Each problem is worth 5 points. For full credit provide proper justification for your answer.

1. Find a solution to the differential equation \( \frac{dm}{dt} = 100 - 0.3m \) subject to the initial condition that \( m(0) = 400 \).

\[
\frac{dm}{dt} = 100 - 0.3m
\]

\[
0_1 \left( \frac{1}{100 - 0.3m} \right) = dt
\]

\[
0_1 \ln|100 - 0.3m| = t + c
\]

\[
0_1 \frac{1}{0.3} \ln(100 - 0.3m) = t + c
\]

\[
0_1 100 - 0.3m = e^{-0.3t} - c
\]

\[
0_1 100 - 0.3m = Ae^{-0.3t}
\]

\[
0_1 -0.3m = Ae^{-0.3t} - 100
\]

\[
m(t) = \frac{100 - Ae^{-0.3t}}{0.3}
\]

\[
m(0) = 400
\]

\[
400 = \frac{100 - Ae^{-0.3 \times 0}}{0.3}
\]

\[
0_1 120 = 100 - Ae^0
\]

\[
0_1, A = 100 - 120 = -20
\]

Hence, the solution of the differential equation is

\[
m(t) = \frac{100 + 20e^{-0.3t}}{0.3}
\]

\[
0_1 m(t) = 333.33 + 66.67e^{-0.3t}
\]

2. Lake Superior has a volume of approximately 12.2 thousand km\(^3\), and an outflow rate of roughly 65.2 km\(^3\) per year. Write a differential equation that models the quantity \( Q \) of some pollutant in the lake over time.

\[
\frac{dQ}{dt} = -\frac{65.2}{12200} \cdot Q
\]

\[
\frac{Q}{12200} \text{ is the proportion of the total water that's polluted, and there are 65.2 km}\(^3\) like that leaving, hence the negative.}