ENVIRONMENTAL AQUATIC CHEMISTRY - CH234

ASSIGNMENT 1- Answers

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2)

a)

Ion	Ca^{2+}	Mg^{2+}	Na^{+}	HCO_3^{-}	Cl^{-}	SO_4^{2-}
C (mg/L)	20	4.8	27.6	67.1	36	24
FW (g/mol)	40	24	23	61	36	96
Z (eq/mol)	2	2	1	1	1	2
EW (g/eq)	20	12	23	61	36	48
M (mmol/L)	0.5	0.2	1.2	1.1	1.0	0.25
N (meq/L)	1.0	0.4	1.2	1.1	1.0	0.5

b)

∑ Cations = 1.0 + 0.4 + 1.2 = 2.6 meq/L

∑ Anions = 1.1 + 1.0 + 0.5 = 2.6 meq/L

∑ Cations = ∑ Anions → Results are acceptable

Your results may not show exact same values for ∑cations and ∑anions (If you use more accurate FW values). In this case, calculate the difference (∑ Cations - ∑ Anions) If it is in the range of ±0.2 meq/L, results are acceptable.

c)

$$Ca^{2+} = \frac{1.0\ meq/L}{2.6\ meq/L} \times 100 = 38.5\%$$

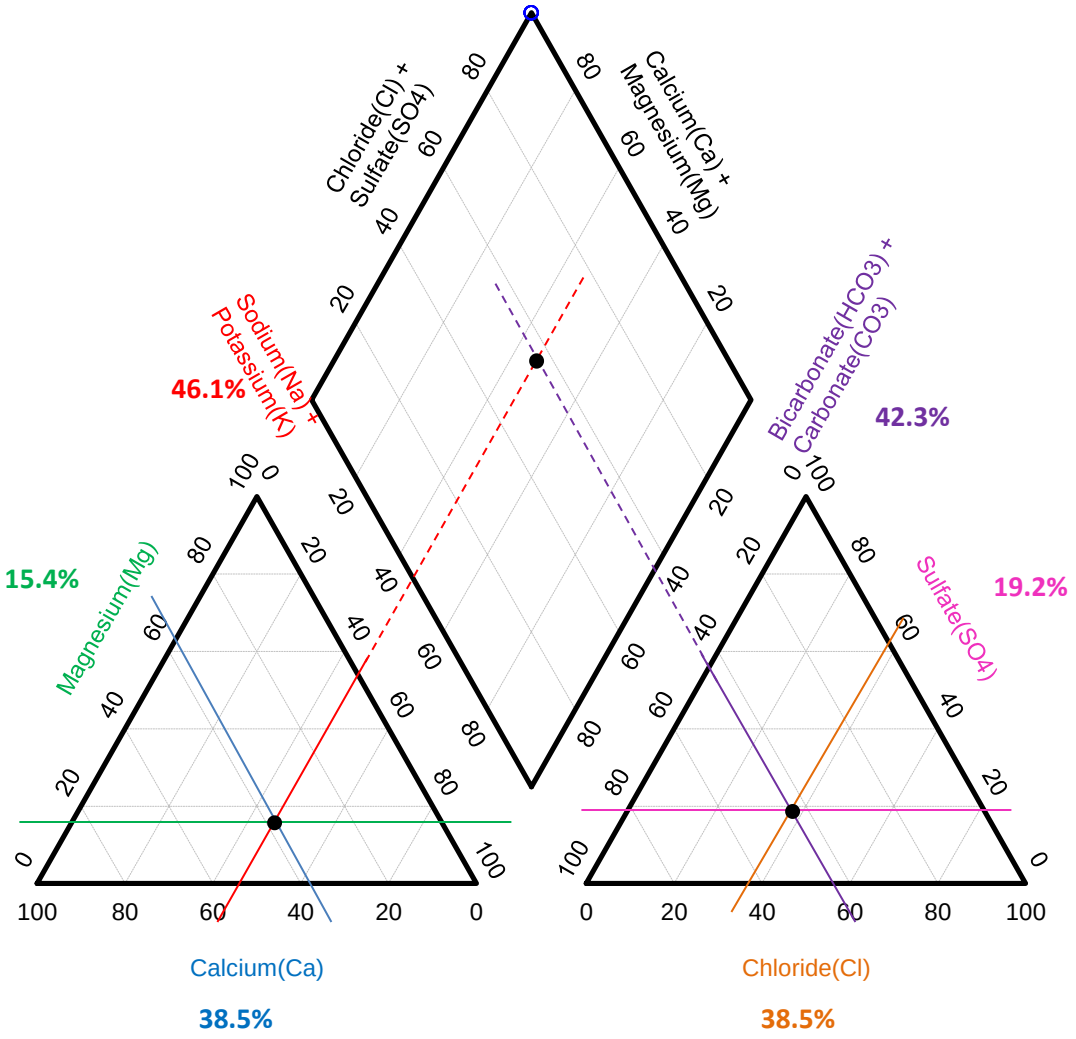
$$Mg^{2+} = \frac{0.4\ meq/L}{2.6\ meq/L} \times 100 = 15.4\%$$

