

Oct 9, 2015

LB 273, Physics I

Prof. Vashti Sawtelle
Prof. Leanne Doughty

Today:

Stress and Strain

Irish Phrasebook (The Collection)

What's the craic?

Wrecking the gaff

How's she cutting?

Gobshite

We're sucking diesel now

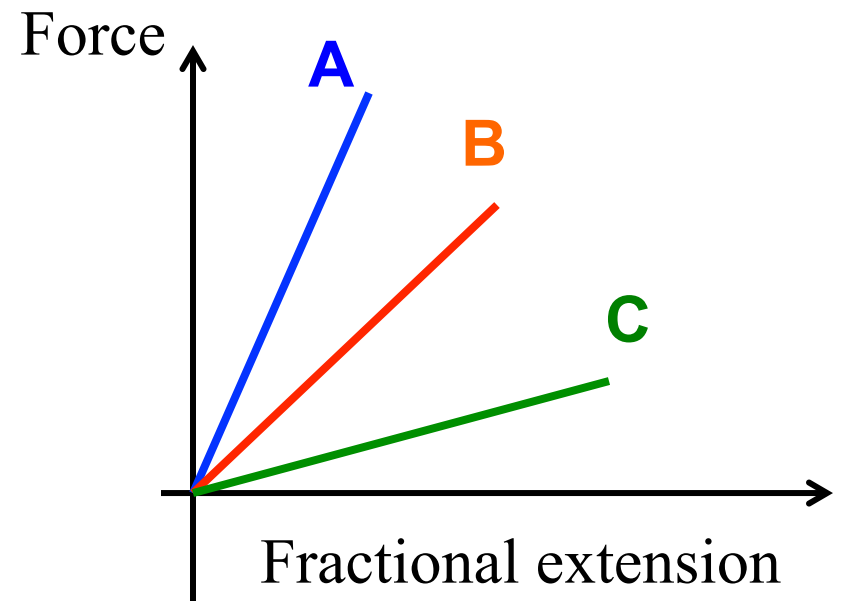
Announcements

- LON-CAPA homework for Ch 3.5-4.2 due tonight
- Reading questions for Ch 5 due Sunday 11th
- Updated help-room hours are on LON-CAPA

Three springs are well approximated by Hooke's law for extensions (but not compressions) up to $\frac{3}{4}$ of its resting length. Which one has the largest spring constant (k)? The force needed for a stretch is plotted as a function of the spring's fractional extension, $\Delta L/L_0$.



- A. A
- B. B
- C. C
- D. You can't tell from the information given.



Three springs are well approximated by Hooke's law for extensions (but not compressions) up to $\frac{3}{4}$ of its resting length. Which one has the largest spring constant (k)? The force needed for a stretch is plotted as a function of the spring's fractional extension, $\Delta L/L_0$.

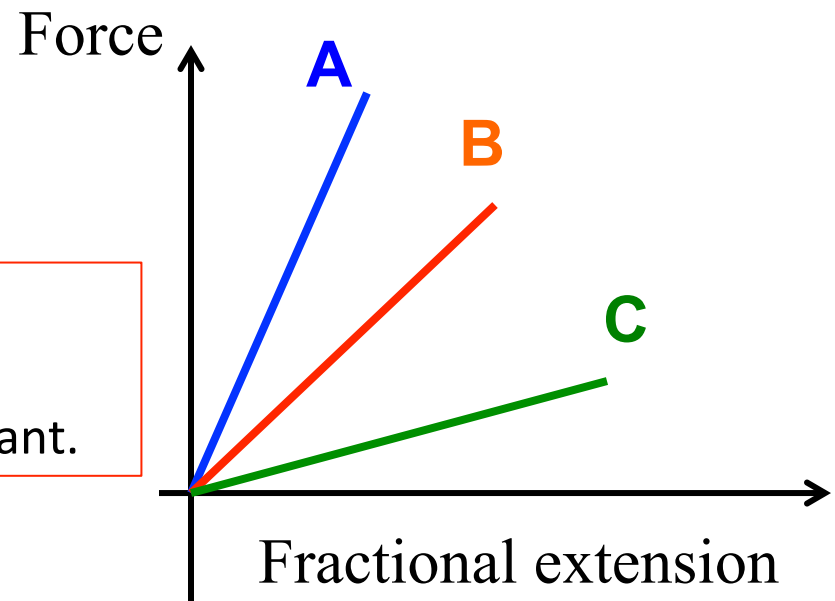


A. A

B. B

A has the largest slope, and the spring constant (k) is proportional to the force exerted, so A has the largest spring constant.

the information given.





