

1. (4 Pts) Determine the pH of a KOH solution made from 0.185 g KOH and enough water to make 100 mL of solution. (K 39.01, O 16.00, H 1.008) (strong base)

$$\frac{0.185 \text{ g KOH}}{56.01 \text{ g/mol}} \div 0.100 \text{ L} = 0.0330 \text{ M}$$

$$\text{pOH} = -\log [0.0330] = 1.481 \quad \text{pH} = 14 - \text{pOH} = \boxed{12.519}$$

2. (3 Pts) What is the pH of 20.0 mL of 0.0020 M HCl?

strong Acid
 so $\text{pH} = -\log (0.0020) = \boxed{2.70}$

3. (4 Pts) What is the pH of 0.014 M Ca(OH)₂ solution?

$$[\text{OH}^-] = 0.028 \quad \text{pOH} = -\log (0.028) = 1.55$$

$$\text{pH} = 14 - \text{pOH} = \boxed{12.45}$$

4. (3 Pts) The pH of tomato juice is about 4.5. Calculate the concentration of hydrogen ions.

$$10^{-\text{pH}} = 10^{-4.5} = \underline{3.16 \times 10^{-5}}$$

5. (5 Pts) Nicotinic acid has a K_a value of 1.4 x 10⁻⁵. Calculate the pH of 25 mL of 0.10 M nicotinic acid solution.

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{A}^-]}{[\text{HA}]}$$

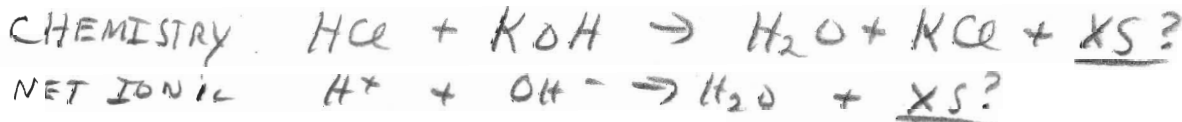
$$1.4 \times 10^{-5} = \frac{x^2}{0.10 - x} \leftarrow \text{try to Drop}$$

		HA	+	H ₂ O	⇌	H ₃ O ⁺	+	A ⁻
I	0.10			0		0		0
C	-x			x		x		x
E	0.10 - x			x		x		x

$$x = 0.00118 = [\text{H}_3\text{O}^+] \quad \text{pH} = -\log [\text{H}_3\text{O}^+] = \boxed{2.93}$$

6. (6 Pts) 20.00 mL of 0.10 M HCl are mixed with 25.00 mL of 0.10 M KOH. Determine the pH of the resulting solution.

(Both strong)



① moles H⁺: $\frac{20.00 \times 10^{-3} \text{ L HCl}}{1 \text{ L HCl}} \times \frac{0.10 \text{ mol HCl}}{1 \text{ mol HCl}} \div \frac{1 \text{ mol H}^+}{1 \text{ mol HCl}} = 0.0020 \text{ mol H}^+$

② mol OH⁻: $\frac{25.00 \times 10^{-3} \text{ L KOH}}{1 \text{ L KOH}} \times \frac{0.10 \text{ mol KOH}}{1 \text{ mol KOH}} \div \frac{1 \text{ mol OH}^-}{1 \text{ mol KOH}} = 0.0025 \text{ mol OH}^-$

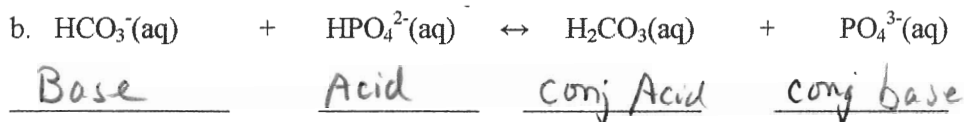
Subtract for XS

$$0.0005 \text{ mol OH}^- \text{ XS}$$

$$\text{pOH} = -\log \frac{0.0005}{45 \times 10^{-3} \text{ L}} = 1.95 \quad \text{pH} = 14 - \text{pOH} = \boxed{12.05}$$

Show all work to receive credit.

1. (4 Pts) In each of the following reactions, identify the acid, the base, the conjugate acid, and the conjugate base.



2. (10 Pts) Refer to the following equation: $\text{Heat} + \text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \leftrightarrow 2\text{NH}_3(\text{g})$

a. If hydrogen gas is added to the above system at equilibrium, which direction will the reaction shift?

Rxn →

b. If nitrogen is added to the system at equilibrium, what will happen to the ammonia concentration?

will increase
→

c. If nitrogen is removed from the system at equilibrium, what will happen to the hydrogen (H₂) concentration?

← Rxn will increase H₂ conc

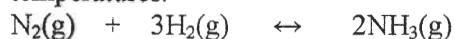
d. The production of ammonia is an endothermic reaction. Will heating the equilibrium system increase or decrease the amount of ammonia produced?

increase

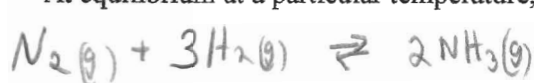
e. If we use a catalyst, which way will the reaction shift?

equilibrium is unchanged only time to reach equilibrium changes

3. (8 Pts) 5.0 mole of ammonia are introduced into a 5.0 L reactor vessel in which it partially dissociates at high temperatures.



At equilibrium at a particular temperature, 1.0 mole of ammonia remains. Calculate K_c for the reaction.



$K_c = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$

I.	0	0	1.0 M
C.	+x	+3x	-2x
E.	x	+3x	1.0 - 2x = 0.2

$K_c = \frac{[0.2]^2}{[0.40][1.20]^3}$

"E."

0.40	1.20	1.0 - 2x = $\frac{1}{5}$ = 0.2
		x = 0.40

$K_c = 0.058$

4. (3 Pts) Complete and balance the following reaction:

