3. $M(t,y) = 1$ $\qquad \dfrac{\partial M}{\partial y} = 0$

$N(t,y) = -\left(y - \dfrac{t}{y}\right) = \dfrac{t}{y} - y$ $\qquad \dfrac{\partial N}{\partial t} = \dfrac{1}{y}$

SINCE $\dfrac{\partial M}{\partial y} \neq \dfrac{\partial N}{\partial t}$ THE ODE IS <u>NOT</u> EXACT.

WE HAVE
$$\frac{\dfrac{\partial N}{\partial t} - \dfrac{\partial M}{\partial y}}{M(t,y)} = \frac{\frac{1}{y} - 0}{1} = \frac{1}{y}$$

SO AN INTEGRATING FACTOR IS
$$\mu = e^{\int \frac{1}{y}\,dy} = e^{\ln(y)} = y$$

THE ODE BECOMES
$$y - (y^2 - t)\frac{dy}{dt} = 0$$

WE MUST HAVE
$$\begin{aligned}
\psi(t,y) &= \int y\,dt \\
&= ty + C(y) \\
\frac{\partial \psi}{\partial y} &= t + C'(y) = -(y^2 - t) = t - y^2 \\
C'(y) &= -y^2 \\
C(y) &= \int (-y^2)\,dy = -\tfrac{1}{3}y^3 + C
\end{aligned}$$

THUS THE SOLUTION IS
$$\psi(t,y) = C$$
$$ty - \tfrac{1}{3}y^3 = C$$