A 0.5 kg mass is hung from a spring, which is stretched from its resting length by 10 cm. What is Hooke's constant for this spring? (Assume $g = 10 \text{ m/s}^2$ to simplify your math)

- A. 0.5 N/m
- B. 50 N/m
- C. 500 N/m
- D. Other



A 0.5 kg mass is hung from a spring, which is stretched from its resting length by 10 cm. What is Hooke's constant for this spring? (Assume $g = 10 \text{ m/s}^2$ to simplify your math)

A. 0.5 N/m

B. 50 N/m

C. 500 N/m

D. Other

The force from gravity balances the force of the spring, so we plug the numbers into the expression for Force of spring and solve for k.



Consider the situation described in the last problem. If I put two identical springs side-by-side (both with the same K as in the last problem) and attached the same single weight to both of them, how would that affect the distance the springs are stretched?

- A. They would stretch $1/2$ the distance
- B. They would stretch double the distance
- C. They would stretch the same distance
- D. None of the answers above is correct



Consider the situation described in the last problem. If I put two identical springs side-by-side (both with the same K as in the last problem) and attached the same single weight to both of them, how would that affect the distance the springs are stretched?

- A. They would stretch $1/2$ the distance
- B. They would stretch double the distance
- C. They would stretch the same distance

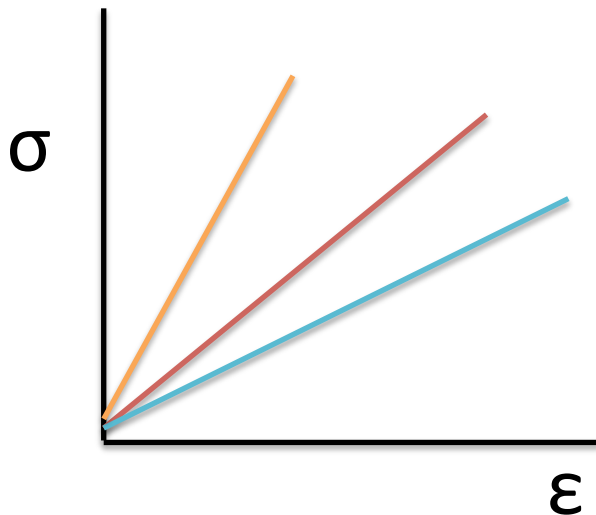
The gravity force downward is balanced by 2 forces upward by the springs (which are equal since they are identical). So that means the stretch is half the original stretch.

above is correct

Foothold Principles of Springs & Stretchy Stuff

- Stress is a measure of how many springs you have – or the force per unit area. $\sigma = \frac{F}{A}$

- Strain is a measure of how much the material stretched due to the stress $\epsilon = \frac{\Delta L}{L}$



