ANNOUNCED QUIZ #1 – ME 2030 –SECTION 001 – Fall 2024

NAME: SOLUTION

This is an open book quiz. You may use a 4-function calculator. An unsigned honors pledge will result in a zero.

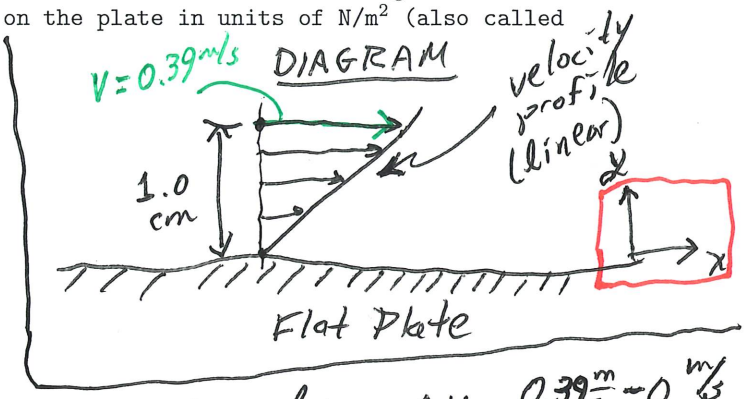
1. Air a 15°C flows over a horizontal flat plate. The velocity profile is linear. If the velocity 1.0 cm above the flat plate is 0.39 m/s, then what is the shearing stress (also called the shear stress) exerted by the flow on the plate in units of N/m^2 (also called Pa)?.

GIVEN: Air, T, velocity at 1.0 cm

FIND: $\tau = ?\ N/m^2$

ASSUME: The air is a Newtonian fluid

DIAGRAM



ANALYSIS: $\tau = \mu \frac{du}{dy}$

Since the velocity profile is linear, I can write $\frac{du}{dy} = \frac{\Delta u}{\Delta y} = \frac{0.39\frac{m}{s} - 0\ m/s}{.01m - 0m}$

$$\frac{du}{dy} = 39\ sec^{-1}$$

From Table 1.8, Air @ 15°C has a dynamic viscosity of

$$\mu = 1.79 \times 10^{-5}\ \frac{N \cdot s}{m^2}$$

So, $\tau = \mu \frac{du}{dy} = \left(1.79 \times 10^{-5}\ \frac{N \cdot s}{m^2}\right)\left(39\ sec^{-1}\right)$

$$\tau = 69.8 \times 10^{-5}\ \frac{N}{m^2} = 6.98 \times 10^{-4}\ \frac{N}{m^2}\quad (6.98 \times 10^{-4}\ Pa)$$

I HAVE NEITHER PROVIDED OR RECEIVED HELP DURING THIS QUIZ.

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SIGNATURE