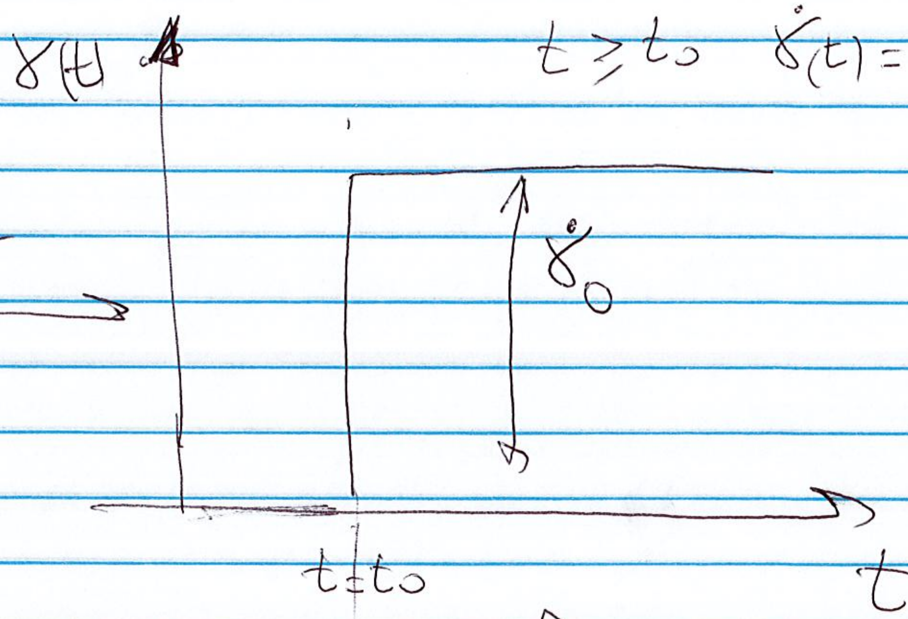
NOTES LECTURE 12-7-17 (1)

Start-Flow

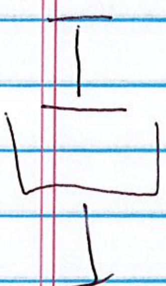
$t < t_0 \quad \dot{\gamma}(t) = 0$

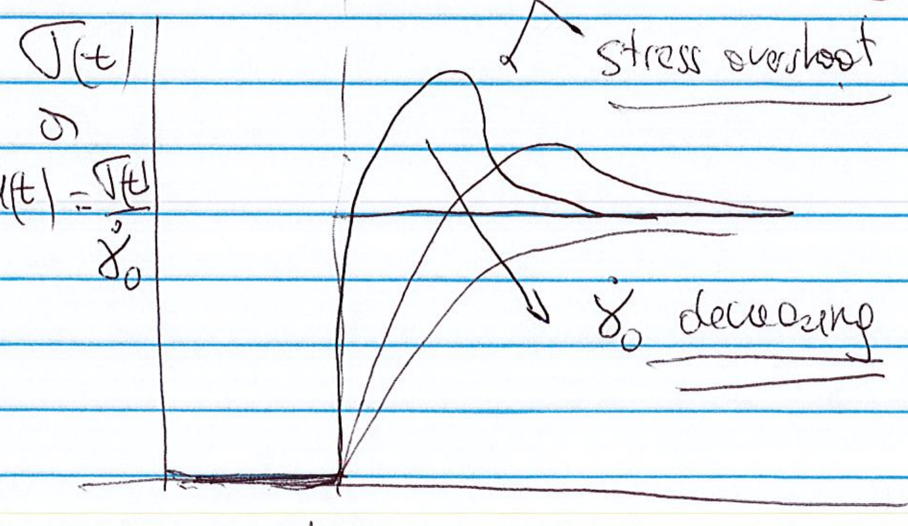
$t \geq t_0 \quad \dot{\gamma}(t) = \dot{\gamma}_0$

