5} M = [H_3O^+],\ pH = 4.04}$

* Ka not needed!

(18) $HA + H_2O \rightleftharpoons H_3O^+ + A^-$

$\% = \frac{[H_3O^+]}{[HA]} \times 100$

$= \frac{6.5 \times 10^{-4} M}{2.0 M} \times 100 = \boxed{0.0325\%}$

(19) $HA + H_2O \rightleftharpoons A^- + H_3O^+$ $\quad K_a = \frac{(2 \times 10^{-5})^2}{0.44}$

0.44		0	0
-2×10^{-5}		$+2 \times 10^{-5}$	2×10^{-5}
0.44		2×10^{-5}	2×10^{-5}

$= \boxed{9.1 \times 10^{-10}}$

(20) $HA + H_2O \rightleftharpoons H_3O^+ + A^-$ $\quad K_a = \frac{[H_3O^+][A^-]}{[HA]}$

0.25		0	0
$-x$		$-x$	$-x$
$0.25 - x$		x	x

$3 \times 10^{-8} = \frac{x^2}{0.25 - x}$ Assume

$x = \boxed{8.66 \times 10^{-5} M = [H_3O^+]}$

$\boxed{pH = 4.06,\ pOH = 9.93}$

(21) $HA + NaOH \rightarrow NaA + H_2O$

$(0.1026 \frac{mol}{L})(0.018L) = 0.00185 mol\ NaOH \times \frac{1}{1} = 0.00185 mol\ HA$

$\frac{0.399g}{0.00185 mol} = \boxed{216.1 g/mol}$

(22) a) $HCO_3^- + HC_2O_4^- \rightleftharpoons H_2CO_3 + C_2O_4^{2-}$

B (weaker acid) A (stronger acid) A B

∴ donates H^+

b) compare acids on each side, HC_2O_4 is stronger than H_2CO_3 (K_a is bigger) ∴ product favoured (HC_2O_4 donates more H^+)

(23)

	H_2X	$+ H_2O \rightleftharpoons$	H_3O^+	$+ HX^-$
I	0.75		0	0
C	-3.16×10^{-4}		3.16×10^{-4}	3.16×10^{-4}
E	0.75		3.16×10^{-4}	3.16×10^{-4}

$[H_3O^+] = 10^{-3.5} = 3.16\times10^{-4}\ M$

$$K_a = \frac{(3.16\times10^{-4})^2}{0.75} = 1.33\times10^{-7}$$

(24)

	HNO_2	$+ H_2O \rightleftharpoons$	H_3O^+	$+ NO_2^-$
I	0.5		0	0
C	$-x$		$+x$	$+x$
E	$(0.5-x)$		x	x

$$K_a = \frac{[H_3O^+][NO_2^-]}{[HNO_2]}$$

$$5.1\times10^{-4} = \frac{x^2}{0.5-x}$$ assume

$x = 0.16\ M = [H_3O^+]$, $pH = 1.8$, $\%\ diss = 3.2\%$

(25) Ans: 10.9

	CO_3^{2-}	$+ H_2O \rightleftharpoons$	HCO_3^-	$+ OH^-$
I	0.00025		0	0
C	$-x$		$+x$	$+x$
E	$0.0025-x$		x	x

$$2.1\times10^{-4} = \frac{x^2}{0.0025-x}$$

$x = 7.25\times10^{-4}\ mol/L = [OH^-]$

$pOH = 3.13$

$pH = 10.9$

(26) $Mg(OH)_2 + H_2SO_3 \rightarrow MgSO_3 + 2H_2O$

$(0.35\ mol/L)(0.655\ L) = 0.229\ mol\ H_2SO_3 \times \frac{1}{1} = 0.229\ mol\ Mg(OH)_2$

$$\frac{0.229\ mol}{5.2\ mol/L} = 0.044\ L$$

44.4 mL

(27) $NaOH \rightarrow Na^+ + OH^-$ (strong base)

$pH = 12$, $pOH = 2$, $\therefore [OH^-] = 10^{-2} = 1 \times 10^{-2}\ mol/L$

strong base, $\therefore [NaOH] = 1 \times 10^{-2}\ \frac{mol}{L} \times 2.0\ L = 2 \times 10^{-2}\ mol\ NaOH$

$2 \times 10^{-2}\ mol \times 40.01\ g/mol = \boxed{0.8\ g\ NaOH}$

(28) NOTES