

null point

$$\text{When } M_z(t) = 0 \Rightarrow M_0 (1 - 2e^{-\frac{t}{T}}) = M_z(t_{\text{null}})$$

$$0 = M_0 (1 - 2e^{-\frac{t_{\text{null}}}{T}})$$

can divide by M_0
as $M_0 \neq 0$

$$0 = 1 - 2e^{-\frac{t_{\text{null}}}{T}}$$

$$2e^{-\frac{t_{\text{null}}}{T}} = 1$$

$$e^{-\frac{t_{\text{null}}}{T}} = \frac{1}{2}$$

$$-\frac{t_{\text{null}}}{T} = \ln\left(\frac{1}{2}\right) = -\ln(2)$$

by log rule
 $\ln\left(\frac{1}{x}\right) = -\ln(x)$

$$t_{\text{null}} = T \ln(2) \approx 0.693T$$

approximately 69% of the relaxation time T .