

Food Rheology Short Course (Montevideo 2022)
Final Exam
(Open books)

Write your name and **briefly** answer **all** the questions. Please submit the answers in a PDF format. You can use a Wolfram Demonstration wherever appropriate.

1. What is the Hencky's strain (also known as True or Natural strain) for 45% deformation (also known as Cauchy's strain) in: (a) Compression (b) Tension (Use the formula or Wolfram Demonstration)
2. In ideal elements in series the force is the same and the deformation is additive. What is the $k_{\text{equivalent}}$ of a spring equivalent to two springs (k_1 and k_2) in series?
3. Consider two Maxwell elements, A and B, the first having $k=1$ and $\eta=10$ and the second $k=10$ and $\eta=1$ (all in appropriate units). Show their stress relaxation curves between 0 to 1 (in the same) time units.
4. Estimate the shear rate (in s^{-1}) range, or order of magnitude, when coating melted hot chocolate is flowing on a candy. Make any reasonable assumptions of the chocolate's speed and thickness.
5. Viscometric measurements gave the following data shear rate (gamadot) in s^{-1} and corresponding shear stress (tau) in 10^{-3} Pa.s: (20,32), (40,48), (60,63), (80,77), (100,90). Draw the flow curve. What can you tell about the food's rheological type/properties?
6. What are this same food's (from Question 5) apparent viscosities at 40s^{-1} and 100s^{-1} ?
7. Give a schematic drawing that shows why a bent specimen can fail (rupture) in tension.
8. Dry brittle cellular snacks or breakfast cereals exposed to moist atmosphere invariably lose their crunchiness, but their *toughness* initially increases and only then drops. In light of that water is a very good *plasticizer* how can this observation be explained?
9. Draw a compressive stress-strain relationship of a typical flexible cellular solid and mark its parts.
10. List (side by side) 3 differences between the gravitational flows of powders and of liquids.