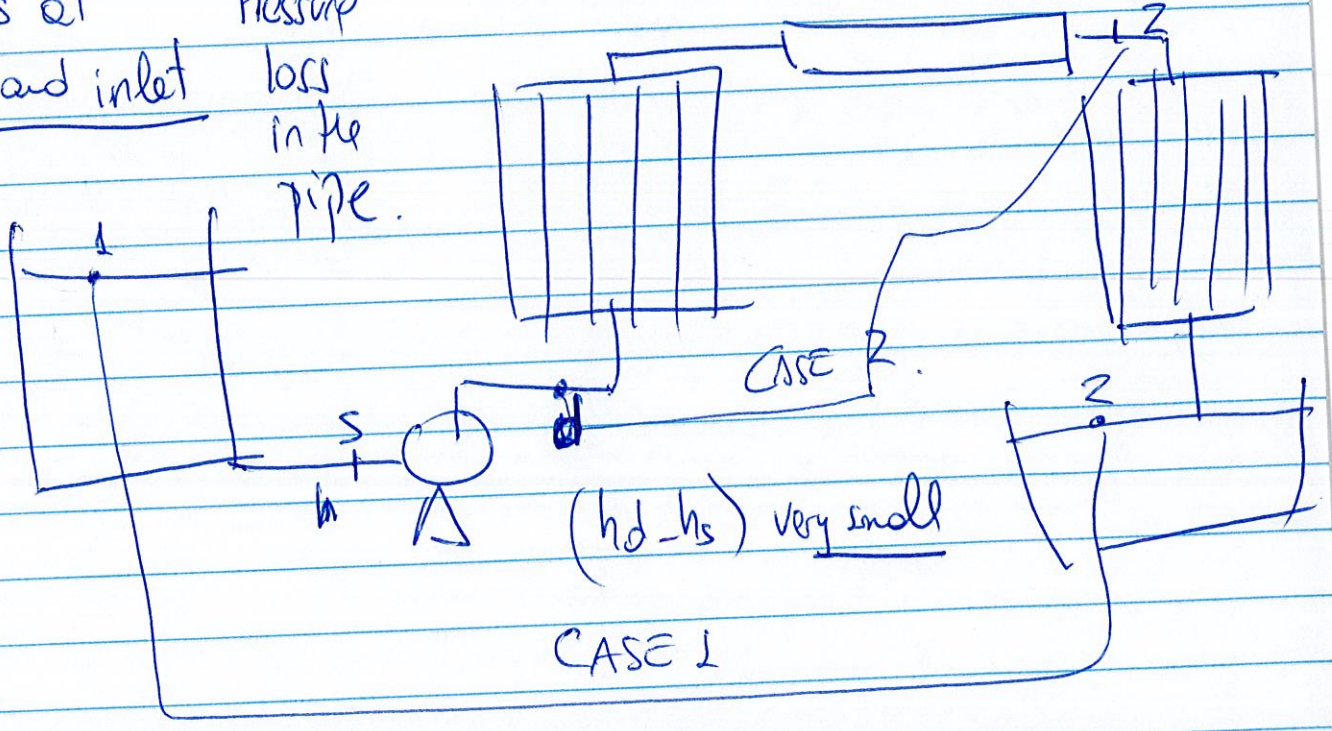
NOTES ON CLASS 11/14/2017

$$\Delta P_{pump} = (P_2 - P_1) + \rho g (h_2 - h_1) + \rho \left(\frac{\bar{u}_2^2 - \bar{u}_1^2}{2\alpha} \right) + \Delta P_{f\ 1 \to 2}$$

- $(P_2 - P_1)$: you need pressures at outlet and inlet
- $\rho g (h_2 - h_1)$: POTENTIAL ENERGY
- $\rho \left(\frac{\bar{u}_2^2 - \bar{u}_1^2}{2\alpha} \right)$: Kinetic energy.
- $\Delta P_{f\ 1 \to 2}$: Pressure loss in the pipe.

