EXAM RETAKE

Long-form question 1 [12pts]: Fifty years ago, an unfortunate mountain goat fell into a crevasse in a glacier, and was buried upright in a standing position. The Burke Museum is interested in recovering this rare specimen; however, the curator is concerned that the specimen may have been distorted too much by shear as a result of ice flow. Use the following information to estimate how distorted the goat would be under a variety of conditions –

Coordinate system:

- x-axis running down-slope, parallel to the surface of the glacier
- z-axis pointing down measuring depth below the surface, perpendicular to the surface of the glacier

Glacier Parameters

- Ice thickness (h) is 200 [m]
- Flow law exponent (n) is 3
- Softness parameter (A) is $2 * 10^{-16}$ $[Pa^{-3}a^{-1}]$
- Density of ice is 917 [kg/m^3]
- Acceleration due to gravity (g) can be approximated as 10 [m/s^2]
- Ice bed (and surface) slope (ϑ) is 4°

Glen's Flow Law:

$$\dot{\varepsilon}_{xz} = \frac{1}{2}\frac{du}{dz} = A\tau^n = -A[\rho g z * \sin(\vartheta)]^n$$

The goat's depth of burial probably varied over the 50-year interval; however, to make calculations simpler, assume that it was buried for the entire 50 years at its average depth.

Part C – [4pt]: Calculate the current "height" of the goat (i.e., distance from hoof to shoulder) if its average depth of burial over the 50-year period was 20 m. (Hint: in this scenario you can model the goat as a rectangle with initial "height" equal to the vertical side length of 1m).

Part D – [2pt]: Calculate the current "height" of the goat (i.e., distance from hoof to shoulder) if its average depth of burial over the 50-year period was 150 m.

Part E – [4pt]: If the goat was on average 10 meters below the surface, how far has it moved from the location where it fell into the crevasse? (Be sure to mention your assumptions about basal sliding.)

Extra evaluation – The quality of your response to this question will determine how many points you get back on your exam. This will range from 0% - 100% of your updated score.

For the glacier described in this problem, plot **precisely** the horizontal velocity gradient ($\frac{du}{dz}$) at z = 200, 180, 160, 140 120, 100, 80, 60, 40, 20, 0. Plot **precisely** the total horizontal velocities (u) at those depths.

Describe, using both **WORDS** and the relevant **EQUATIONS,** why the shear stress increases with depth, what that means for the shear strain rate with depth, and how those shear strain rate ultimately result in the characteristic depth-velocity profile plotted above.