INPUT $\Rightarrow$



Liquid





$\sigma(t) = \mu \dot{\gamma}(t)$

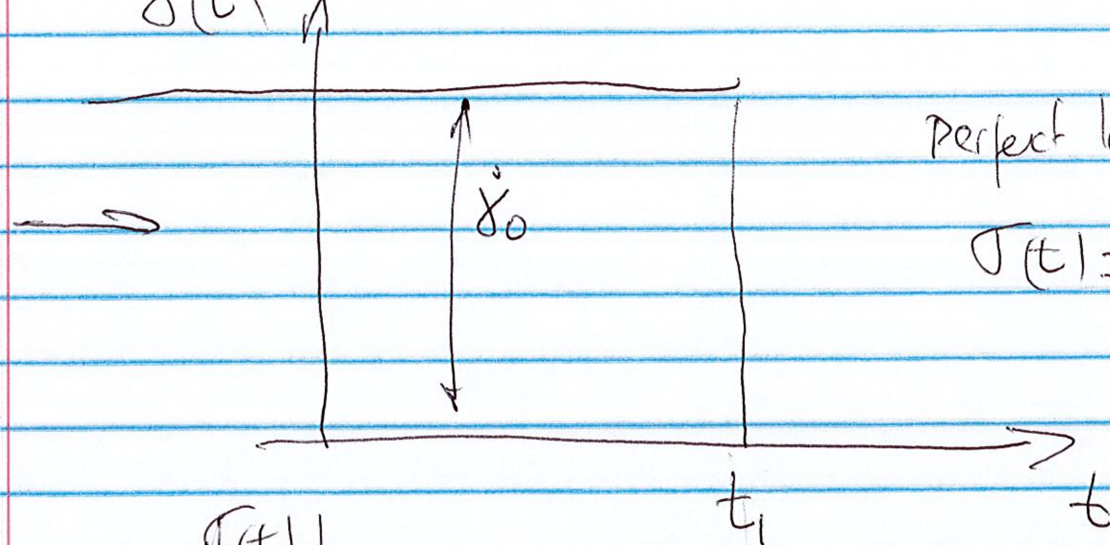
$\Downarrow$

MODEL

For $t < t_0 \quad \dot{\gamma}(t) = 0 \Rightarrow \sigma(t) = 0$

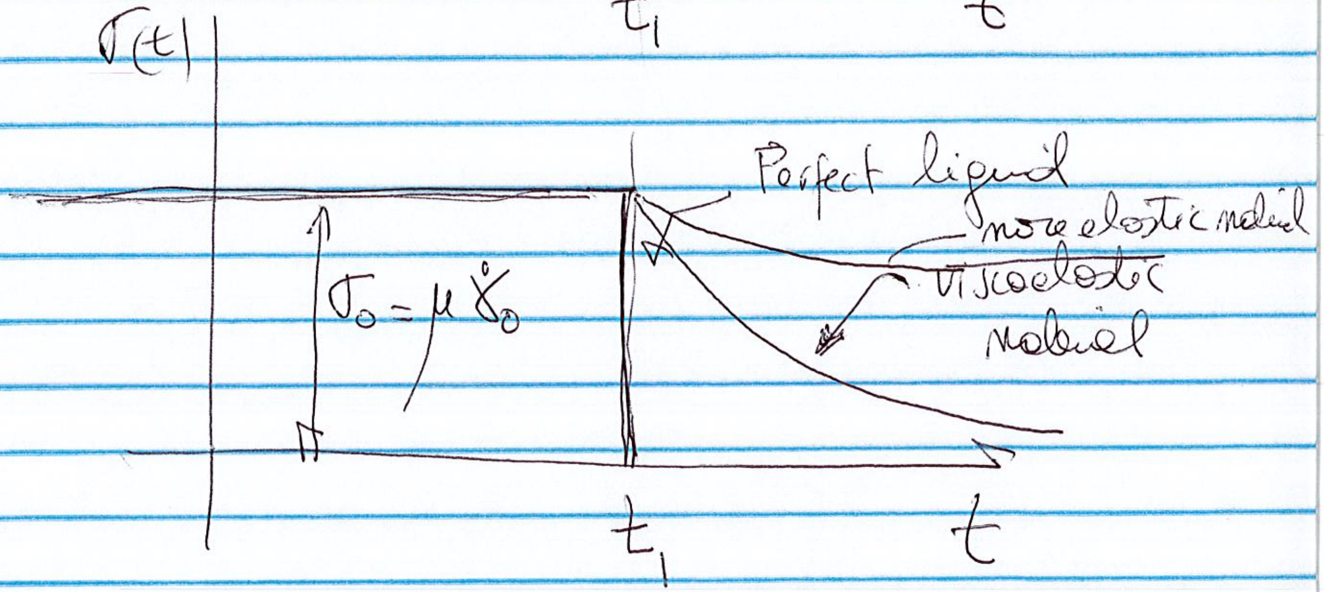
For $t > t_0 \quad \dot{\gamma}(t) = \dot{\gamma}_0 \longrightarrow \sigma(t) = \mu \dot{\gamma}_0$

