30.64

The fraction of a radioactive sample with decay constant λ that is left after a time t is given by Eq. (30.14) to be $N/N_0 = e^{-\lambda t}$. In this case $\lambda = 5.5 \times 10^{-3}$ decays/s, and so the fraction of ^{15}O left after $t = 4.0\,\text{s}$ is

$$\frac{N}{N_0} = e^{-\lambda t} = e^{-(5.5\times10^{-3}\,\text{s}^{-1})(4.0\,\text{s})} = 0.98 = 98\%\,,$$

meaning that the amount of the ^{15}O isotope will be diminished to 98% of its original value in 4.0 s.

30.65

Similar to Problem (30.62), we first express the time t $(= 1.00\,\text{h} = 60.0\,\text{min})$ in terms of $t_{1/2}$ $(= 1.18\,\text{min})$: $t = [(60.0\,\text{min/h})/1.18\,\text{min}]\, t_{1/2} = 50.847\,46\, t_{1/2}$. Since the amount of the sample decreases by a factor of 2 with every passing half-life, after 50.847 46 half-lives (i.e., 1.00 h) the fraction of protactinium-234 left is

$$\frac{N}{N_0} = \left(\frac{1}{2}\right)^{50.847\,46} = 4.94 \times 10^{-16}\,.$$