1. The initial mass of a certain species of fish is 7 million tons. The mass of fish, if left alone, would increase at a rate proportional to the mass, with a proportionality constant of 2/year. However, commercial fishing removes fish mass at a constant rate of 15 million tons per year. When will all the fish be gone?

\[
\frac{dm}{dt} = 2m - 15
\]

\[
m(0) = 7 \text{ (in millions of tons)}
\]

\[
\frac{dm}{dt} - 2m = -15 \quad \Rightarrow \quad y(t) = e^{-2t}
\]

\[
\frac{d}{dt}(me^{-2t}) = -15e^{-2t} \quad \Rightarrow \quad me^{-2t} = 7.5e^{-2t} + C
\]

\[
\Rightarrow \quad m = 7.5 + Ce^{2t}
\]

\[
m(0) = 7 = 7.5 + C
\]

\[
\Rightarrow \quad C = -0.5
\]

\[
m(t) = 7.5 - 0.5e^{2t}
\]

When is \( m = 0? \)

\[
0 = 7.5 - 0.5e^{2t} \quad \Rightarrow \quad e^{2t} = 15 \quad \Rightarrow \quad t = \frac{\ln(15)}{2}
\]

2. On a hot Saturday morning while people are working inside, the air conditioner keeps the temperature inside the building at 24°C. At noon the air conditioner is turned off, and the people go home. The temperature outside is a constant 35°C for the rest of the afternoon. If the time constant for the building is 4 hr, what will be the temperature inside the building at 2:00 pm?

\[
\frac{dT}{dt} = \frac{1}{4}(35 - T) \quad T(0) = 24^\circ\text{C. (at noon)}
\]

\[
\int \frac{dT}{35 - T} = \int \frac{1}{4} \, dt \quad \Rightarrow \quad -\ln|35 - T| = \frac{1}{4}t + C
\]

\[
\Rightarrow \quad \ln|35 - T| = -\frac{1}{4}t + C
\]

\[
\Rightarrow \quad 35 - T = Ce^{-\frac{t}{4}}
\]

\[
T = 35 - Ce^{-\frac{t}{4}}
\]

\[
T(0) = 24 = 35 - C \quad \Rightarrow \quad C = 11 \quad \Rightarrow \quad T(t) = 35 - 11e^{-\frac{t}{4}}
\]

\[
\text{So} \quad T(2) = 35 - 11e^{-\frac{1}{2}} = \text{temp at 2 pm.}
\]