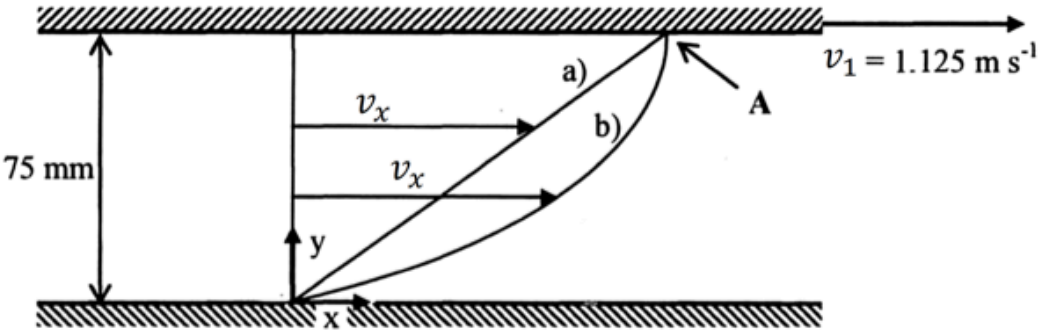
Introduction to Transport Phenomena: Exercises Module 5

Exercise 5.1



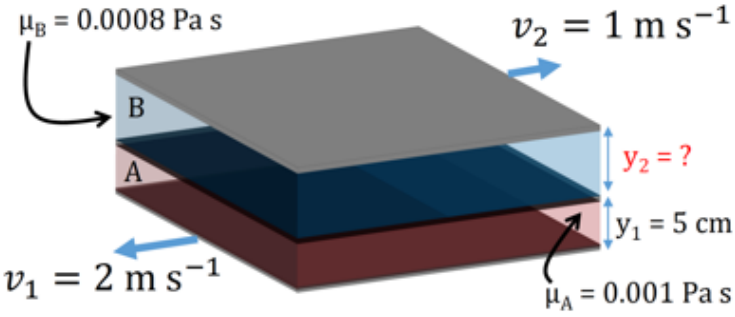
A plate moves with a constant speed of $v_1 = 1.125$ m s^{-1} on top of another plate which is stationary. The two plates are spaced 75 mm apart and a Newtonian fluid ($\mu = 0.048$ Pa s) fills the space between. Estimate the shear stress at the wall and at the stationary points 25 mm and 75 mm from the stationary wall, in the case of:

a) A linear velocity profile.

b) A parabolic velocity profile (The parabola has its maximum at point A)

Exercise 5.2

Three flat plates are parallel and separated by two fluids A and B (see picture). The top and bottom plates are pulled in opposite directions at the indicated velocities. What should the value of y_2 be so that the middle plate remains motionless? (consider linear velocity gradients)



Exercise 5.3

A lift for cars consists of a piston (20 cm diameter, 1 m in height) in a sliding tube with an internal diameter of 20.005 cm. The space between the piston and the tube wall is filled with an oil ($\mu = 0.707$ Pa.s). The piston and the car together weigh 1.5 tons.

What is the maximum rate of descent when the piston slides in the cylinder?

Consider a linear velocity gradient in the annulus.