3.39

1 3.39, §1 Asked

Solve:

\[ \frac{dx}{dt} = \frac{x}{t} \]

2 3.39, §2 Solution

\[ \frac{dx}{dt} = \frac{x}{t} \]

The unknown is clearly \( x(t) \).

Separation of variables:

\[ \frac{dx}{x} = \frac{dt}{t} \]

\[ \ln |x| = \ln |t| + C \]

\[ e^{\ln |x|} = e^{\ln |t| + C} \quad \implies \quad |x| = |t|e^C \quad \implies \quad x = \pm e^C t \]

\[ x = Dt \]

An additional “initial” condition would be needed to find \( D \). For example, \( x = 1 \) at \( t = 1 \).

Note: the O.D.E. applies at all positions. Initial or boundary conditions apply only to a specific point.