Titration Questions - If You Can Do This One You Can Do Them All!

1. A mixture of sulphuric acid, phosphoric acid and an unknown solid diprotic acid is neutralized with potassium hydroxide and then sodium carbonate. Given that there is 3.45 L of 18.0 H_2SO_4, 25.2 L of 14.8 M H_3PO_4, ~~24.248~~ 12.124 kg of the diprotic acid, 50 kg of Na_2CO_3 and 25 kg of KOH, determine the molar mass of the unknown acid.

(unknown)

$$2n_A^{H_2SO_4} + 3n_A^{H_3PO_4} + 2n_A^{H_2A} = n_B^{KOH} + 2n_B^{Na_2CO_3}$$

$$2C_A^{H_2SO_4}V_A^{H_2SO_4} + 3C_A^{H_3PO_4}V_A^{H_3PO_4} + 2n_A^{H_2A} = n_B^{KOH} + 2n_B^{Na_2CO_3}$$

$$n_A^{H_2A} = \frac{n_B^{KOH} + 2n_B^{Na_2CO_3} - 2C_A^{H_2SO_4}V_A^{H_2SO_4} - 3C_A^{H_3PO_4}V_A^{H_3PO_4}}{2}$$

$$n_A^{H_2A} = \frac{\left(25\,kg \times \frac{1000\,g}{1\,kg} \times \frac{1\,mol}{56.11\,g}\right) + 2\left(50.0\,kg \times \frac{1000\,g}{1\,kg} \times \frac{1\,mol}{105.99\,g}\right) - 2\left(\frac{18.0\,mol}{L} \times 3.45\,L\right) - 3\left(\frac{14.8\,mol}{L} \times 25.2\,L\right)}{2}$$

$$n_A^{H_2A} = 72.98\,mol$$

$$\frac{12.124\,kg \times \frac{1000\,g}{1\,kg}}{72.98\,mol} = 166.13\,g/mol$$

molar mass is g/mol (i.e. a ratio)

P.S. acid is pthalic acid