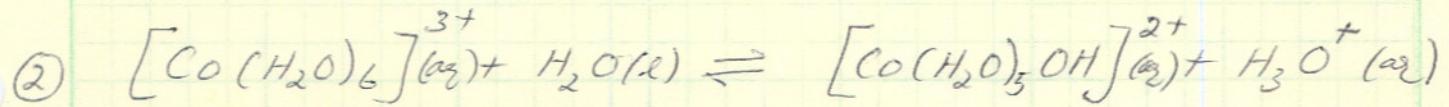
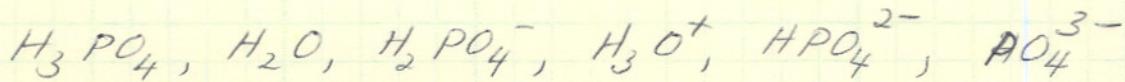
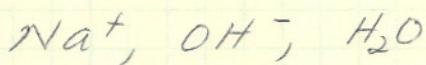
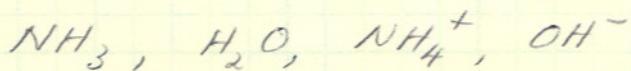
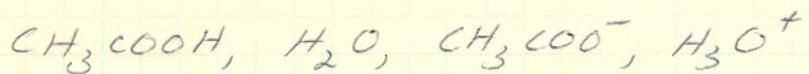
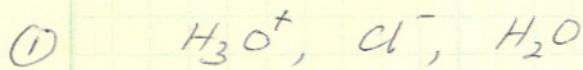


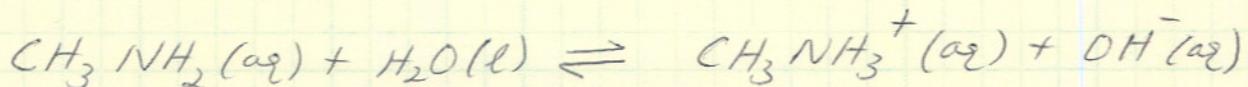
Introduction to Natural Science

Spring Quarter, Week 5, Chemistry Workshop

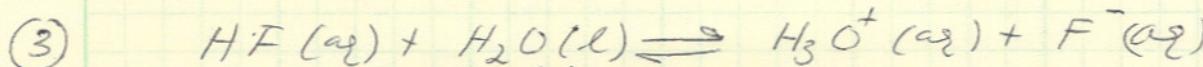
Answer Key



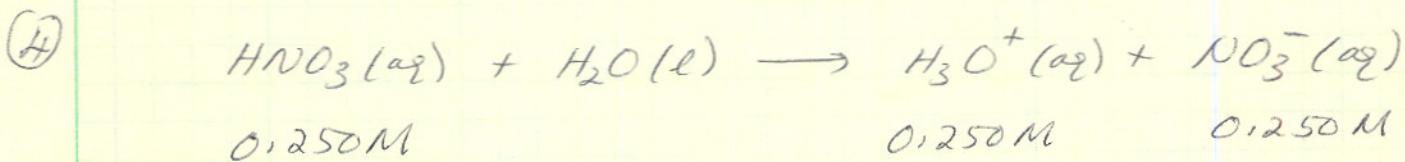
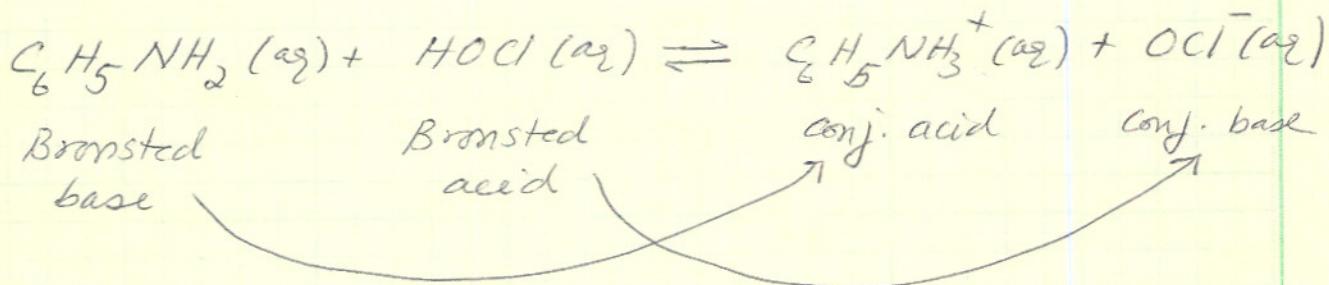
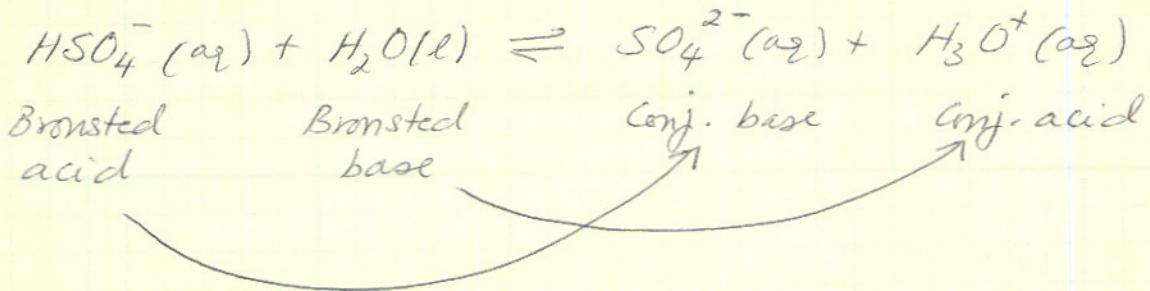
$$K_a = \frac{[\text{Co}(\text{H}_2\text{O})_5\text{OH}]_{\text{eq}}^{2+} [\text{H}_3\text{O}^+]_{\text{eq}}}{[\text{Co}(\text{H}_2\text{O})_6]_{\text{eq}}^{3+}}$$