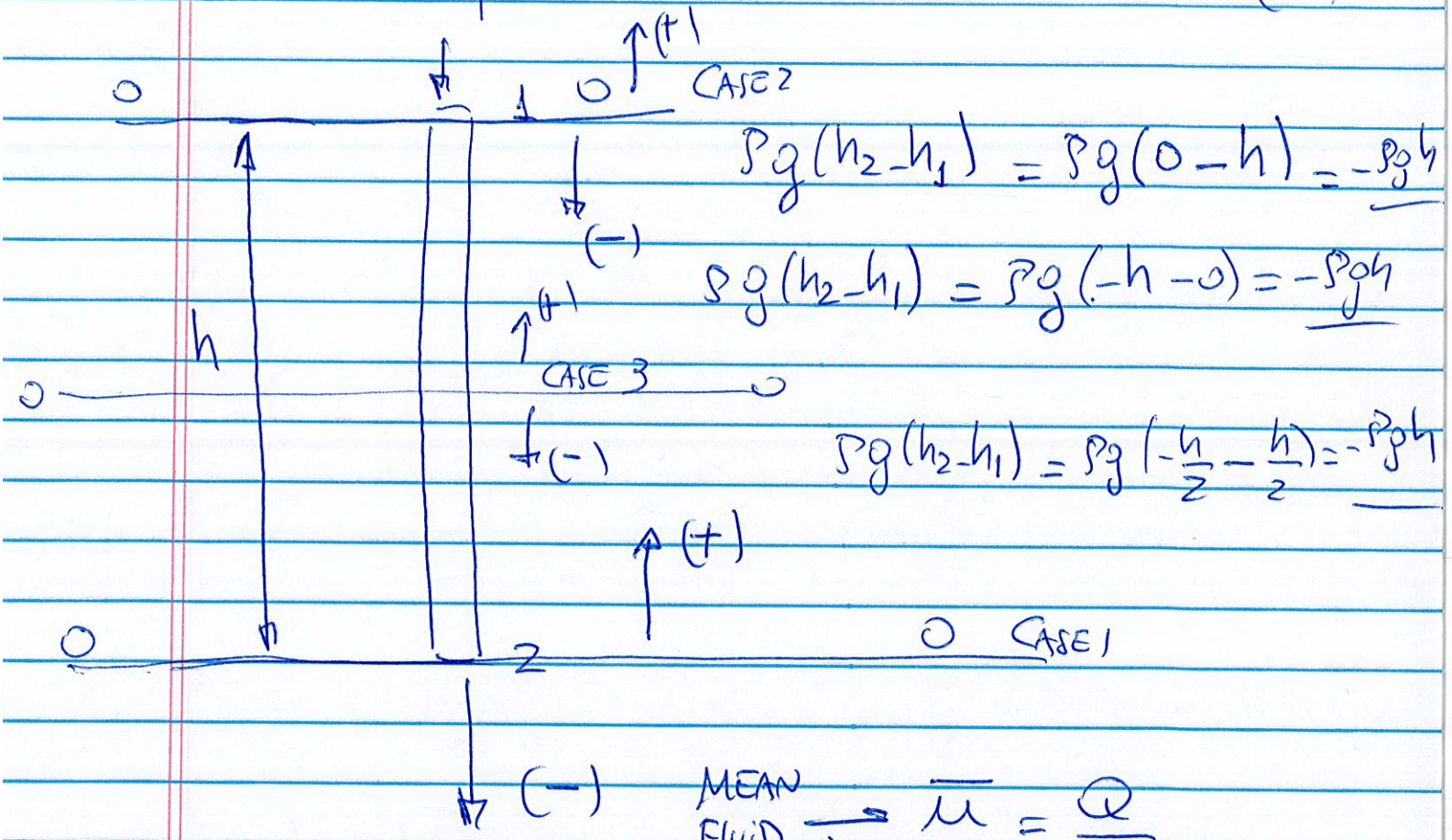
→ MECHANICAL ENERGY BALANCE BETWEEN LOCATIONS ("1" and "2")



If use CASE 1 to calculate P_d ← discharge pressure

~~with~~ P_d will be the same if you use case 2.