2. Cessation of Steady Flow (2)

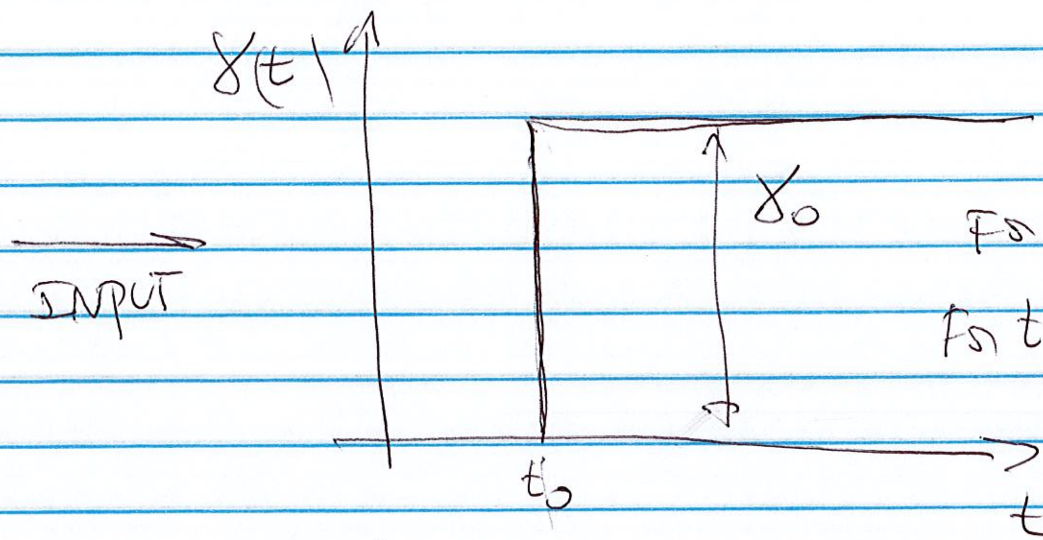


Perfect liquid

$\sigma(t) = \mu \dot{\gamma}(t)$

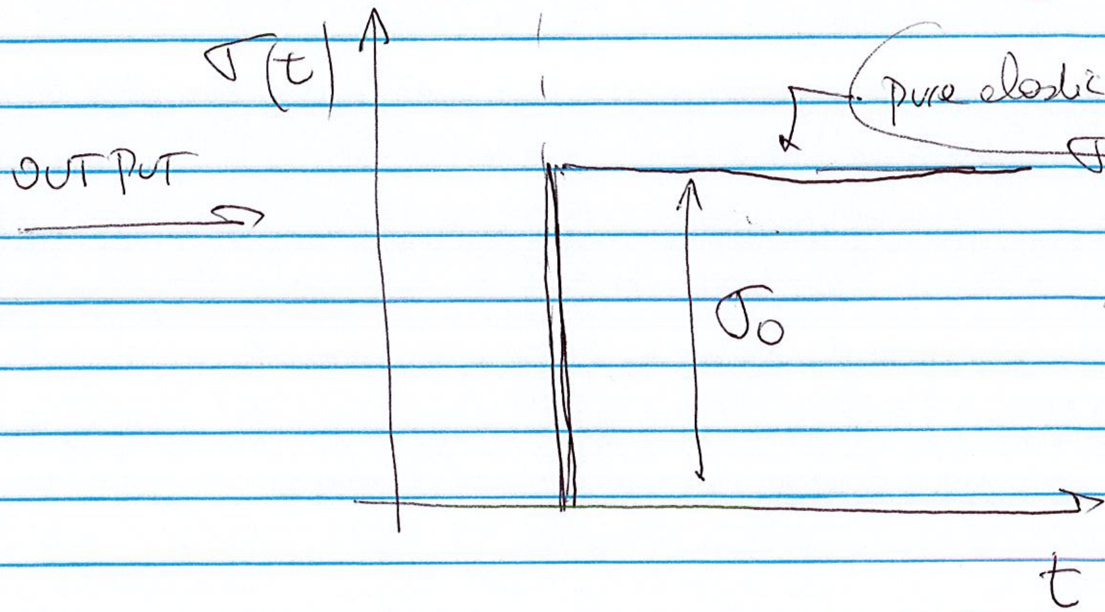


Relaxation Test



For $t < t_0$ $\gamma(t) = 0$