$$Na^{+} = \frac{1.2\ meq/L}{2.6\ meq/L} \times 100 = 46.1\%$$

$$HCO_3^{-} = \frac{1.1\ meq/L}{2.6\ meq/L} \times 100 = 42.3\%$$

$$Cl^{-} = \frac{1.0\ meq/L}{2.6\ meq/L} \times 100 = 38.5\%$$

$$SO_4^{2-} = \frac{0.5\ meq/L}{2.6\ meq/L} \times 100 = 19.2\%$$


Chloride(Cl) + Sulfate(SO4)
Calcium(Ca) + Magnesium(Mg)
Sodium(Na) + Potassium(K)
46.1%
Bicarbonate(HCO3) + Carbonate(CO3)
42.3%
Magnesium(Mg)
15.4%
Sulfate(SO4)
19.2%
Calcium(Ca)
38.5%
Chloride(Cl)
38.5%

3)

Ca^{2+}=80 mg/L Mg^{2+}=36 mg/L

$$EW(Ca^{2+}) = \frac{40\left(\frac{g}{mol}\right)}{2\left(\frac{eq}{mol}\right)} = 20\left(\frac{g}{eq}\right) \qquad EW(Mg^{2+}) = \frac{24\left(\frac{g}{mol}\right)}{2\left(\frac{eq}{mol}\right)} = 12\left(\frac{g}{eq}\right)$$

$$Ca^{2+}\left(\frac{meq}{L}\right) = \frac{80\ \left(\frac{mg}{L}\right)}{20\left(\frac{g}{eq}\right)} = 4.0\left(\frac{meq}{L}\right) \qquad Mg^{2+}\left(\frac{meq}{L}\right) = \frac{36\ \left(\frac{mg}{L}\right)}{12\ \left(\frac{g}{eq}\right)} = 3.0\left(\frac{meq}{L}\right)$$

$$Ca^{2+}\left(\frac{meq}{L}\right) + \ Mg^{2+}\left(\frac{meq}{L}\right) = 4.0\left(\frac{meq}{L}\right) + 3.0\left(\frac{meq}{L}\right) = 7.0\left(\frac{meq}{L}\right)$$

$$Total\ hardness = 7.0\left(\frac{meq}{L}\right) \times 50\left(\frac{g\ CaCO_3}{eq}\right) = 350\left(\frac{mg\ CaCO_3}{L}\right)$$

4)

$$NH_4^+:\ \ 36\ ppm = 36\frac{mg}{L}$$

$$C_{NH_4-N}\left(\frac{mg\ N}{L}\right) = \frac{36\left(\frac{mg}{L}\right)}{18\left(\frac{g}{mol}\right)} \times 14\left(\frac{g}{mol}\right) = 28\left(\frac{mg\ N}{L}\right)$$

$$C_{NO_3-N}\left(\frac{mg\ N}{L}\right) = C_{NH_4-N}\left(\frac{mg\ N}{L}\right) = 28\left(\frac{mg\ N}{L}\right)$$

5)

$$\mu = 2.5\times10^{-5} \times \mathrm{TDS}$$

$$\mu = 2.5\times10^{-5} \times 600 = 0.015$$

$$\log\gamma = -0.5\,Z^2\,\frac{\sqrt{\mu}}{\left(1+\sqrt{\mu}\right)}$$

For monovalent ions (Na^{+}, K^{+}, HCO_3^{-}, Cl^{-}, NO_3^{-}) γ = 0.88

$$\log\gamma = -0.5\times1^2\times\frac{\sqrt{0.015}}{\left(1+\sqrt{0.015}\right)} = -0.054 \qquad \rightarrow \qquad \gamma = 0.88$$

For divalent ions (Ca^{2+}, Mg^{2+}, SO_4^{2-}) γ = 0.61

$$\log\gamma = -0.5\times2^2\times\frac{\sqrt{0.015}}{\left(1+\sqrt{0.015}\right)} = -0.218 \qquad \rightarrow \qquad \gamma = 0.61$$

For trivalent ion (Fe^{3+}) γ = 0.32

$$\log\gamma = -0.5\times3^2\times\frac{\sqrt{0.015}}{\left(1+\sqrt{0.015}\right)} = -0.491 \qquad \rightarrow \qquad \gamma = 0.32$$