See notes from 11-13-17



MEAN FLUID VELOCITY → $\bar{u} = \frac{Q}{\pi R^2}$

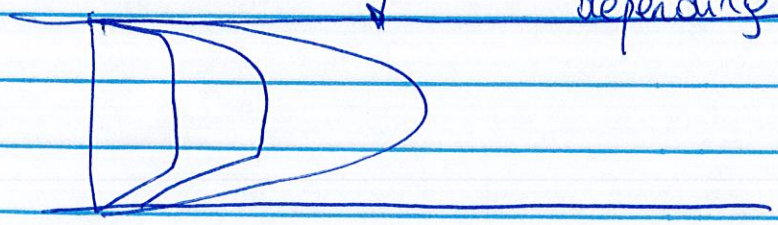
Kinetic Energy

MEAN VELOCITIES

$\frac{\rho g(\bar{u}_2^2 - \bar{u}_1^2)}{2\alpha}$

FACTOR TO CORRECT FOR VELOCITY PROFILE.

different velocity profiles. depending on the rheology.

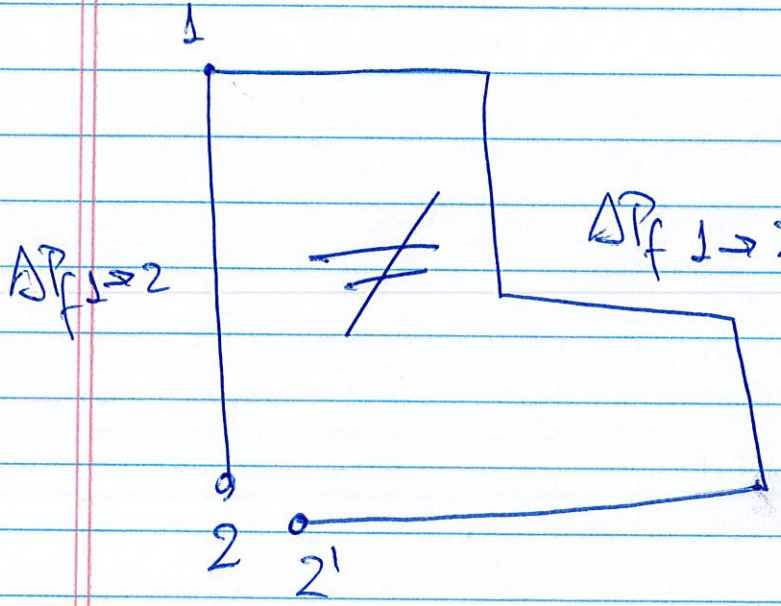


EQUATIONS FOR α ARE NOT GIVEN IN LIST OF EQUATION BUT ARE GIVEN IN LECTURES

If you have to use for the exam (3)
will be provided

Pressure loss in the Pipe $\Delta P_{f\ 1\to 2}$

IMPORTANT TO KNOW YOUR INLET & OUTLET IN MECH. ENERGY BALANCE



ΔP_f ALSO DEPENDS ON FLUID PROPERTIES
IN PARTICULAR THE RHEOLOGICAL PROPERTIES

How do we introduce the rheology of the material in the calculation of ΔP_f ?

$$\frac{Q}{\pi R^2} = \frac{1}{\tau_w^3} \int_0^{\tau_w} \tau^2 f(\dot{\gamma}) \, d\tau$$