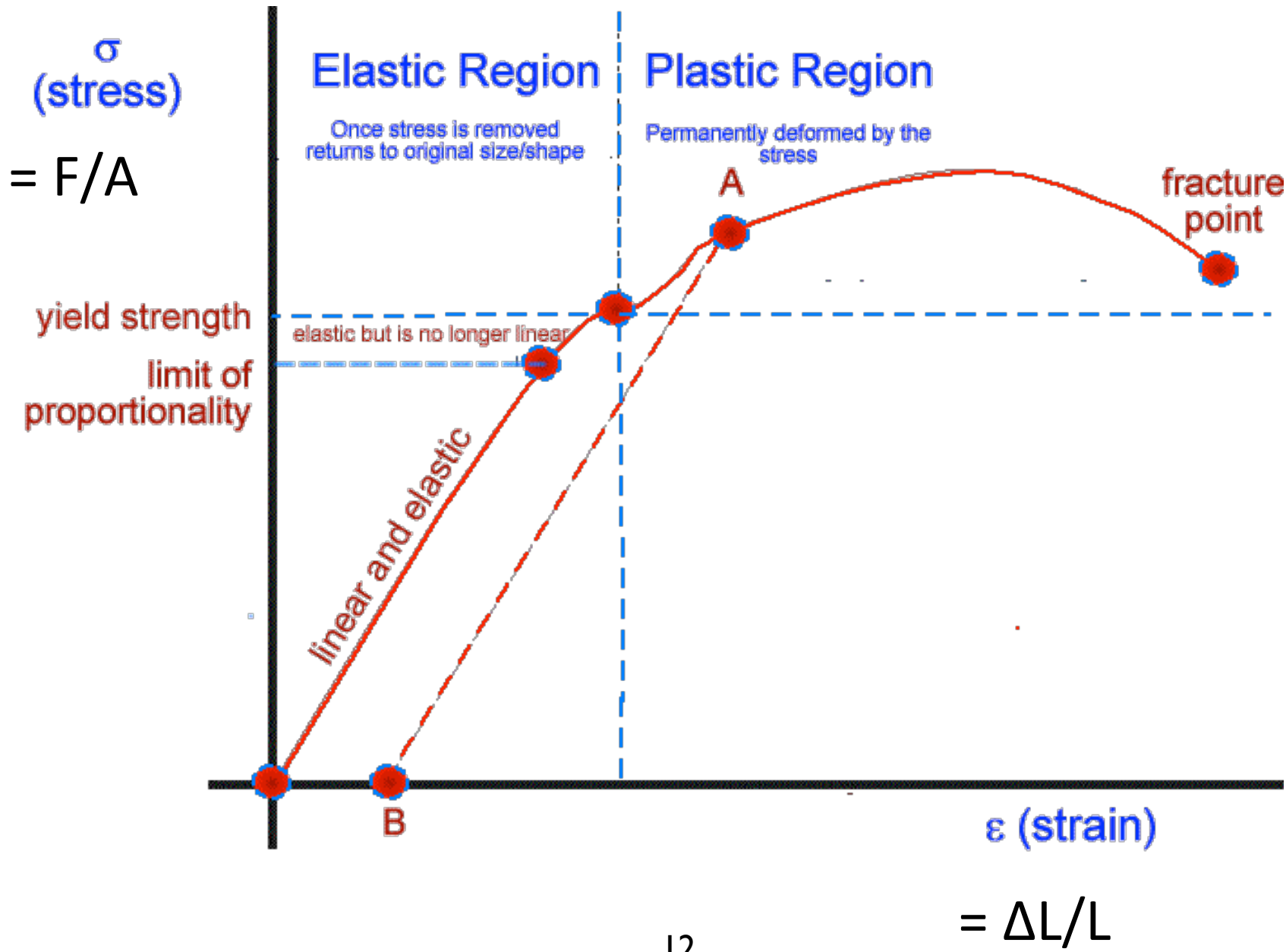
This slope is called the “modulus”, and it depends on the material

The average adult human female femur is 45 cm in length, 3 cm in diameter, and has a Young's Modulus of 18 Gpa. When running, the femur experiences the full weight of the body on every stride. Assuming the average female weighs 55 kg and her entire weight is concentrated on the femur at each step, by approximately how much is the femur shortened when you land on it?

