Weak Bases

① $K_w = K_a \cdot K_b$

$1 \times 10^{-14} = K_a (1.7 \times 10^{-6})$

$K_a = \frac{1 \times 10^{-14}}{1.7 \times 10^{-6}}$

$K_a = \boxed{5.9 \times 10^{-9}}$

② a) $HIO_3 \rightleftharpoons H^+ + IO_3^-$

$K_a = 1.7 \times 10^{-1}$

$K_w = K_a \cdot K_b$

$1 \times 10^{-14} = 1.7 \times 10^{-1} \; K_b$

$K_b = \boxed{5.9 \times 10^{-14}}$

b) $HNO_2 \rightleftharpoons H^+ + NO_2^-$

$K_a = 5.1 \times 10^{-4}$

$K_w = K_a \cdot K_b$

$1 \times 10^{-14} = 5.1 \times 10^{-4} \; K_b$

$K_b = \boxed{1.96 \times 10^{-11}}$

② c) $C_6H_5COOH \rightleftharpoons H^+ + C_6H_5COO^-$

$K_a = 6.6 \times 10^{-5}$

$K_w = K_a \cdot K_b$

$1 \times 10^{-14} = 6.6 \times 10^{-5} \; K_b$

$K_b = \boxed{1.5 \times 10^{-10}}$

③ $C_{17}H_{19}NO_3 + H_2O \rightleftharpoons HC_{17}H_{19}NO_3^+ + OH^-$

I	0.01	—	0	0
C	$-x$	—	$+x$	$+x$
E	$0.01-x$	—	x	x

$K_b = \dfrac{[HC_{17}H_{19}NO_3^+][OH^-]}{[C_{17}H_{19}NO_3]}$

$7.5 \times 10^{-7} = \dfrac{(x)(x)}{(0.01-x)}$

$7.5 \times 10^{-7} = \dfrac{x^2}{0.01}$

$x = 8.66 \times 10^{-5}$

$[OH^-] = 8.66 \times 10^{-5}$ mol/L

$pOH = -\log(8.66 \times 10^{-5})$

$= 4.06$

$pH = 14 - pOH$

$= 14 - 4.06$

$pH = \boxed{9.94}$

④ $HC_4H_7O_2 \rightleftharpoons H^+ + C_4H_7O_2^-$

	$HC_4H_7O_2$	H^+	$C_4H_7O_2^-$
I	0.3	0	0
C	$-x$	$+x$	$+x$
E	$0.3-x$	x	x

$$K_a = \frac{[H^+][C_4H_7O_2^-]}{[HC_4H_7O_2]}$$

$$1.52\times10^{-5} = \frac{(x)(x)}{0.3-x}$$

$$1.52\times10^{-5} = \frac{x^2}{0.3}$$

$$x = 0.00214$$

$$[H^+] = \boxed{0.00214 \text{ mol/L}}$$

$$pH = -\log(0.00214)$$

$$pH = \boxed{2.67}$$

⑤ $C_{21}H_{22}N_2O_2 + H_2O \rightleftharpoons HC_{21}H_{22}N_2O_2^+ + OH^-$

I	0.001	—	0	0
C	$-x$	—	$+x$	$+x$
E	$0.001-x$	—	x	x

$$K_b = \frac{[HC_{21}H_{22}N_2O_2^+][OH^-]}{[C_{21}H_{22}N_2O_2]}$$

$$1\times10^{-6} = \frac{(x)(x)}{(0.001-x)}$$

$$1\times10^{-6} = \frac{x^2}{0.001}$$

$$x = 3.16\times10^{-5}$$

$$[OH^-] = 3.16\times10^{-5}\ mol/L$$

$$pOH = -\log(3.16\times10^{-5})$$

$$= 4.5$$

$$pH = 14 - pOH$$

$$= 14 - 4.5$$

$$pH = \boxed{9.5}$$