pH and Ka Problems

Example- Find the pH of a 0.45 mol/L Solution of HF ($K_a = 6.6 \times 10^{-4}$)

i) $HF + H_2O \rightleftharpoons H_3O^+ + F^-$

	HF		H_3O^+	F^-
I	0.45		0	0
C	x		x	x
E	0.45-x		x	x

$$K_a = \frac{[H_3O^+][F^-]}{[HF]}$$

$$6.6 \times 10^{-4} = \frac{x \cdot x}{0.45 - x}$$ ← assume x is small

$$(6.6 \times 10^{-4})(0.45) = x^2$$

$$\sqrt{2.97 \times 10^{-4}} = \sqrt{x^2}$$

$$1.7 \times 10^{-2} = x$$

$$pH = -\log(1.7 \times 10^{-2})$$

$$= 1.8$$

Worksheet - #2, 7, 5

Text - p. 591 #5, 7

Ionization of Water Kw

Recall: H_2O is amphoteric (both acid & base)

$$H_2O_{(l)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + OH^-_{(aq)}$$

↑ ionization

$$K_{eq} = \frac{[H_3O^+][OH^-]}{[H_2O]^2}$$ ← constant

new constant

$$K_w = [H_3O^+][OH^-]$$ for all dilute solutions

Value of (in water) 1.0×10^{-7} mol/L 1.0×10^{-7} mol/L

$$K_w = (1.0 \times 10^{-7})(1.0 \times 10^{-7}) = 1.0 \times 10^{-14}$$

Example- What is $[OH^-]$ of a solution pH = 2.5 ?

i) $[H_3O^+] = 3.2 \times 10^{-3}$

ii) $K_w = [H_3O^+][OH^-]$

$1.0 \times 10^{-14} = 3.2 \times 10^{-3}[OH^-]$

$\frac{1 \times 10^{-14}}{3.2 \times 10^{-3}} = [OH^-]$

$3.1 \times 10^{-12} = [OH^-]$

Text quest. p. 566 #12, 14

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Acid-Base Indicators

Indicators are, themselves, weak acids.
Different colours for acid/base form.

example: phenolphthalein (Hpt)

$Hpt + H_2O \rightleftharpoons H_3O^+ + pt^-$

↑ clear pink ↑

i) If Hpt is mixed with acidic solution.

- stress ↑ $[H_3O^+]$
- accomodate by shift reactants
- consequence clear

ii) If Hpt is mixed in basic sol'n....

- Stress OH^- neutralizes $-H_3O^+$ ↓
- Shift products
- consequence pink