Part (b)

Game plan: We turn the proportional rate of decrease into a differential equation, solve it, then use the known height after 45 seconds to find the constant.

Step 1: Write the differential equation

Let $k > 0$ be the constant of proportionality. Because the height is decreasing,

$$\frac{dx}{dt} = -kx.$$

Step 2: Separate and integrate

Logarithmic integral — **Logbook Page 26**

$$\int \frac{1}{x}\,dx = \ln|x| + C.$$

Since $x > 0$ while water remains in the tank,

$$\frac{dx}{x} = -k\,dt,$$
$$\ln x = -kt + C.$$

At $t = 0$, $x = H$, so $C = \ln H$. Therefore

$$\ln\left(\frac{x}{H}\right) = -kt, \qquad x = He^{-kt}.$$

Step 3: Use the height after 45 seconds

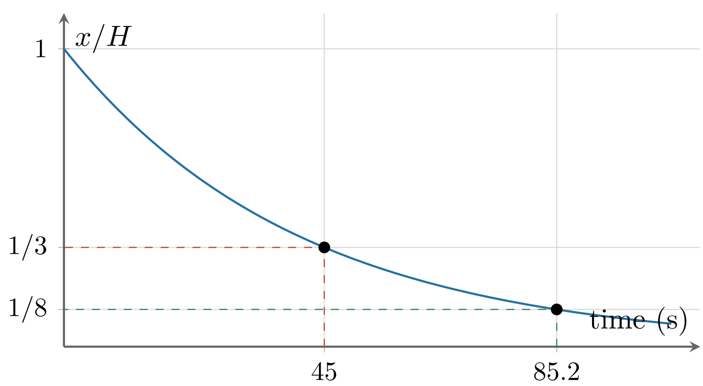
At $t = 45$, $x = H/3$. Substitute into the logarithmic form:

$$\ln\left(\frac{1}{3}\right) = -45k,$$
$$k = \frac{\ln 3}{45}.$$

Step 4: Find when the height is $H/8$

$$\ln\left(\frac{1}{8}\right) = -kt,$$
$$t = \frac{\ln 8}{k} = 45\frac{\ln 8}{\ln 3}$$
$$= 85.175\ldots \text{ s}.$$

The graph shows the height as a fraction of its initial value.



Final Answer

$t \approx$ **85.2 s after the water starts draining.**