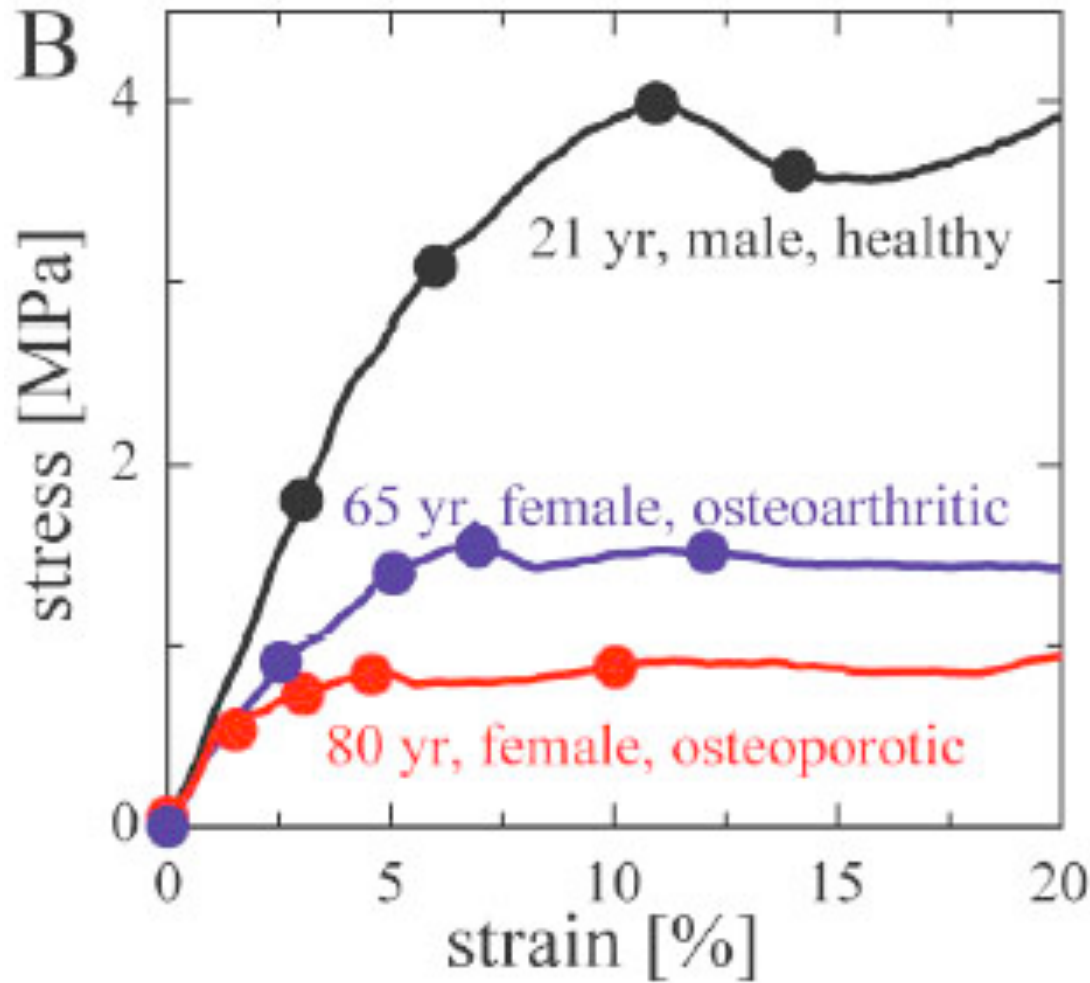
- A. 0.2 cm
- B. 0.002 cm
- C. 2.0×10^{-5} cm
- D. 2.0×10^{-7} cm
- E. 2.0×10^{-9} cm



