ACID/BASE I REVIEW

KEY

①	$[H^+]$	pH	pOH	$[OH^-]$	A/B/N?
a)	$3.0\times10^{-2}M$	$1.52\cancel{3}$	12.48	$3.3\times10^{-13}M$	A
b)	$4.6\times10^{-8}M$	7.34	6.66	$2.2\times10^{-7}M$	B
c)	$1.9\times10^{-12}M$	11.72	2.28	$5.2\times10^{-3}M$	B
d)	$5.9\times10^{-9}M$	8.23	5.77	$1.7\times10^{-6}M$	B
e)	$8.0\times10^{-5}M$	4.10	9.90	$1.3\times10^{-10}M$	A
f)	$1.0\times10^{-7}M$	7.00	7.00	$1.0\times10^{-7}M$	N
g)	$1.0\times10^{-3}M$	3.00	11.00	$1.0\times10^{-11}M$	A
h)	10M	−1.0	15.0	$1\times10^{-15}M$	A
i)	$1.1\times10^{-12}M$	11.96	2.06	$8.7\times10^{-3}M$	B
j)	$2.6\times10^{-6}M$	5.58	8.42	$3.8\times10^{-9}M$	A.

2) ② $[H^+] = 3.7\times10^{-8}M$ $[OH^-] = 2.7\times10^{-7}M$

③ a) pH = −0.30 pOH = 14.30 b) pH = 10.54, pOH = 3.46 c) 0.70, pOH = 13.30.
↳ (the second proton will be donated to a small degree which we will learn about next unit)

d) pH = 8.398 pOH = 5.602

④ $H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$

mol H_2SO_4 = (0.500M)(0.02500L) = 0.0125 / H_2SO_4 is diprotic

mol H^+ = 2 × 0.0125 = 0.0250

mol OH^- = 0.0250

mol NaOH = 0.0250

mass NaOH = $\dfrac{0.0250\,mol \mid 40.0\,g}{\mid 1\,mol}$ = 1.00 g NaOH

⑤ $M_iV_i = M_fV_f$

$\therefore M_f = \dfrac{M_iV_i}{V_f}$

$M_f = \dfrac{(0.15M)(0.02500L)}{0.1000L} = 0.0375\,M$

$[H_3O^+]_f = 0.0375M \therefore$ pH = 1.43

⑥ a) H_2Te b) HTe^-

⑦ $\underset{B}{HCO_3^-} + \underset{A}{HIO_3} \rightleftharpoons \underset{A}{H_2CO_3} + \underset{B}{IO_3^-}$

⑧ a) Conjugate base : The base produced when an acid reacts with water. A conj base has one less proton than its corresponding acid.

b) $\underset{A}{HCN}$, $\underset{B}{CN^-}$

⑨ $HNO_3 + KOH \longrightarrow KNO_2 + H_2O$.

mol HNO_3 = (0.35M)(0.25 L) = 0.0875

mol H^+ = 0.0875

mol OH^- = 0.0875

mol KOH = 0.0875

Volume KOH = $\dfrac{mol}{M} = \dfrac{0.0875\,mol}{0.050M}$ = 1.75 or 1.8 L

⑩ $[H_3O^+] = 6.3\times10^{-5}M$ $[OH^-] = 1.6\times10^{-10}M$

⑪ $HCl + KOH \longrightarrow KCl + H_2O$

mol H^+ = (0.150M)(0.0600L) = 0.00900

mol OH^- = (0.100M)(0.1400L) = 0.0140

mol OH^- in excess = 0.0140 − 0.00900 = 0.0050

$[OH^-] = \dfrac{0.0050\,mol}{0.200\,L}$ = 0.025 M ∴ pOH = 1.60 ∴ pH = 12.40

⑫ a) a substance that can act as an acid or a base

b) $H_2PO_4^-$

⑬ a) $H_2C_2O_4 + 2NaOH \longrightarrow Na_2C_2O_4 + 2H_2O$

b) $\dfrac{1.00\,g \mid 1\,mol}{\mid 90\,g}$ = 0.01111 mol / $H_2C_2O_4$ is diprotic

mol H^+ = 2 × 0.01111 = 0.02222 mol

mol OH^- = 0.02222 mol

mol NaOH = 0.02222 mol

$[NaOH] = \dfrac{0.02222\,mol}{0.06000\,L}$ = 0.370 M

⑭ 9.6×10^{-14}

6.51 × 2 = 13.02 = pKw

invlog(−13.02) = 9.55×10^{-14}

OMIT

~~⑮ Volume NaOH = $\dfrac{Trial\ 1 + Trial\ 3}{2} = \dfrac{11.33 + 11.31}{2}$ = 11.32 mL~~ ⊛ Throw out Trial 2