$$K_b = \frac{[\text{CH}_3\text{NH}_3^+]_{\text{eq}} [\text{OH}^-]_{\text{eq}}}{[\text{CH}_3\text{NH}_2]_{\text{eq}}}$$

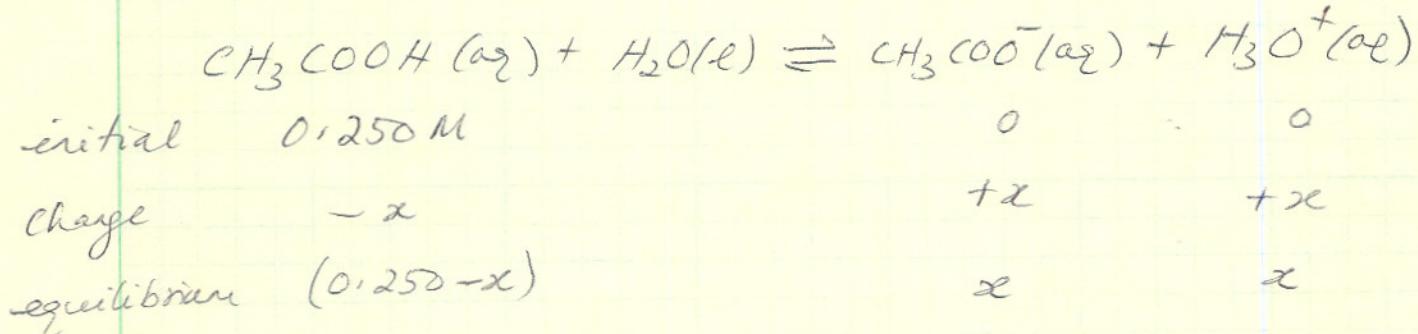


Bronsted acid Bronsted
base $\xrightarrow{\text{conf. acid}}$ $\xrightarrow{\text{conf. base}}$



$$pH = -\log [H_3O^+] = -\log(0.250) = \underline{0.60}$$

$$pOH = 14 - pH = \underline{\underline{13.40}}$$



$$K_a = \frac{[CH_3COO^-][H_3O^+]}{[CH_3COOH]_{eq}} = \frac{(x)(x)}{(0.250-x)} = 1.8 \times 10^{-5}$$

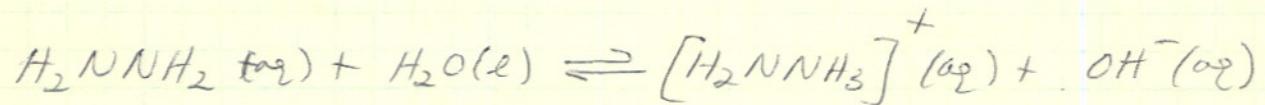
$$x^2 + 1.8 \times 10^{-5}x - 4.5 \times 10^{-6} = 0$$

$$x = \frac{-1.8 \times 10^{-5} \pm \sqrt{(1.8 \times 10^{-5})^2 + 4(4.5 \times 10^{-6})}}{2}$$

