29. (a) The decay rate is given by $R = \lambda N$, where λ is the disintegration constant and N is the number of undecayed nuclei. Initially, $R = R_0 = \lambda N_0$, where N_0 is the number of undecayed nuclei at that time. One must find values for both N_0 and λ. The disintegration constant is related to the half-life $T_{1/2}$ by $\lambda = (\ln 2)/T_{1/2} = (\ln 2)/(78\,\text{h}) = 8.89 \times 10^{-3}\,\text{h}^{-1}$. If M is the mass of the sample and m is the mass of a single atom of gallium, then $N_0 = M/m$. Now, $m = (67\,\text{u})(1.661 \times 10^{-24}\,\text{g/u}) = 1.113 \times 10^{-22}\,\text{g}$ and $N_0 = (3.4\,\text{g})/(1.113 \times 10^{-22}\,\text{g}) = 3.05 \times 10^{22}$. Thus $R_0 = (8.89 \times 10^{-3}\,\text{h}^{-1})(3.05 \times 10^{22}) = 2.71 \times 10^{20}\,\text{h}^{-1} = 7.53 \times 10^{16}\,\text{s}^{-1}$.

(b) The decay rate at any time t is given by

$$R = R_0\, e^{-\lambda t}$$

where R_0 is the decay rate at $t = 0$. At $t = 48\,\text{h}$, $\lambda t = (8.89 \times 10^{-3}\,\text{h}^{-1})(48\,\text{h}) = 0.427$ and

$$R = (7.53 \times 10^{16}\,\text{s}^{-1})\, e^{-0.427} = 4.91 \times 10^{16}\,\text{s}^{-1}\ .$$