31. (a) The half-life $T_{1/2}$ and the disintegration constant are related by $T_{1/2} = (\ln 2)/\lambda$, so $T_{1/2} = (\ln 2)/(0.0108\,\mathrm{h}^{-1}) = 64.2\,\mathrm{h}$.

(b) At time t, the number of undecayed nuclei remaining is given by

$$N = N_0\, e^{-\lambda t} = N_0\, e^{-(\ln 2)t/T_{1/2}} \ .$$

We substitute $t = 3T_{1/2}$ to obtain

$$\frac{N}{N_0} = e^{-3\ln 2} = 0.125 \ .$$

In each half-life, the number of undecayed nuclei is reduced by half. At the end of one half-life, $N = N_0/2$, at the end of two half-lives, $N = N_0/4$, and at the end of three half-lives, $N = N_0/8 = 0.125N_0$.

(c) We use

$$N = N_0\, e^{-\lambda t} \ .$$

$10.0\,d$ is $240\,\mathrm{h}$, so $\lambda t = (0.0108\,\mathrm{h}^{-1})(240\,\mathrm{h}) = 2.592$ and

$$\frac{N}{N_0} = e^{-2.592} = 0.0749 \ .$$