Nguyen Xuan Binh 887799 Round 1 Problem 1

A plate size 0.3m x 3m pulled with $u = 2 \times 1.9 = 3.8$ m/s (Last digit of my student number is 9). The plate is on oil film, below oil film is a fixed plate. Viscosity of the oil is $\mu = 0.38$ kg/ms

a) Calculate velocity gradient du/dy (= rate of shearing strain $\dot{\gamma}$) when the oil film thickness is 1mm, 0.5 mm?

Let oil thickness be "b"

=) When $b = 1mm$ =) $\frac{du}{dy} = \frac{u}{b} = \frac{3.8}{10^{-3}} = 3800\ s^{-1}$

=) When $b = 0.5mm$ =) $\frac{du}{dy} = \frac{u}{b} = \frac{3.8}{0.5 \times 10^{-3}} = 7600\ s^{-1}$

b) The shearing stress

- $b = 1mm$ =) $\tau = \mu \frac{du}{dy} = 0.38 \times 3800 = 1444\ kg/ms^2 = 1444\ Pa$
- $b = 0.5mm$ =) $\tau = \mu \frac{du}{dy} = 0.38 \times 7600 = 2888\ kg/ms^2 = 2888\ Pa$

c) The force needed in both cases

$A = 0.3m \times 3m = 0.9\ m^2$

- $b = 1mm$ =) $P = \tau A = 1444 \cdot 0.9 = 1299.6N$
- $b = 0.5mm$ =) $P = \tau A = 2888 \cdot 0.9 = 2599.2N$