(19.5) Calculate the thermal fission factor for a mixture of 60% ^{239}Pu, 30% ^{240}Pu, and 10% ^{241}Pu.

It is possible to use % directly in the equations. For α it will cancel out and for ν we have to divide by 100 if %-values are not converted to fractions first.

Data, constants, and units:

$barn := 10^{-28} \cdot m^2$ From Table 19.2 we obtain

$\sigma_{f239} := 742.5 \cdot barn$ $\sigma_{f240} := 0.030 \cdot barn$ $\sigma_{f241} := 1009 \cdot barn$

$\sigma_{\gamma 239} := 268.8 \cdot barn$ $\sigma_{\gamma 240} := 289.5 \cdot barn$ $\sigma_{\gamma 241} := 368 \cdot barn$

$\nu_{239} := 2.871$ $\nu_{240} := 2.90$ $\nu_{241} := 2.927$

Data given in the text (the %-values are automatically converted to fractions):

$x_{239} := 60 \cdot \%$ $x_{240} := 30 \cdot \%$ $x_{241} := 10 \cdot \%$

Calculations:

$$\alpha_{tot} := \frac{x_{239} \cdot \sigma_{\gamma 239} + x_{240} \cdot \sigma_{\gamma 240} + x_{241} \cdot \sigma_{\gamma 241}}{x_{239} \cdot \sigma_{f239} + x_{240} \cdot \sigma_{f240} + x_{241} \cdot \sigma_{f241}}$$

$$\nu_{tot} := x_{239} \cdot \nu_{239} + x_{240} \cdot \nu_{240} + x_{241} \cdot \nu_{241}$$

$$\eta_{tot} := \frac{\nu_{tot}}{\left(1 + \alpha_{tot}\right)} \qquad \eta_{tot} = 1.896$$