For $t \geq t_0$ $\gamma(t) = \gamma_0$



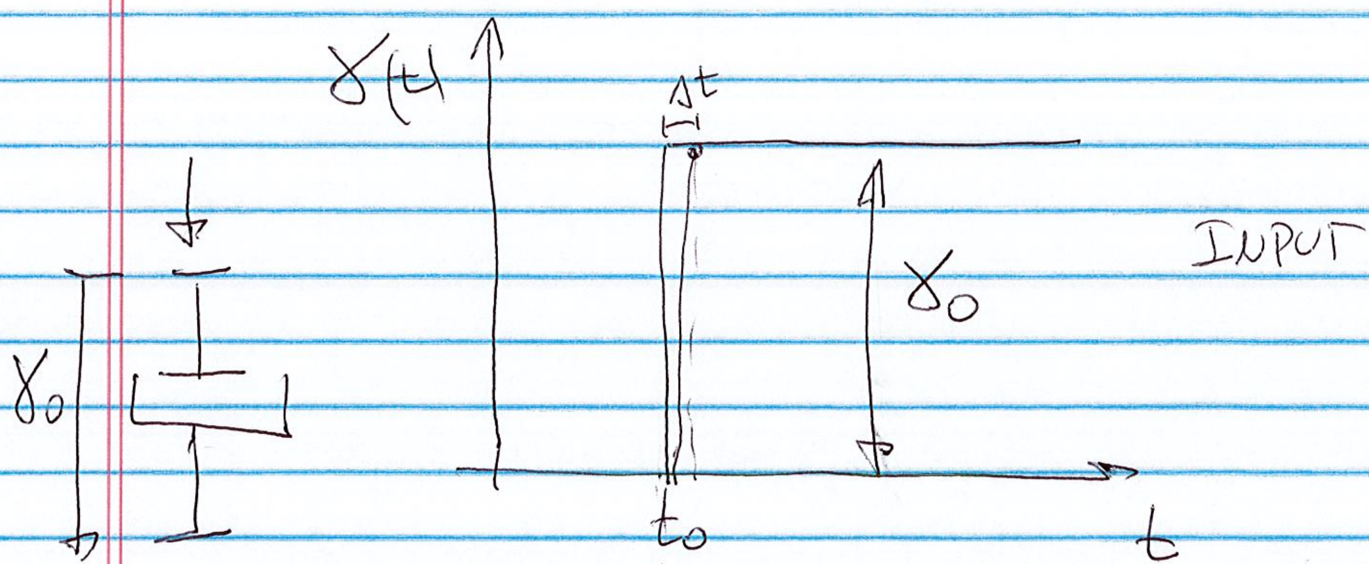
pure elastic material

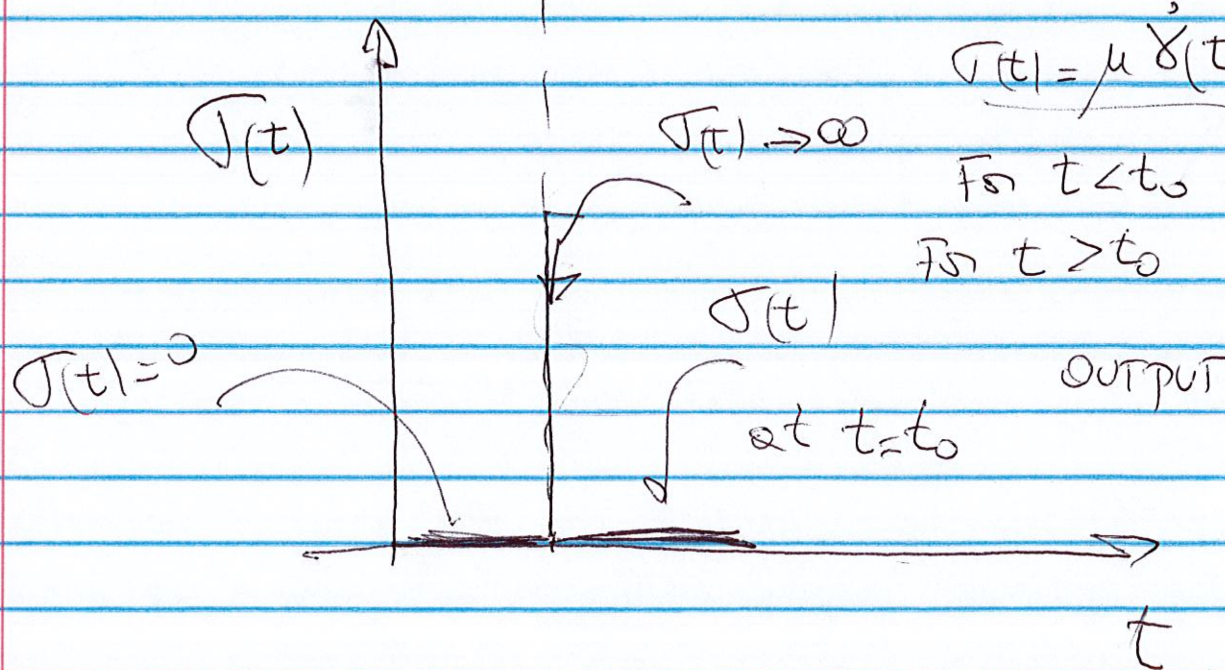
$\sigma_0 = G\gamma_0$

Property you measure.

