a.

$0-180°)\ M_z^0$

$0+180°)\ -M_z^0$

$1-\theta)\ M_z' = M_z^0(1-2e^{-T_I/T_1})$

$1+\theta)\ M_z' = M_z^0(1-2e^{-T_I/T_1})\cos\theta$

In steady state; $M_z^{(n)}(0_-) = M_z^{(n-1)}(0_-) = M_z^{ss}(0_-)$

$2-180°)\ M_z' = M_z^0(1-e^{-(T_R-T_I)/T_1})$

$2+180°)\ M_z' = -M_z^0(1-e^{-(T_R-T_I)/T_1})$

$3-\theta)\ M_z' = M_z^0(1-2e^{-T_I/T_1}+e^{-T_R/T_1})$

$3+\theta)\ M_z' = M_z^0(1-2e^{-T_I/T_1}+e^{-T_R/T_1})\cos\theta$

$M_z^{(n)}(0_-) = M_z^{ss(n)}(0_-) = M_z^{ss(n-1)}\cdot e^{-T_R/T_1}\cos\theta + M_z^0(1-2e^{-T_I/T_1}+e^{-T_R/T_1})$

$\therefore M_{z\,ss}^{(n)}(0_-) = \dfrac{M_z^0(1-2e^{-T_I/T_1}+e^{-T_R/T_1})}{1-e^{-T_R/T_1}\cos\theta}$

$\therefore M_{xy}^{(n)}(0_-) = \dfrac{M_z^0(1-2e^{-T_I/T_1}+e^{-T_R/T_1})}{1-e^{-T_R/T_1}\cos\theta}\cdot\sin\theta$

b. $\therefore \dfrac{dM_{xy}}{dt} = \dfrac{M_z^0(1-2e^{-T_I/T_1}+e^{-T_R/T_1})[\cos\theta-e^{-T_R/T_1}]}{(1-e^{-T_R/T_1}\cos\theta)^2}$

let $\dfrac{dM_{xy}}{dt}=0$. get $\theta = \arccos e^{-T_R/T_1}$

c. $T_1=T_R$. $\theta = \arccos e^{-1} = 68.4°$

d. $M_{xy} = \dfrac{M_z^0(1-2e^{-T_I/T_1}+e^{-T_R/T_1})}{1-e^{-2T_R/T_1}}\cdot\sqrt{1-e^{-\frac{2T_R}{T_1}}}$

$\text{regular\_}M_{xy} = M_z^0(1-2e^{-T_I/T_1}+e^{-T_R/T_1})$

while $0<e^{-2T_R/T_1}<1$ the M_{xy} is bigger.