RHEOLOGY

$$\dot{\gamma} = f(\tau)$$

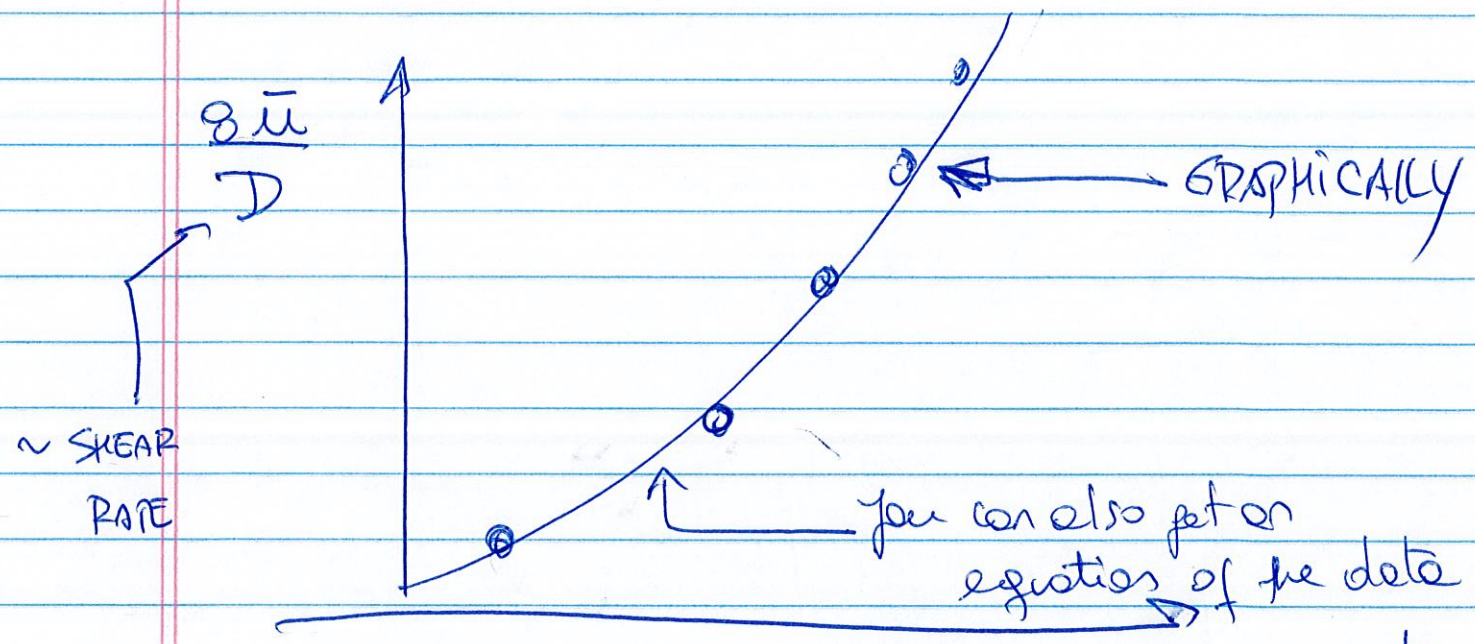
τ_w = function of [R, L, RHEOLOGICAL PROPERTIES]

ΔP_f for a particular rheology.

Newtonian

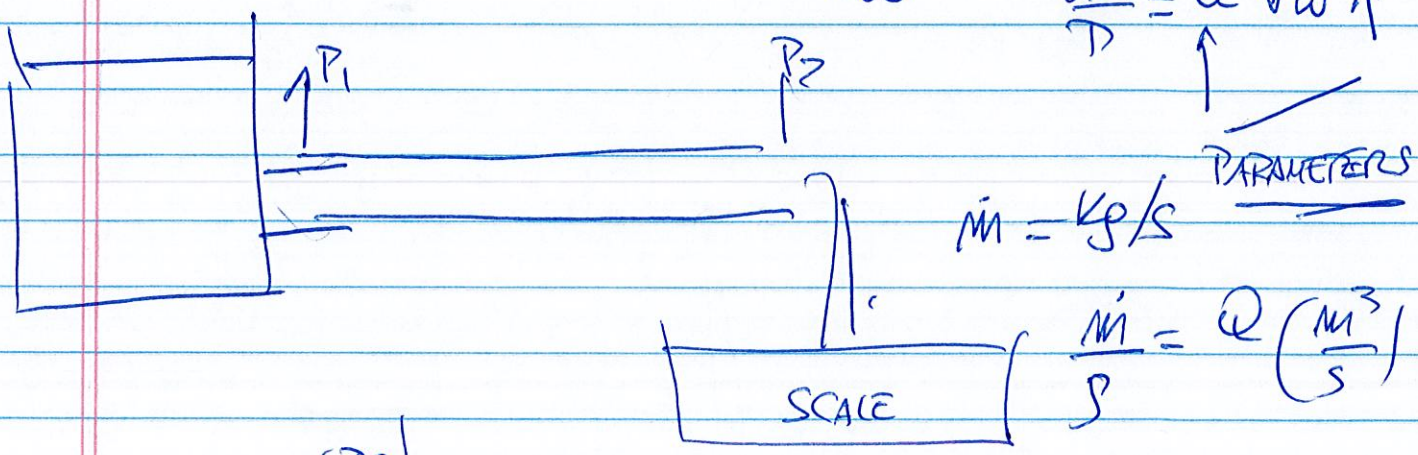
$$\tau = \mu \dot{\gamma} \Rightarrow \dot{\gamma} = \frac{\tau}{\mu}$$

