

Chemistry 192  
Quiz Number 5  
Spring 2018  
Solution

$$R = 8.3144 \text{ J mol}^{-1} \text{ K}^{-1}$$

$$R = 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$$

$$R = 0.08314 \text{ L bar mol}^{-1} \text{ K}^{-1}$$

$$N_A = 6.022 \times 10^{23} \text{ molecules mol}^{-1}$$

$$T = t + 273.15$$

$$[\text{H}_3\text{O}^+][\text{OH}^-] = 1.0 \times 10^{-14}$$

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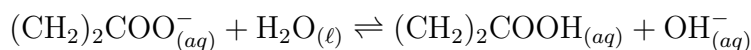
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Acrylic acid  $[(\text{CH}_2)_2\text{COOH}]$  has  $\text{p}K_a = 4.25$ . When a 0.200 L sample of acrylic acid is titrated with 0.100 M NaOH, the equivalence point is reached after the addition of 0.106 L of the strong base. Calculate the initial concentration of acrylic acid and the pH of the solution at the equivalence point. Approximations work for this problem.

**Solution**

$$n_{(\text{CH}_2)_2\text{COOH}} = n_{\text{OH}^-} = (0.100 \text{ mol L}^{-1})(0.106 \text{ L}) = 0.0106 \text{ mol}$$

$$[(\text{CH}_2)_2\text{COOH}] = \frac{0.0106 \text{ mol}}{0.200 \text{ L}} = 0.053 \text{ M}$$



$$\text{p}K_b = 14.00 - \text{p}K_a = 9.75 \quad K_b = 10^{-9.75} = 1.8 \times 10^{-10}$$

$$[(\text{CH}_2)_2\text{COO}^-] = \frac{0.0106 \text{ mol}}{0.200 \text{ L} + 0.106 \text{ L}} = 3.46 \times 10^{-2} \text{ M}$$

	$[(\text{CH}_2)_2\text{COO}^-]$	$[(\text{CH}_2)_2\text{COOH}]$	$[\text{OH}^-]$
initial	$3.46 \times 10^{-2} \text{ M}$	0 M	0 M
change	$-x \text{ M}$	$x \text{ M}$	$x \text{ M}$
equilibrium	$3.46 \times 10^{-2} - x \text{ M}$	$x \text{ M}$	$x \text{ M}$

$$1.8 \times 10^{-10} = \frac{x^2}{3.46 \times 10^{-2} - x} \approx \frac{x^2}{3.46 \times 10^{-2}}$$

$$x = [\text{OH}^-] = 2.5 \times 10^{-6} \text{ M} \quad \text{pOH} = 5.60 \quad \text{pH} = 8.40$$

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