~~$H_2C_4H_4O_6 + 2NaOH \longrightarrow Na_2C_4H_4O_6 + 2H_2O$~~

~~moles NaOH = (0.104M)(0.01132L) = 1.177×10⁻³~~

~~moles H^+ = 1.177×10^{-3}~~

~~moles $H_2C_4H_4O_6$ = $1.177\times10^{-3} \div 2 = 5.886\times10^{-4}$~~

~~$\dfrac{5.886\times10^{-4}\,mol \mid 150.0\,g}{\mid 1\,mol} = 8.829\times10^{-2}\,g$~~

~~10.00 mL wine samples = 10.00 g samples due to 1.0 g/mL density~~

~~% of tartaric acid in wine = $\dfrac{8.829\times10^{-2}\,g}{10.00\,g}\times100 = 0.883\%$~~

⑯ ① III 1.0M HBr strong acid / 100% dissoc. into charges

I 1.0M CH_3COOH weak acid] CH_3COOH stronger 'weak acid' than HCN

II 1.0M HCN weak acid] ∴ CH_3COOH dissociates to a greater extent!

The more charge produced in solution, the greater the conductivity.

⑰ a) $NH_4Br + KHCO_3 \longrightarrow KBr + NH_3 + H_2CO_3$

b) $NH_4^+ + HCO_3^- \rightleftharpoons NH_3 + H_2CO_3$

c) reactants H_2CO_3 is the stronger acid + drives the equil. to the left thereby favouring reactants.

⑱ starting pH = 4.50 ∴ $[H_3O^+] = 3.16 \times 10^{-5} M$

mol H_3O^+ = $(3.16 \times 10^{-5} M)(140 L)$ = 0.00443 mol H_3O^+ in solution

target pH = 7.20 ∴ $[H_3O^+] = 6.31 \times 10^{-8} M$

mol H_3O^+ = $(6.31 \times 10^{-8} M)(140 L) = 8.8 \times 10^{-6}$ mol

mol OH^- needed is difference between starting and target moles of H_3O^+

$0.00443 - 8.8 \times 10^{-6}$ mol $= 4.42 \times 10^{-3}$ mol OH^- ⇒ $Ca(OH)_2 \rightarrow Ca^{2+} + 2OH^-$ 4.42×10^{-3} stoich ÷2

mol $Ca(OH)_2$ = $\frac{4.42 \times 10^{-3}}{2} = 2.21 \times 10^{-3}$

mass $Ca(OH)_2$ = 2.21×10^{-3} mol | $\frac{74.1 g}{1 mol}$ = 1.6×10^{-1} g

⑲ H_3O^+ is the strongest of any weak acid.

When any strong acid is reacted with water, it reacts 100% to form H_3O^+

e.g. $HCl + H_2O \xrightarrow{100\%} H_3O^+ + Cl^-$

∴ no strong acids exist in water!

⑳ pKw = $-\log(2.95 \times 10^{-15}) = 1.453 \times 10^1 = 14.530$

a) pH of pure water = $\frac{14.530}{2} = 7.265$

b) neutral as $[H_3O^+] = [OH^-]$ and/or pH = pOH.

㉑ a) $\underset{A}{HSO_3^-} + \underset{B}{IO_3^-} \rightleftharpoons \underset{B}{SO_3^{2-}} + \underset{A}{HIO_3}$

c) reactants. HIO_3 is a stronger acid than HSO_3^-, thereby driving the equation to the left, favouring reactants!

㉒ a) $2H_2O + 59 kJ \rightleftharpoons H_3O^+ + OH^-$ ⓑ $K_w = [H_3O^+][OH^-]$

ⓒ $K_w = 1.0 \times 10^{-14}$ $pK_w = 14$

d) Kw increases as an increase in temp favours endothermic rxn (fwd rxn) and therefore both $[H_3O^+]$ and $[OH^-]$ increase.

㉓ a) 7-8 b) 5-7 c) 10-14 d) 1-3 e) 5

㉔ a) Arrhenius acid: any substance that releases H^+ in water.

b) Arrhenius base: any substance that releases OH^- in water.

c) Bronsted-Lowry Acid: a substance that donates a proton to another substance.

d) Bronsted-Lowry Base: a substance that accepts a proton from another substance.

㉕ $CO_{3\,(aq)}^{2-} + H_2O_{(l)} \rightleftharpoons HCO_{3\,(aq)}^- + OH^-_{(aq)}$

$Al(H_2O)_{6\,(aq)}^{3+} + H_2O_{(l)} \rightleftharpoons Al(H_2O)_5(OH)^{2+}_{(aq)} + H_3O^+_{(aq)}$

㉖ a) Conductivity test

The strong acid solution will conduct much better than an equal molar concentration of a weak acid solution

b) pH meter

The strong acid solution will have a lower pH than an equal molar concentration of a weak acid solution.