SCALE UP APPROACH



$$\frac{8\bar{u}}{D} = a\,\nabla w^{b}$$

PARAMETERS



$$\dot{m} = K\rho/s$$

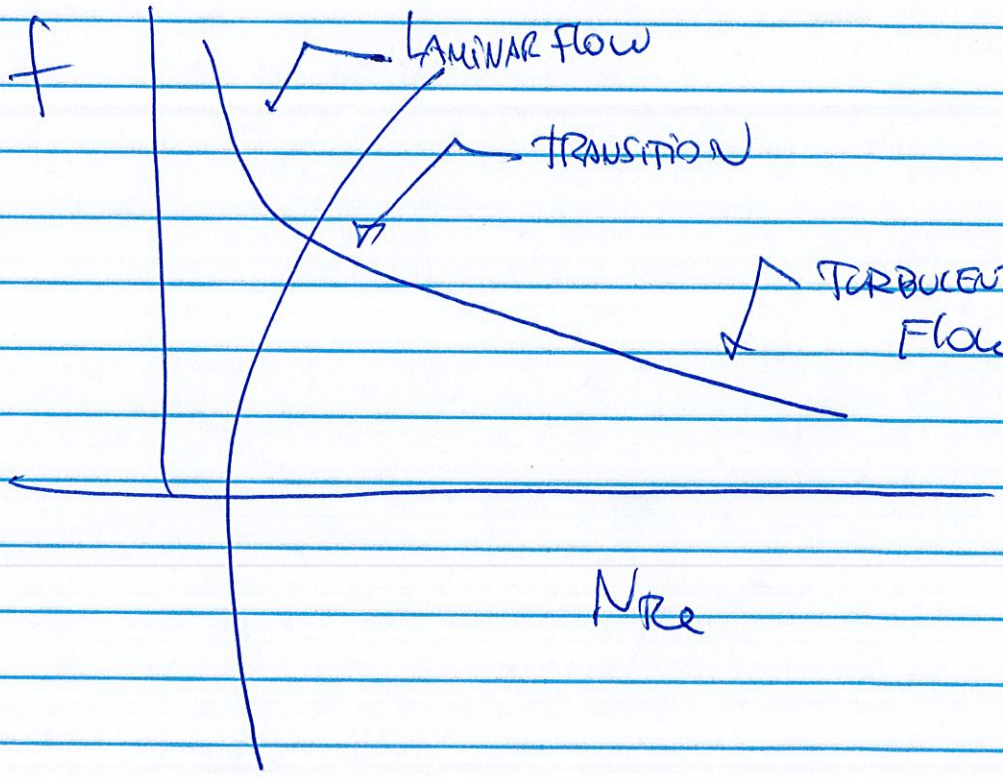
$$\frac{\dot{m}}{\rho} = Q\left(\frac{m^3}{s}\right)$$

