

(3.10) In a distillation column with total reflux,  $^{10}\text{B}$  is enriched through exchange distillation of  $\text{BF}_3\text{O}(\text{C}_2\text{H}_5)_2$  from the natural value of 20 atom % to a product containing 95%  $^{10}\text{B}$ . The packed column has a length of 5 m and a diameter of 3 cm. What is the approximate height of a theoretical stage if the enrichment factor is 0.026?

The enrichment factor is defined as  $\alpha - 1$  (below eqn. (3.61)), hence we can calculate  $\alpha$  as:

$$\alpha := 1 + 0.026$$

The column height,  $h$ , is given as:

$$h := 5 \cdot \text{m}$$

The product and feed atomic fractions are:

$$x_p := \frac{95}{100} \quad x_f := \frac{20}{100}$$

Using eqn. (3.66) we can estimate the number of theoretical stages,  $N_p$ , as:

$$N_p := \frac{\ln \left[ \frac{x_p (1 - x_f)}{x_f (1 - x_p)} \right]}{\ln(\alpha)} \quad N_p = 168.723$$

The height of a theoretical plate, HETP, is then given by the height divided by the number of theoretical plates:

$$\text{HETP} := \frac{h}{N_p} \quad \text{HETP} = 0.030 \cdot \text{m}$$