PRESSURE, STRESS

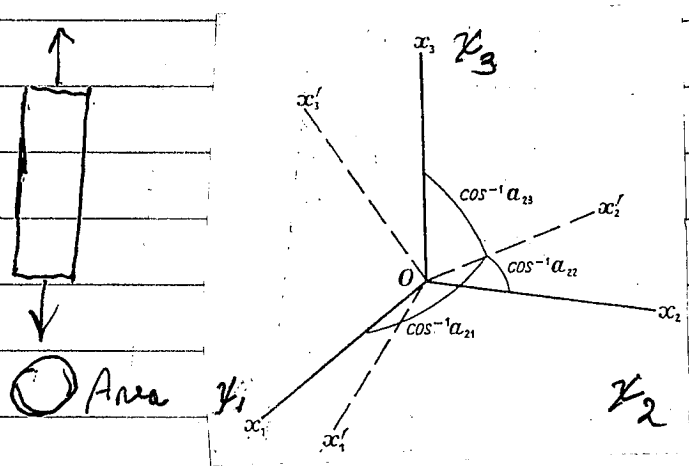
GPA GIGAPASCAL

DEEPEST SPOT IN OCEAN ~0.1 GPa

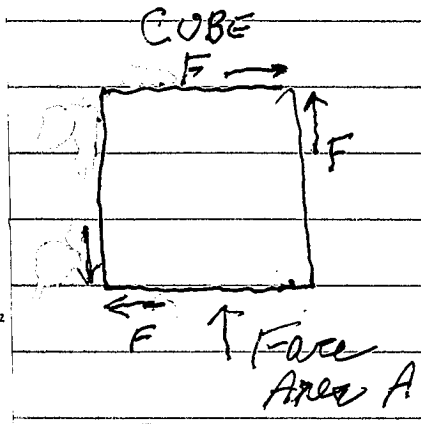
1 GPA ~ 5000 times the pressure in a car tire

361 GPa PRESSURE AT CENTER OF EARTH

TENSILE STRESS σ SHEAR STRESS τ



$\sigma = \frac{F}{A}$



$\tau = \frac{F}{A}$

The x_i' are related to the x_j by $x_i' = \sum a_{ij} x_j$ $i,j = 1,2,3$

where a_{ij} is the cosine of the angle between x_i' and x_j.

VECTOR Given a Force $\bar{F} = (F_1, F_2, F_3)$, $F_i' = \sum a_{ij} F_j$ $i,j = 1,2,3$

STRESS IS A SECOND RANK CARTESIAN TENSOR

σ_{ij} is the stress owing to a force in the F_i direction acting on a plane whose normal is in the x_j direction

$$\begin{pmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{pmatrix} \quad \sigma = \begin{pmatrix} & & \\ & \sigma & \\ & & \end{pmatrix} \quad \tau = \begin{pmatrix} & \tau & \\ \tau & & \\ & & \end{pmatrix}$$

Tensile Stress SHOWN

SHEAR STRESS SHOWN

THE σ_{ij} not shown are zero.

$$\begin{pmatrix} -P & & \\ & -P & \\ & & -P \end{pmatrix}$$ HYDROSTATIC PRESSURE

A BIG ENOUGH TENSILE STRESS CAUSES FRACTURE

A BIG ENOUGH SHEAR STRESS CAUSES PLASTIC FLOW (PERMANENT DEFORMATION).

WHEN YOU HAVE A ROD IN TENSION WITH A STRESS σ, YOU can show, that. on a plane 45° to the axis of the cylinder (rod), there is a shear stress $\tau = \sigma/2$

If no body couples are present the stress tensor can always be diagonalized