RELAXATION TEST PURE LIQUID MATERIAL

$$\sigma(t) = \mu\, \dot{\gamma}(t)$$





$\sigma(t) = \mu\, \dot{\gamma}(t) = \mu \frac{d\gamma(t)}{dt}$

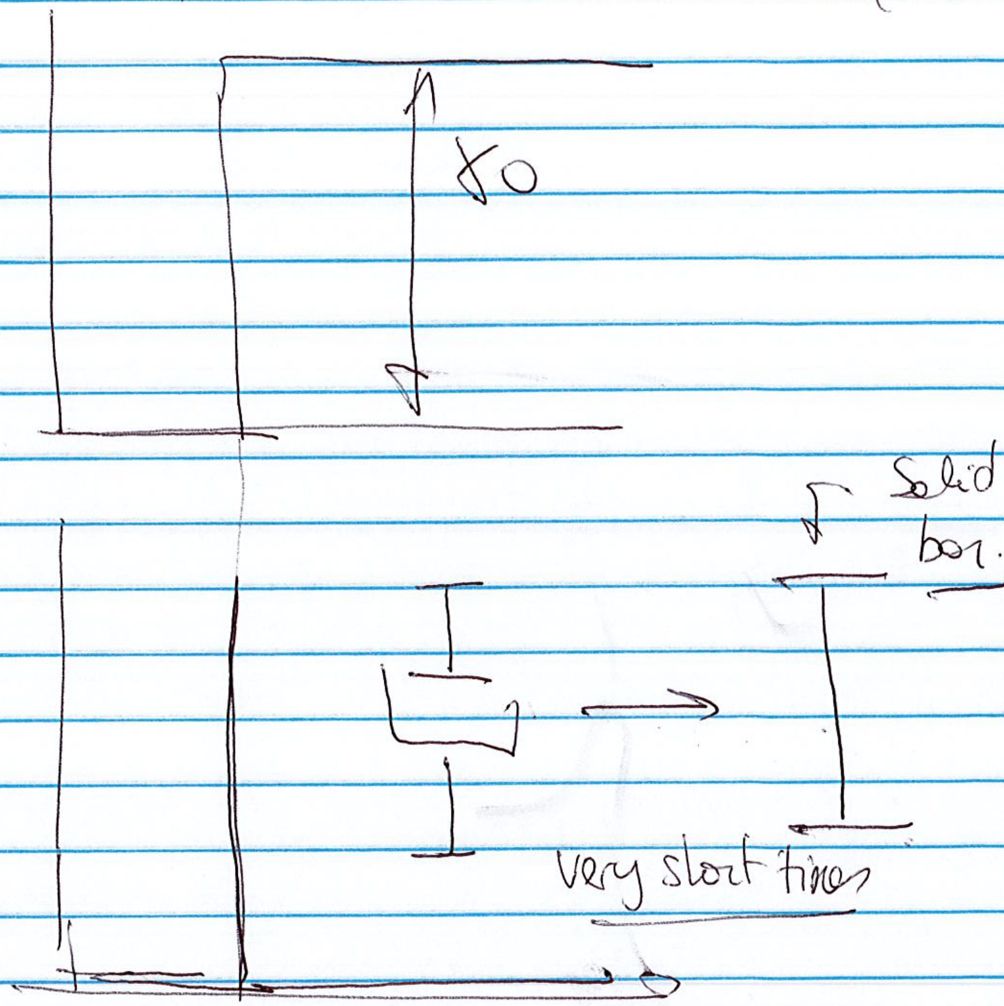
For $t < t_0$ $\sigma(t) = 0$

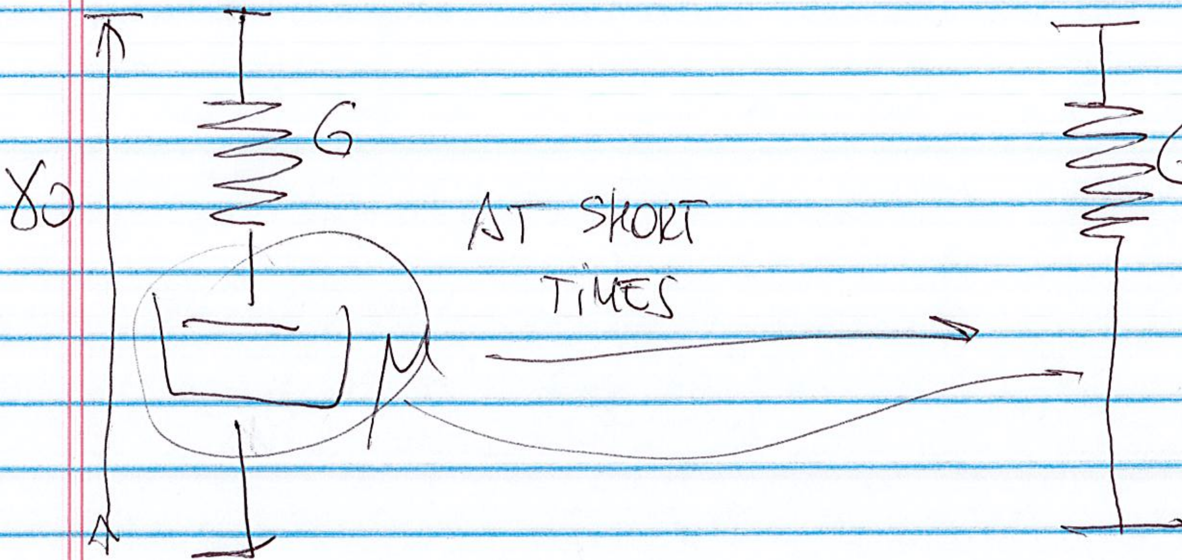
For $t > t_0$

at t_0 $\quad \frac{d\gamma(t)}{dt} \approx \frac{\gamma_0 - 0}{\cancel{t_0} + \Delta t - \cancel{t_0}} \simeq \frac{\gamma_0}{\Delta t}$