3

$$x = 2.11 \times 10^{-3} = [H_3O^+]$$

$$pH = -\log [H_3O^+] = \underline{\underline{2.68}} \quad pOH = \underline{\underline{11.32}}$$



initial	2.0 M	0	0
change	-x	+x	+x
equilibrium	(2.0-x)	x	x

$$K_b = \frac{[H_2NNH_3^+][OH^-]_{eq}}{[H_2NNH_2]_{eq}} = \frac{x^2}{2.0-x} = 3.0 \times 10^{-6}$$

$$x^2 + 3.0 \times 10^{-6}x - 6.0 \times 10^{-6} = 0$$

$$x = \frac{-3.0 \times 10^{-6} \pm \sqrt{(3.0 \times 10^{-6})^2 + 4(6.0 \times 10^{-6})}}{2}$$

$$x = 2.45 \times 10^{-3} = [OH^-]$$

$$pOH = -\log [OH^-] = \underline{\underline{2.61}} \quad pH = \underline{\underline{11.39}}$$

4.

(5)

HCl

molarity

5.00M

volume

90.0mL

of moles of
 H_3O^+

$$\frac{5.00 \text{ mol} \times 90.0 \times 10^{-3} \text{ L}}{\text{L}}$$

$$= 0.450 \text{ mol}$$

 HNO_3

8.00M

30.0mL

$$\frac{8.00 \text{ mol} \times 30.0 \times 10^{-3} \text{ L}}{\text{L}}$$

$$= 0.240 \text{ mol}$$

total

B

120.0mL

B

0.690 mol

Total $[\text{H}_3\text{O}^+]$ concentration = $\frac{0.690 \text{ mol}}{120.0 \text{ mL}} \times \boxed{\frac{10^3 \text{ mL}}{\text{L}}}$

$$= 5.75 \text{ mol L}^{-1}$$

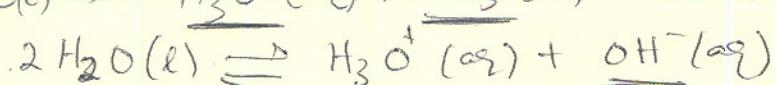
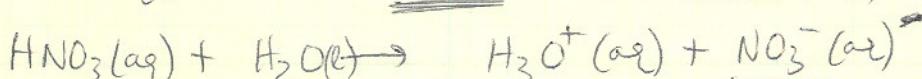
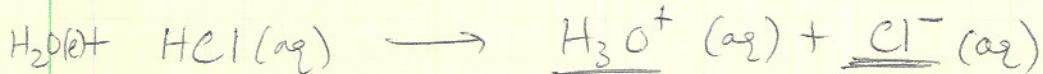
$$\text{pH} = -\log [\text{H}_3\text{O}^+] = -\underline{0.76}$$

$$\text{pOH} = \underline{14.76}$$

$$[\text{H}_3\text{O}^+] = \underline{5.75 \text{ mol L}^{-1}}$$

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

$$\Rightarrow [\text{OH}^-] = \underline{1.74 \times 10^{-15}}$$

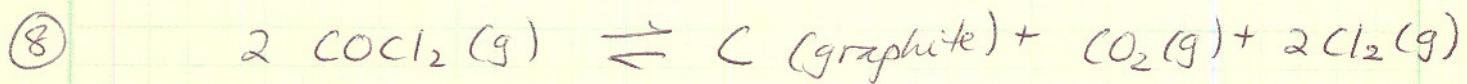


- ⑥ Exothermic reaction (ΔH is negative)
 o^o Low T favors the reaction.

Number of species decrease from 2 to $1\frac{1}{2}$ during the reaction. o^o High P favors the reaction.

Answer is (C).

- ⑦ (C) changing the temperature.



initial	1.0 atm			
charge	-2x	+x	+2x	
equilibrium	(1.0 - 2x)	x	2x	

$$K_p = \frac{(P_{\text{CO}_2(\text{g})})(P_{\text{Cl}_2(\text{g})})^2}{(P_{\text{COCl}_2(\text{g})})^2} = \frac{(x)(2x)^2}{(1.0 - 2x)^2}$$

Answer is (C)