if 38.71 mL of 0.108M NaOH solution is required to titrate a 10.0-mL sample of an unknown H2SO4 solution, what is the molarity of the acid solution?

Solution:

The law of equivalence is:

$C_{N1} \cdot V_1 = C_{N2} \cdot V_2$, where C_N – normal concentration, V- volume.

$C_N = \frac{C_i}{f_{eq}}$, where C_i – molar concentration, f_{eq} - equivalence factor.

For NaOH normal concentration is equal to molar concentration because the equivalence factor of NaOH is 1. So $C_N = C_M = 0.108$ N.

Calculate the normal concentration of H_2SO_4 for the law of equivalence:

$$C_N(H_2SO_4) = \frac{C_N(NaOH) \cdot V(NaOH)}{V(H_2SO_4)} = \frac{0.108 \cdot 38.71}{10} = 0.418 \text{N}$$

The equivalence factor H_2SO_4 is 0.5, because its diprotonic acid. So, the molar concentration of H_2SO_4 is $C_i(H_2SO_4) = C_N(H_2SO_4) \cdot f_{eq}(H_2SO_4) = 0.418 \cdot 0.5 = 0.209$ M.

Answer:

The molarity of the H_2SO_4 is 0.209 M.