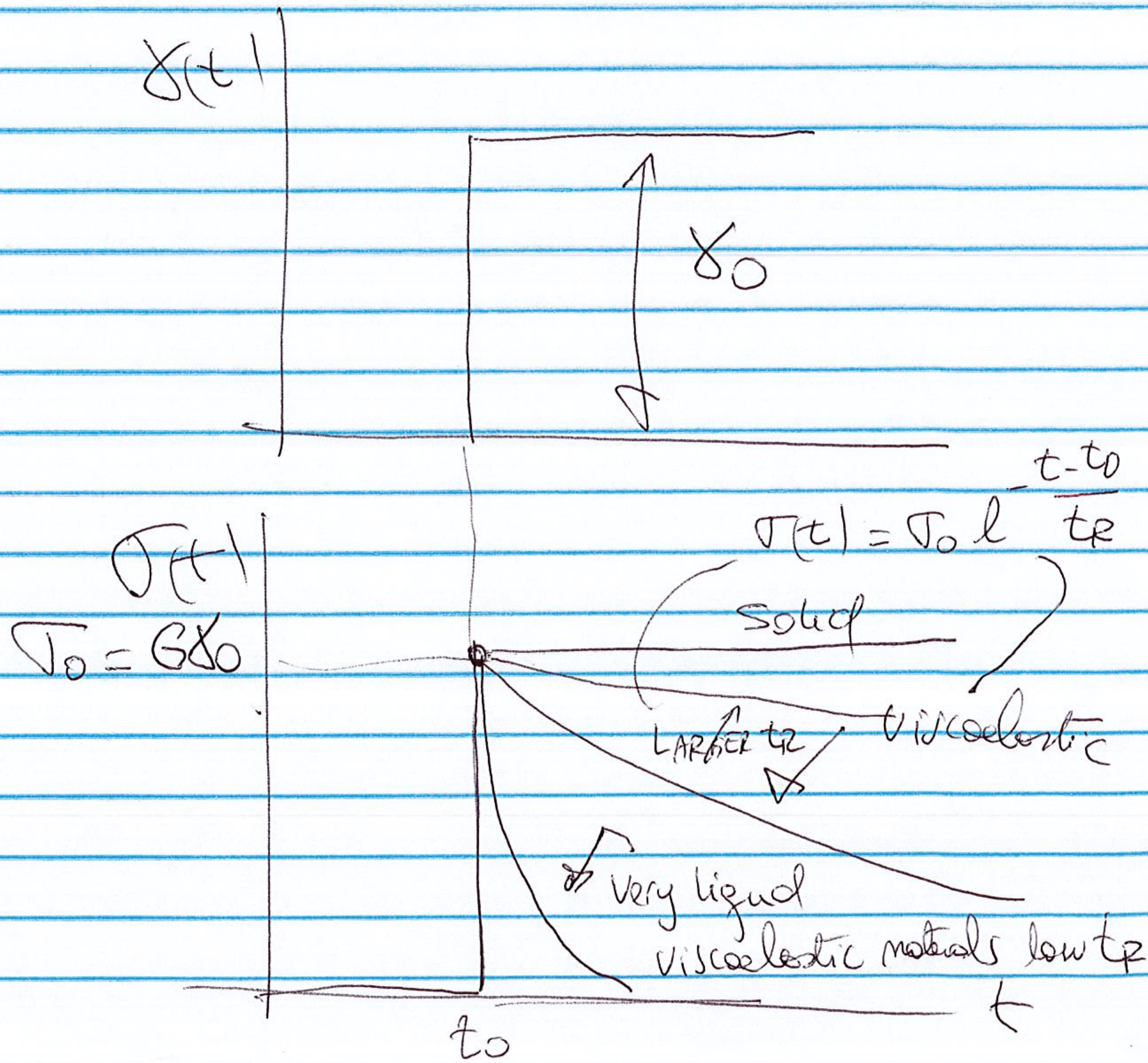
$\Delta t \to 0 \quad \frac{d\gamma(t)}{dt} \to \infty$

