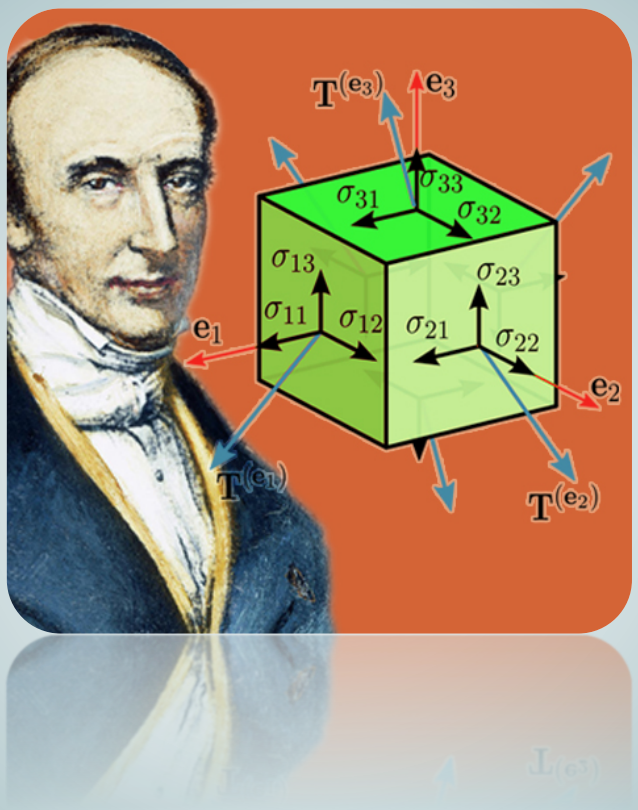
Mechanical Properties of Materials, Processing and Design

Third exam continuos evaluation



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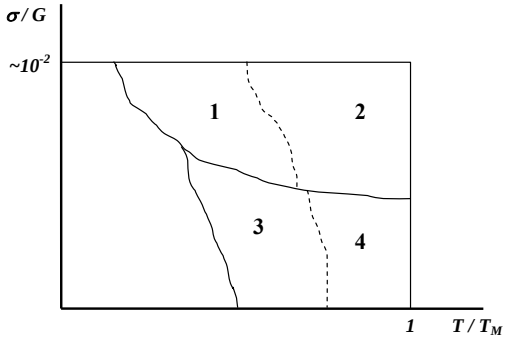
MECHANICAL PROPERTIES OF MATERIALS - CONTINUOUS EVALUATION - 3rd TEST (13/03/2020)

The following figure represents a generic creep map. It allows the different regions corresponding to the most important micromechanisms that lead to strains over time to de distinguished.



a) Indicate the micromechanism in each of the regions (numbered from 1 to 4) (**1 point**).

b) Write and explain the generic expression for the strain rate (**1 point**).

The results gathered in the following table express the strain rate as a function of the applied stress for an alloy tested at a temperature of 180ºC.

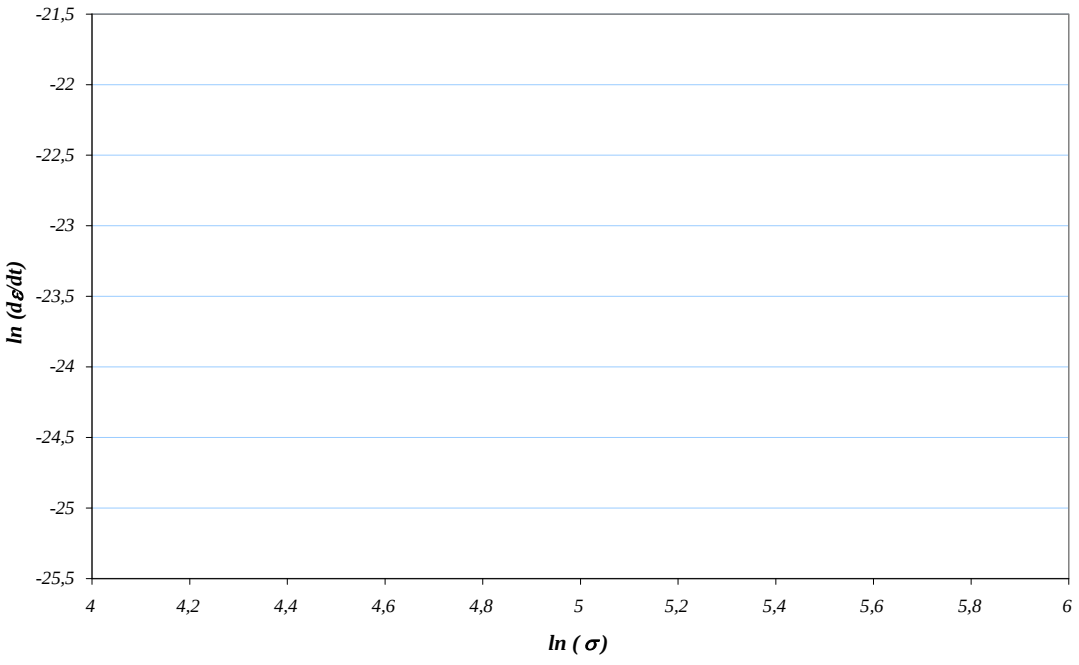
σ (MPa)	dε/dt (s^{-1})
65	1.282 E-11
75	1.510 E-11
85	1.669 E-11
95	1.903 E-11
110	2.995 E-11
125	5.711 E-11
140	9.404 E-11
155	1.535 E-10
170	2.321 E-10
185	3.510 E-10

c) Represent the experimental data in the following graph. From the representation:

(i) Distinguish the different regions in the graph (**1 points**).

(ii) Fit the data according to the creep model obtaining its unknown parameters (**2 points**).

(iii) Obtain the stress in the limit between regions (**1 points**).



Several bolts were manufactured with this material. Their purpose is to join to non-deformable plates. The Young's modulus of the material of the bolts is E=40 GPa, the in-service temperature is 180ºC and the initial stress in the bolts is 170 MPa. Moreover, for safety requirements, the stress of the bolts must be over 85 MPa.

d) Determine the time necessary for the stress to go below 85 MPa (**3 points**).

e) Do you consider it adequate to assess the stress of the bolts every two years? (**1 point**).