

Acids + Bases Review

① B

② A



	HNO_2	H_3O^+	NO_2^-
I	.1	0	0
C	-x	+x	+x
E	.1-x	x	x

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{NO}_2^-]}{[\text{HNO}_2]}$$

$$5.1 \times 10^{-4} = \frac{(x)(x)}{.1}$$

$$[\text{H}_3\text{O}^+] = 0.0071 \text{ mol/L}$$

④ strong acid, so $[\text{H}^+] = 0.015 \text{ mol/L}$

$$\begin{aligned} \text{pH} &= -\log[\text{H}^+] \\ &= -\log(0.015) \end{aligned}$$

$$\text{pH} = 1.8$$

$$\text{⑤ } \frac{[\text{H}_3\text{O}^+]}{\text{initial}} \times 100 = \frac{5.0 \times 10^{-3}}{0.16} \times 100 = 3.1\%$$

⑥ A

⑦ D



$$[\text{KOH}] = \frac{\text{mol}}{\text{L}}$$

$$.1 = \frac{x}{.04}$$

$$x = 0.004 \text{ mol of KOH}$$

∴ we need 0.004 mol of HBr

$$[\text{HBr}] = \frac{\text{mol}}{\text{L}} = \frac{.004}{.02} = \underline{0.2 \text{ mol/L}}$$

$\textcircled{9}$ strong base, so $[\text{OH}^-] = 0.2 \text{ mol/L}$

$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$$

$$1 \times 10^{-14} = [\text{H}_3\text{O}^+](0.2)$$

$$\underline{[\text{H}_3\text{O}^+] = 5 \times 10^{-14} \text{ mol/L}}$$

$\textcircled{10}$ B

$\textcircled{11}$ C



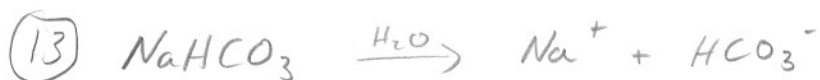
$$\text{pH} = -\log[\text{H}_3\text{O}^+]$$

$$-3.56 = -\log[\text{H}_3\text{O}^+]$$

$$[\text{H}_3\text{O}^+] = 2.75 \times 10^{-4} \text{ mol/L}$$

	HBrO_3	BrO_3^-	H_3O^+
I	0.1	0	0
C	-2.75×10^{-4}	$+2.75 \times 10^{-4}$	$+2.75 \times 10^{-4}$
E	0.0997	2.75×10^{-4}	2.75×10^{-4}

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{BrO}_3^-]}{[\text{HBrO}_3]} = \frac{(2.75 \times 10^{-4})(2.75 \times 10^{-4})}{(0.0997)} = \underline{7.59 \times 10^{-7}}$$



$\text{Na}^+ + \text{H}_2\text{O} \rightarrow$ no reaction, from strong base



$$(K_a)(K_b) = K_w$$

$$(4.4 \times 10^{-7}) K_b = 1 \times 10^{-14}$$

$$K_b = 2.27 \times 10^{-8} \quad \text{for } \text{HCO}_3^-$$

$$K_b = \frac{[\text{H}_2\text{CO}_3][\text{OH}^-]}{[\text{HCO}_3^-]}$$

$$2.27 \times 10^{-8} = \frac{x^2}{.25}$$

	HCO_3^-	H_2CO_3	OH^-
I	.25	0	0
C	-x	+x	+x
E	.25-x	x	x

$$[\text{OH}^-] = 7.53 \times 10^{-5}$$

$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$$

$$1 \times 10^{-14} = [\text{H}_3\text{O}^+](7.53 \times 10^{-5})$$

$$[\text{H}_3\text{O}^+] = 1.33 \times 10^{-10}$$

$$\text{pH} = -\log[\text{H}_3\text{O}^+]$$

$$= -\log(1.33 \times 10^{-10})$$

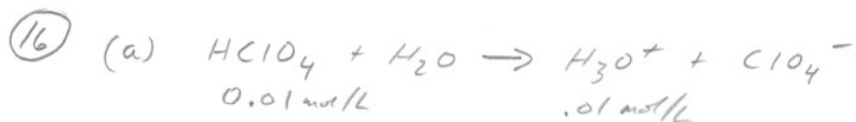
$$\text{pH} = \underline{9.88}$$

- 14 (a) strong (b) weak (c) weak (d) strong
 (e) strong (f) strong (g) weak

15 acetic acid CH_3COOH



$$K_a = \frac{[\text{CH}_3\text{COO}^-][\text{H}_3\text{O}^+]}{[\text{CH}_3\text{COOH}]}$$



$$\text{pH} = -\log[\text{H}_3\text{O}^+] = -\log(0.01) = \underline{2}$$



$$\text{pOH} = -\log[\text{OH}^-] = -\log(0.01) = 2$$

$$\text{pH} + \text{pOH} = 14$$

$$\text{pH} = \underline{12}$$

(c) pH = 7



$\text{K}^+ + \text{H}_2\text{O} \rightarrow$ no reaction (K^+ is from a strong base)



$$K_b = \frac{[\text{HF}][\text{OH}^-]}{[\text{F}^-]}$$

$$K_w = (K_a)(K_b)$$

$$K_b = \frac{K_w}{K_a} = \frac{1 \times 10^{-14}}{6.7 \times 10^{-4}} = 1.49 \times 10^{-11}$$

	F^-	HF	OH^-
I	.5	0	0
C	-x	+x	+x
E	.5-x	x	x

↑

not significant

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17 cont'd

$$1.49 \times 10^{-11} = \frac{(x)(x)}{.5}$$

$$x = 2.73 \times 10^{-6} \text{ mol/L}$$

$$pOH = -\log[OH^-] = -\log(2.73 \times 10^{-6}) = 5.56$$

$$pH + pOH = 14$$

$$pH = 14 - pOH = 14 - 5.56 = \underline{8.44}$$



	HNO_2	H_3O^+	NO_2^-
I	0.0150	0	0
C	-x	+x	+x
E	0.015-x	x	x

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

$$4.5 \times 10^{-4} = \frac{(x)(x)}{.015}$$

$$x = 0.0026$$

$$pH = -\log[H_3O^+]$$

$$= -\log(0.0026)$$

$$\underline{pH = 2.59}$$

(19) $pOH = -\log[OH^-] = -\log(2) = -0.301$

$$pH + pOH = 14$$

$$pH = \underline{14.3} \quad \underline{\text{basic}}$$

(20) $pH = -\log(1) = 0$

$$pH + pOH = 14$$

$$pOH = 14$$

$$pOH = -\log[OH^-]$$

$$-14 = +\log[OH^-]$$

$$\underline{[OH^-] = 1 \times 10^{-14} \text{ mol/L}}$$