ΔP (Pa)	Q m^3/s

$$\bar{u} = \frac{Q}{\pi R^2}$$

$$N_{Re} = \frac{D \bar{u} \rho}{\mu}$$

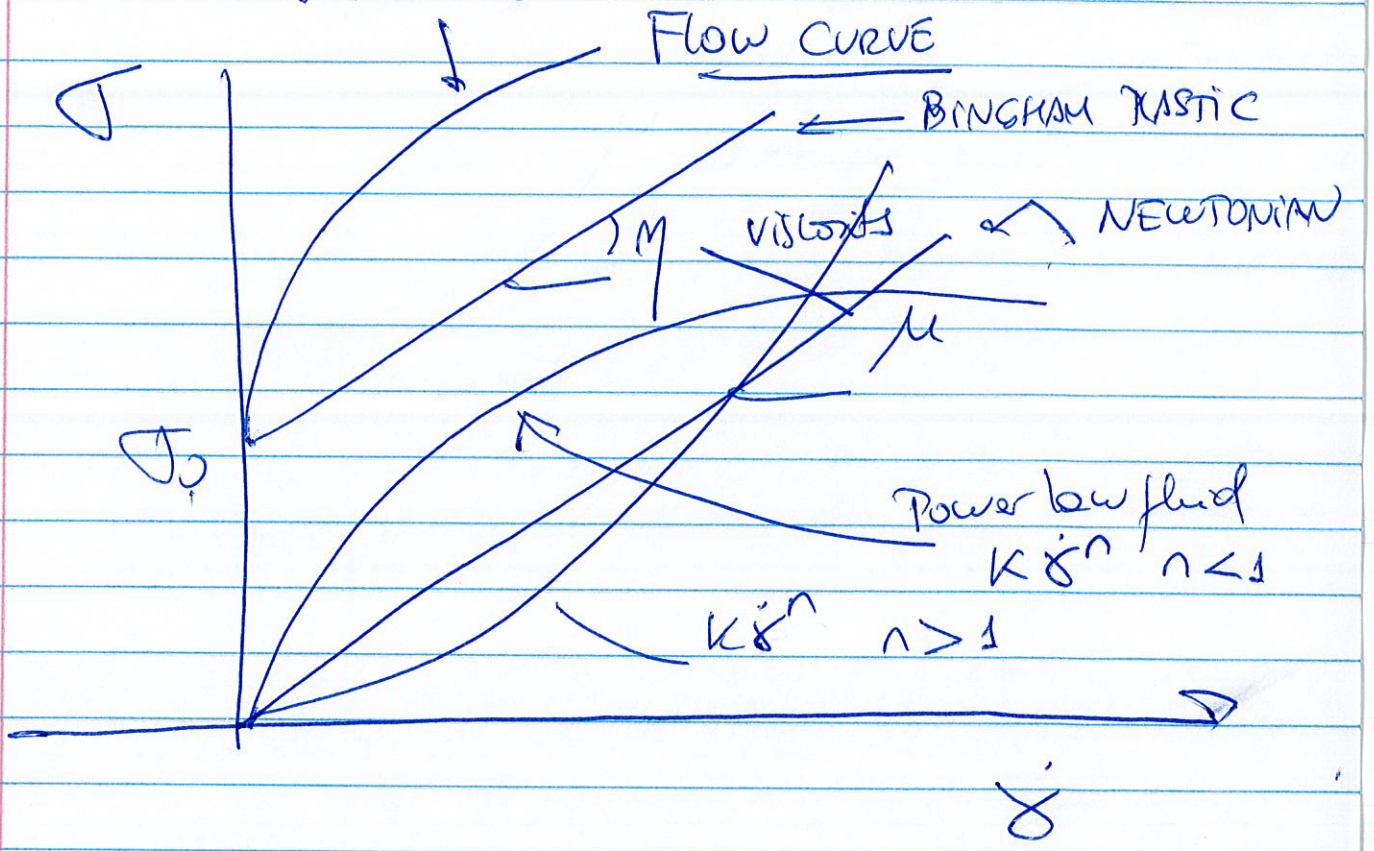
NEWTONIAN FLUID

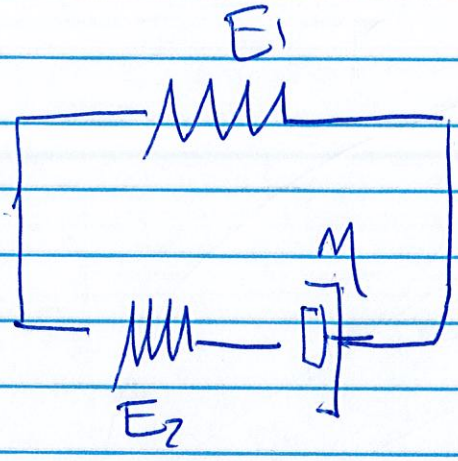


$$f = \frac{16}{N_{Re,gen.}}$$

How do we know the fluid model. (7)

$\tau = \tau_0 + K\dot{\gamma}^n$





E_1 & E_2 ARE SPRINGS ("ELASTIC PART OF THE ~~MATERIA~~ MATERIAL WITH YOUNG MODULUS E_1 & E_2

WHAT is η ? LIQUID PART OF THE MATERIAL ("DASHPOT")

"SHOCK ABSORBER" IN THE CAR

VISCOELASTIC MATERIALS

LIQUID SOLID

SLIDE 5

WHAT ARE G' & G'' ?

G' : STORAGE MODULUS [MEASURES ELASTICITY OF THE SAMPLE]

G'' : LOSS MODULUS [MEASURES VISCOSITY OF THE SAMPLE]