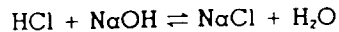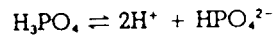## Example 1-2

Find the normality of the following solutions:
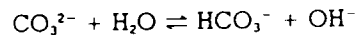
1. 36.5 mg HCl/liter, with respect to the reaction

$$HCl + NaOH \rightleftharpoons NaCl + H_2O$$
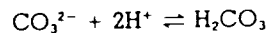
2. 49 mg H_3PO_4/liter, with respect to the reaction

$$H_3PO_4 \rightleftharpoons 2H^+ + HPO_4^{2-}$$

3. 45 mg CO_3^{2-}/liter, with respect to the reaction

$$CO_3^{2-} + H_2O \rightleftharpoons HCO_3^- + OH^-$$

4. 45 mg CO_3^{2-}/liter, with respect to the reaction

$$CO_3^{2-} + 2H^+ \rightleftharpoons H_2CO_3$$

Solution

1. One H^+ reacts per HCl. Therefore, we find

$$\text{Gram equivalent weight} = \frac{\text{gram molecular weight}}{1 \text{ eq/mole}} = \frac{36.5 \text{ g/mole}}{1 \text{ eq/mole}}$$

$$= 36.5 \text{ g/eq} = 36.5 \text{ mg/meq}$$

$$\text{Normality} = \frac{36.5 \text{ mg/liter}}{36.5 \text{ mg/meq}} = 1 \text{ meq/liter}$$

2. $2H^+$ react per H_3PO_4. Therefore,

$$\text{Gram equivalent weight} = \frac{\text{gram molecular weight}}{2 \text{ eq/mole}} = \frac{98 \text{ g/mole}}{2 \text{ eq/mole}}$$

$$= 49 \text{ g/eq} = 49 \text{ mg/meq}$$

$$\text{Normality} = \frac{49 \text{ mg/liter}}{49 \text{ mg/meq}} = 1 \text{ meq/liter}$$

3. One OH^- results from this reaction. Thus

$$\text{Gram equivalent weight} = \frac{\text{gram molecular weight}}{1 \text{ eq/mole}}$$

$$= 60 \text{ g/eq} = 60 \text{ mg/meq}$$

$$\text{Normality} = \frac{45 \text{ mg/liter}}{60 \text{ mg/meq}} = 0.75 \text{ meq/liter}$$

4. Two H^+ react with each CO_3^{2-}. Thus

$$\text{Gram equivalent} = \frac{\text{gram molecular weight}}{2 \text{ eq/mole}} = \frac{60 \text{ g}}{2 \text{ eq/mole}}$$

$$= 30 \text{ g/eq} = 30 \text{ mg/meq}$$

$$\text{Normality} = \frac{45 \text{ mg/liter}}{30 \text{ mg/meq}} = 1.5 \text{ meq/liter}$$

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