Limitations of Hooke's Law



Stress-strain curve for human bone

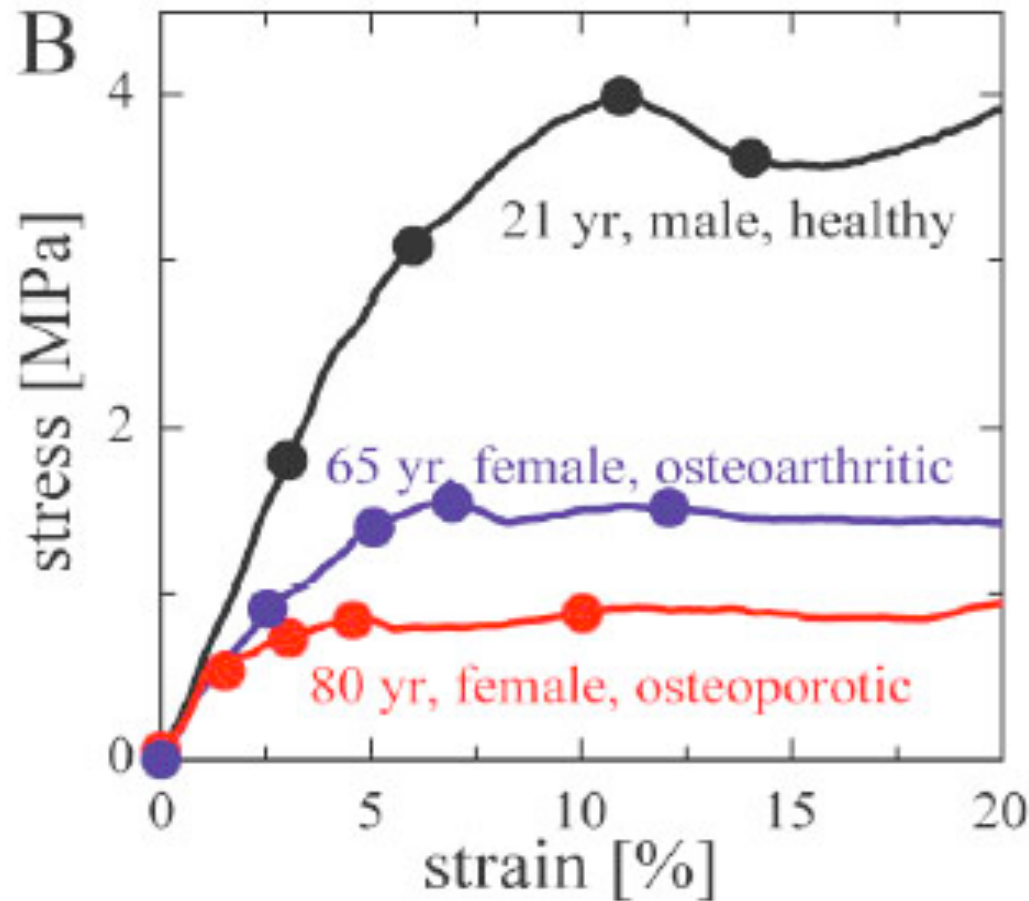


Turner et al. 2005, Mat. Res. Soc. Symp. Proc. vol 874

Which curve has a higher Young's Modulus?



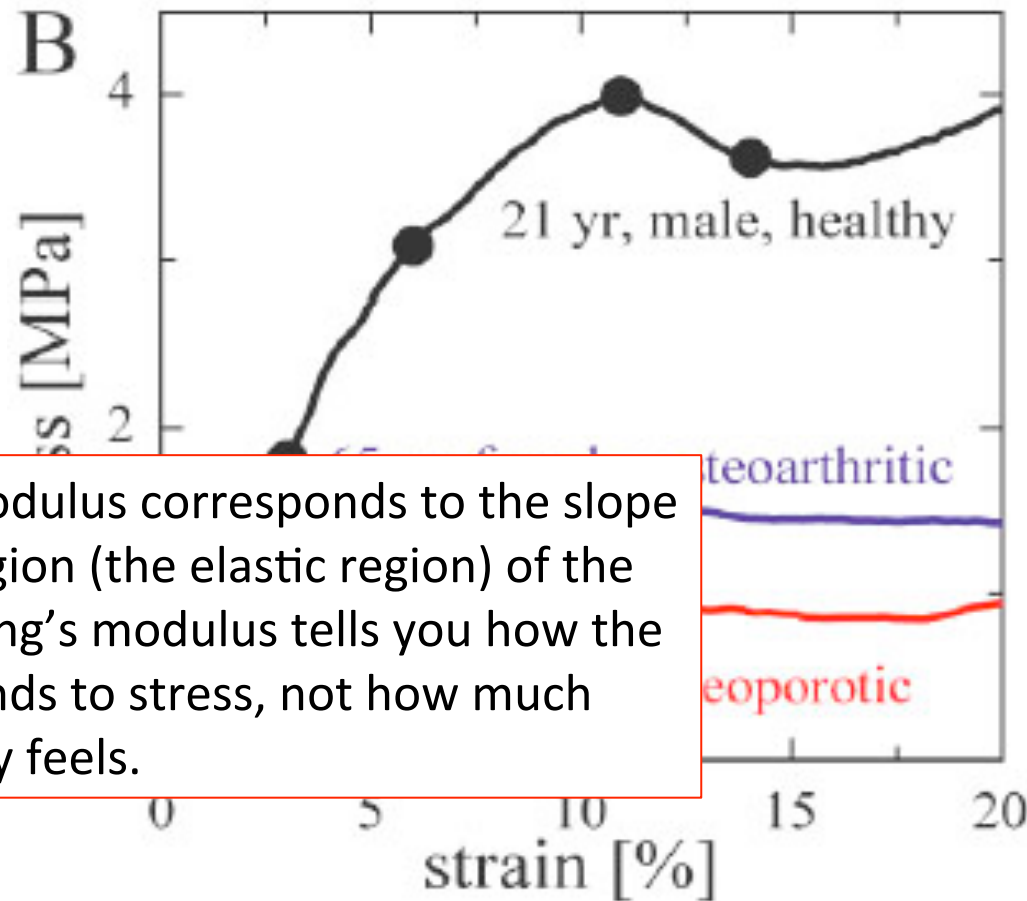
- A. 21 yr, because it has the largest stress value.
- B. 21 yr, because it has the largest slope
- C. 80 yr, because it has the lowest slope
- D. 80 yr, because it goes flat the fastest
- E. Something else



Which curve has a higher Young's Modulus?



- A. 21 yr, because it has the largest stress value.
- B. 21 yr, because it has the largest slope
- C. 80 yr, because it has the lowest slope
- D. 80 yr, because it is the flattest
- E. Something else



The Young's modulus corresponds to the slope in the linear region (the elastic region) of the graph. The Young's modulus tells you how the material responds to stress, not how much stress it actually feels.