

UNIT
OPERATIONS AND
PROCESSES IN
ENVIRONMENTAL
ENGINEERING

solution manual

Second Edition



Reynolds/Richards

Instructor's Manual

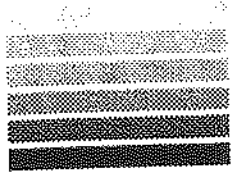
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Instructor's Manual

UNIT OPERATIONS AND PROCESSES IN ENVIRONMENTAL ENGINEERING

Second Edition

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¹ No quantitative problems in Chapter 6 or Chapter 24 - hence no worked solutions

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Problem 1.1

$$\text{Na}^+ \quad \underline{AW = 23} \quad \text{Eq. wt.} = 23/1 = 23 \text{ gm}$$

$$\text{Ca}^{+2} \quad \underline{AW = 40} \quad \text{Eq. wt.} = 40/2 = 20 \text{ gm}$$

$$\text{Na}^+ \text{ meq wt} = 23 \text{ mg}$$

$$\text{Meqs} = (102 \text{ mg/l}) \div 23 \text{ mg/meq} = \underline{4.43 \text{ meq/l}}$$

$$\text{Ca}^+ \text{ meq wt} = 20 \text{ mg}$$

$$\text{Meqs} = (68 \text{ mg/l}) \div 20 \text{ mg/meq} = \underline{3.40 \text{ meq/l}}$$

Problem 1.2

$$\text{Ca Cl}_2 \text{ MW} = 40 + 2(35) = 110$$

$$\text{Meg wt} = 110/2 = 55 \text{ mg}$$

$$\text{Megs} = (168 \text{ mg/L}) \div 55 \text{ mg/meg} = \underline{3.05 \text{ meg/L}}$$

Problem 1.3

$1 \text{ ppm} = 1 \text{ mg/L}$ if specific gravity = 1.00

$134 \text{ parts per million} = \underline{134 \text{ mg/L}}$

Problem 1.4

$$pH = 7.6$$

$$pH = \log \frac{1}{[H^+]}$$

$$[H^+] = \underline{10^{-7.6} \text{ moles/l}}$$

$$[H^+][OH^-] = 10^{-14}$$

$$[10^{-7.6}][OH^-] = 10^{-14}$$

$$[OH^-] = \underline{10^{-6.4} \text{ moles/l}}$$

1 of 1

Problem 1.5

It goes to completion because an insoluble product is formed.

Problem 1.6

Carbonate CO_3^{-2}

Bicarbonate HCO_3^{-}

Hydroxyl OH^{-}

Problem 1.7

$$\text{CaCl}_2 \text{ Meq wt} = [40 + 12 + 3(16)]^{1/2} = 50$$

$$\text{Meq/l} = (185 \text{ mg/l}) \div 50 \text{ mg/meq} = \underline{3.70 \text{ m.}}$$

Problem 1.8

$$\text{CaCO}_3 \text{ Meq wt} = [40 + 12 + 3(16)] \frac{1}{2} = 50$$

$$\text{Meq/l} = (225 \text{ mg/l}) \div 50 \text{ mg/meq} = \underline{4.50 \text{ meq}}$$

Problem 1.9

a. Second

b. Zero

c. First