1. \((10 \text{ points})\) Find the general solution to the differential equation
\[
\frac{dy}{dx} = \frac{1}{e^y(1 + x^2)}
\]

Solution:
\[
\int e^y dy = \int \frac{dx}{(1 + x^2)}
\]
\[
e^y = \arctan(x) + C
\]
\[
y = \ln(\arctan(x) + C)
\]

2. \((10 \text{ points})\) Find a solution to the initial value problem
\[
\frac{dy}{dx} = (y - 1) \frac{1}{x}
\]
\[
y(-1) = 0
\]

Solution:
\[
\frac{dy}{dx} = (y - 1) \frac{1}{x}
\]
\[
\frac{1}{y - 1} dy = \frac{1}{x} dx
\]
\[
\ln|y - 1| = \ln|x| + c
\]
\[
y - 1 = \pm |x| e^c
\]
\[
y = 1 \pm |x| e^c
\]
We are working near $-1$, so $|x| = -x$. Plugging in $y(-1) = 0$,

$$0 = 1 \pm e^c \left(\frac{-(-1)}{|-1|}\right)$$

e$^c$ is always positive, so we must have

$$0 = y(-1) = 1 - e^c$$

Thus $1 = e^c$ and we get as our final answer

$$y(x) = 1 - e^c(-x)$$
$$y(x) = 1 + x$$