BEHAVIOR AT SHORT TIMES

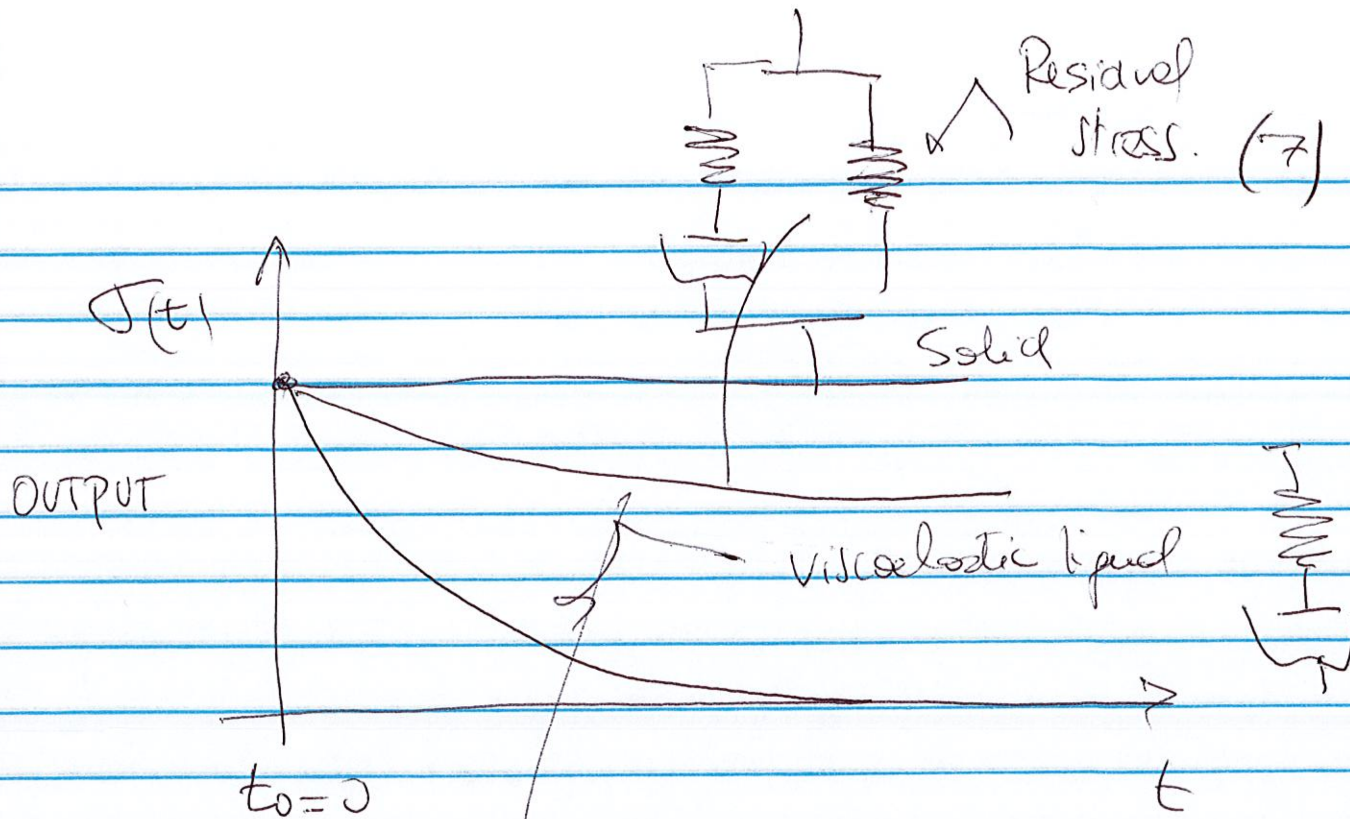




γ_0
G
μ
AT SHORT TIMES
G



$\gamma(t)$
γ_0
$\sigma(t)$
$\sigma_0 = G\gamma_0$
$\sigma(t) = \sigma_0 e^{-\frac{t-t_0}{t_R}}$
solid
viscoelastic
LARGER t_R
very liquid
viscoelastic materials low t_R
t_0
t



$$\sigma(t) = \sigma_0 e^{-t/t_e} + \sigma_{eq}$$

Creep test

red $\equiv$ elastic

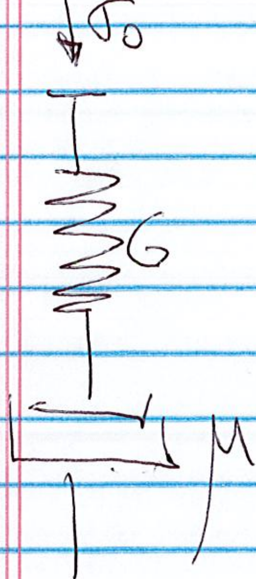
green $\equiv$ liquid.

black $\equiv$ viscoelastic.

