Chapter 14 – Practice FRQ

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1. (a)

$$k_b = \frac{[C_6H_5NH_3{}^+][OH^-]}{[C_6H_5NH_2]} \tag{1}$$

(b)

$$\begin{aligned} [OH^-] &= 10^{8.82-14} = 6.61 \cdot 10^{-6} \\ k_b &= \frac{(6.61 \cdot 10^{-6})^2}{.1} \\ &= 4.37 \cdot 10^{-10} \end{aligned} \tag{2}$$

(c) $C_6H_5NH_2(aq) + H^+(aq) \longrightarrow C_6H_5NH_3{}^+(aq)$

	$C_6H_5NH_2$	H^+	$C_6H_5NH_3{}^+$
I	.0025	.0005	0
C	-.0005	-.0005	.0005
E	.002	0	.0005

$$\begin{aligned} [C_6H_5NH_2] &= \frac{.002}{.03} = .066\bar{6} \\ [C_6H_5NH_3{}^+] &= \frac{.0005}{.03} = .016\bar{6} \\ pOH &= -\log_{10}\left(4.37 \cdot 10^{-10}\right) + \log_{10}\left(\frac{.016\bar{6}}{.066\bar{6}}\right) \\ pH &= 14 - 8.757 = 5.24 \end{aligned} \tag{3}$$

(d)

	$C_6H_5NH_2$	H^+	$C_6H_5NH_3{}^+$
I	.0025	.0025	0
C	-.0025	-.0025	.0025
E	0	0	.0025

$$\begin{aligned}
[C_6H_5NH_2] &= \frac{.0025}{.05} = .05 \\
k_a &= \frac{k_w}{k_b} = 2.29 \cdot 10^{-5} \\
\frac{x^2}{.05} &= 2.29 \cdot 10^{-5} \\
x &= .00107 \\
-\log_{10}(.00107) &= 2.97
\end{aligned} \tag{4}$$

(e) Erythrosine is the best option because its pk_a is closest to the pH (3 is close to 2.97)