2. $ty'' + (1-2t)y' + (t-1)y = 0$, $y_1(t) = et$

$\downarrow$

$y'' + \frac{(1-2t)}{t}y' + \frac{(t-1)}{t}y = 0 \rightarrow p(t) = \frac{1}{t} - 2$

$\int p(t)dt = \ln t - 2t$ so $\omega(t) = \frac{e^{-\ln t + 2t}}{e^{2t}} = \frac{t^{-1}e^{2t}}{e^{2t}} = \frac{1}{t}$

thus $u(t) = \ln(t)$

and $\boxed{y_2(t) = \ln(t)\,et.}$

check: $y_2'(t) = \frac{1}{t}et + \ln t\, et$

$y_2''(t) = -\frac{1}{t^2}et + 2\frac{1}{t}et + \ln t\, et$

$\rightarrow \left(-\frac{1}{t}et + 2et + t\ln t\, et\right) + \left(\frac{1}{t}et + \ln t\, et - 2et - 2\ln t\, et\right)$

$+ t\ln(t)et - \ln(t)et = 0$ ✓