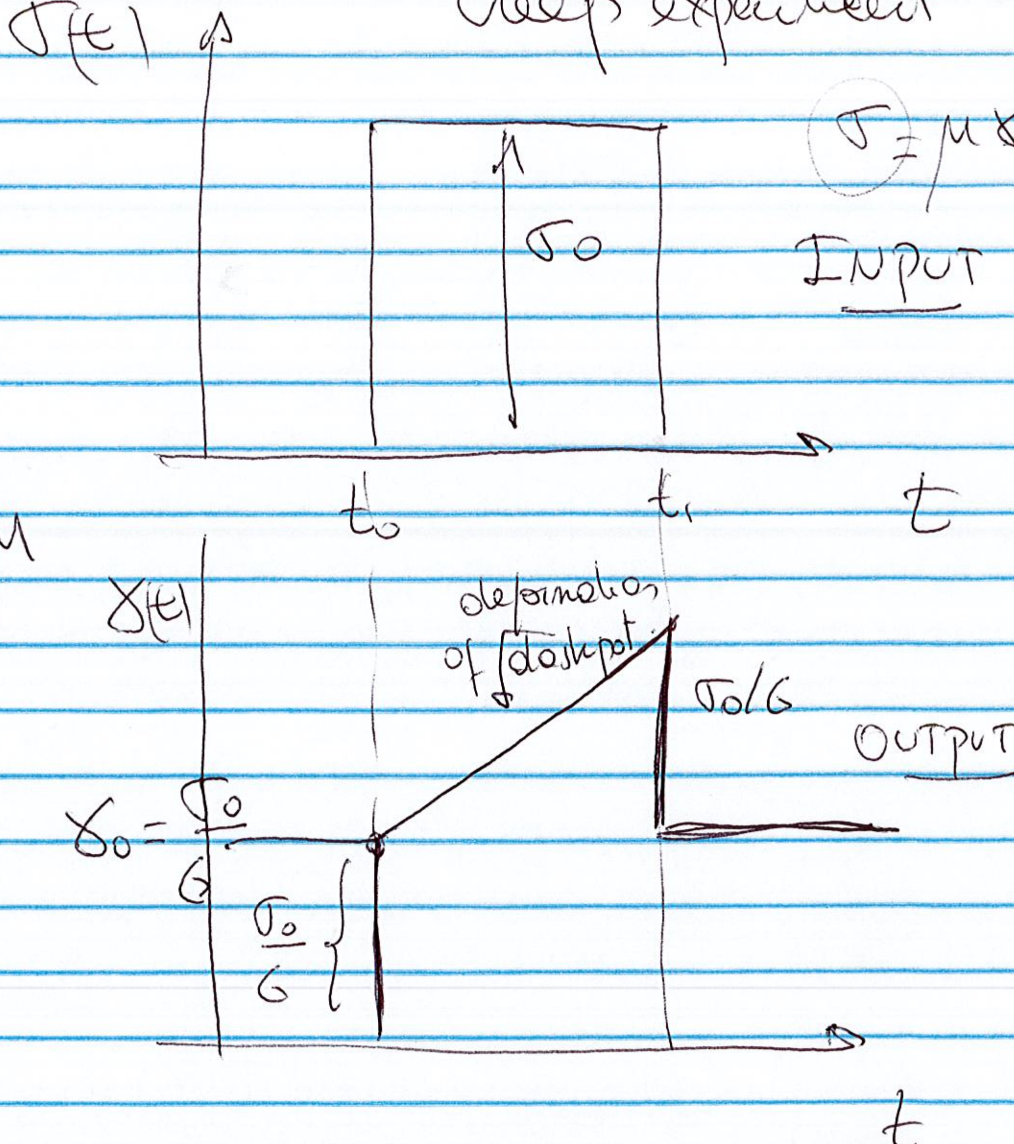
$$\sigma(t) = \mu \dot{\gamma}(t) = \mu \frac{d\gamma(t)}{dt}$$

$$\sigma_0 = \mu \frac{d\gamma(t)}{dt} \implies \boxed{\gamma(t) = \frac{\sigma_0}{\mu} t}$$

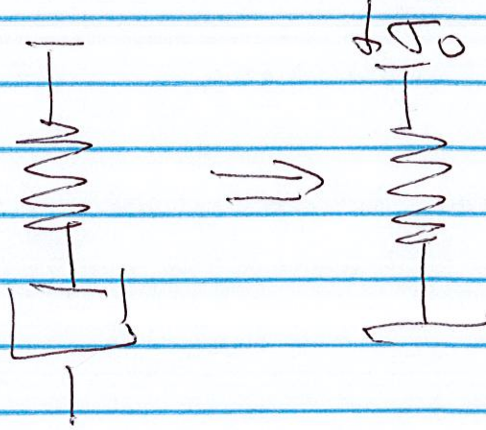
Creep experiment



$\sigma = \mu\dot{\gamma}$



very short times



at long times