Answer on Question #67878 - Chemistry – General Chemistry

Task:

A metal hydroxide has the formula M(OH)2. An aqueous solution of this hydroxide has a concentration 6.16g per liter 30cm^3 of this solution required 24cm^3 of acid solution containing 5.67g/dm^{-3} of nitric acid for complete neutralization. Calculate:

a) The molarity of the metallic hydroxide

b) Relative atomic mass of the metal M

Solution:

Let's write down the reaction of chemical interaction:

$$Me(OH)_2 + 2HNO_3 = Me(NO_3)_2 + 2H_2O$$

By the reaction equation: $n(Me(OH)_2) = n(HNO_3)/2$

Then, $$C(Me(OH)_2)*V(Me(OH)_2) = \frac{C(HNO_3)*V(HNO_3)}{2}$$

Let's find the molar concentration of HNO_3:

$$C(HNO_3) = \frac{n(HNO_3)}{V(HNO_3)} = \frac{m(HNO_3)}{M(HNO_3)*V(HNO_3)}$$

$$M(HNO_3) = 63.012\,{}^{g}\!/_{mol};$$

$$C(HNO_3) = \frac{5.67g}{63.012\,{}^{g}\!/_{mol}*1L} = 0.08998\,{}^{mol}\!/_{L} \approx 0.09\,{}^{mol}\!/_{L}$$

Let's find the molar concentration (molarity) of $Me(OH)_2$:

$$C(Me(OH)_2) = \frac{C(HNO_3)*V(HNO_3)}{2*V(Me(OH)_2)} = \frac{0.09\,{}^{mol}\!/_{L}*24cm^3}{2*30cm^3} = 0.036\,{}^{mol}\!/_{L}$$

Let's find atomic mass of the metal Me:

$$C(Me(OH)_2) = \frac{n(Me(OH)_2)}{V(Me(OH)_2)};$$

$$C(Me(OH)_2) = \frac{m(Me(OH)_2)}{M(Me(OH)_2) * V(Me(OH)_2)}; \quad \Rightarrow \quad M(Me(OH)_2) = \frac{m(Me(OH)_2)}{V(Me(OH)_2) * C(Me(OH)_2)};$$

$$M(Me(OH)_2) = \frac{6.16g}{1L * 0.036 \, mol/L} = 171.11 \, g/mol$$

$$M(Me(OH)_2) = Ar(Me) + 2 * Ar(O) + 2 * Ar(H)$$
$$171.11 = Ar(Me) + 2*16 + 2*1;$$
$$171.11 = Ar(Me) + 34;$$
$$Ar(Me) = 137.11$$

This metal is barium (Ba). A metal hydroxide = $Ba(OH)_2$.

Answer: 1) The molarity of the metallic hydroxide is 0.036 mol/L;

2) Atomic mass of the metal M is 137.11. This is barium (Ba).