3.39

1 3.39, §1 Asked

Solve:

$$\frac{\mathrm{d}x}{\mathrm{d}t} = \frac{x}{t}$$

2 3.39, §2 Solution

$$\frac{\mathrm{d}x}{\mathrm{d}t} = \frac{x}{t}$$

The unknown is clearly $x(t)$.

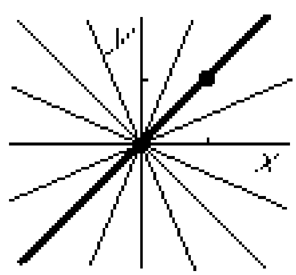
Separation of variables:

$$\frac{\mathrm{d}x}{x} = \frac{\mathrm{d}t}{t}$$

$$\ln|x| = \ln|t| + C$$

$$e^{\ln|x|} = e^{\ln|t|+C} \quad\Longrightarrow\quad |x| = |t|e^C \quad\Longrightarrow\quad x = \pm e^C t$$

$$x = Dt$$



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.