Tentamen FYSISCHE TRANSPORTVERSCHIJNSELEN 2

donderdag 7 februari 2005

14:00–17:00 / 5118.-0156

Vermeld op het eerste blad met uw antwoorden:
Naam
Adres
Studentnummer
Studierichting
Geboortedatum
Jaar van inschrijving

vermeld op elk volgend blad uw naam

Veel Succes!

Prof.dr.ir. L.P.B.M. Janssen

Question 1

A cylindrical tube is filled with a Bingham liquid. At the bottom this tube is closed by a plate.

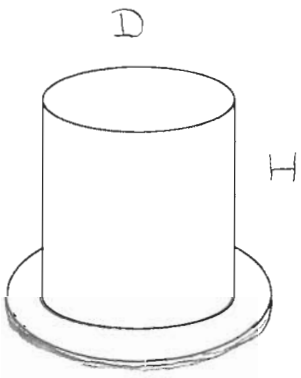
a. If the plate is removed the liquid sometimes flows due to gravity forces and sometimes it does not. Explain this.

b. Give a criterion for which tube diameter the fluid will just flow.

c. Give the velocity distribution if the fluid flows.

d. Sketch this distribution.

e. Give an expression for the throughput.



Question 2

A closed vessel containing a liquid A stands in a laboratory. The vessel has a leak above the fluid level, the surface of the leak is 5 mm^2. At the location of the leak the wall thickness of the vessel is 5mm. Gaseous A difusses through this leak. The volume of the laboratory is 37,5 m^3 and an air conditioner refreshes the air with a flowrate of $3{,}48*10^{-3}$ m^3/s. The partial pressure of A above the liquid in the vessel equals the saturation pressure and is $4{,}85 * 10^4$ Pa. The diffusion coefficient of A in air equals 0,128 cm^2/s.

a) show that:

$$\phi''_{molA,x} = -D\frac{dc_A}{dx} + \left(\phi''_{molA,x} + \phi''_{mol\,air,x}\right)\frac{c_A}{c}$$

with $c = c_A + c_{air}$

b) give an expression of the molar flux of A through the leak

c) what will be the equilibrium vapour pressure of A in the laboratory

Question 3

The fuel elements of a water cooled nuclear reactor consist of long cylindrical fuel elements with a diameter of 10 cm. The nuclear reaction produces heat with a power of 40 kW/m^3. The material of the fuel elements has a heat conductivity of 25 W/m K. The heat transfer between the rods and the cooling water is given by Nu = 10 and the heat conductivity of water equals 0,6 W/m K.

a) Give the differential equation that describes the temperature profile in the rod.

b) What is the temperature difference between the water and the outside of the fuel elements?

c) What is the maximum temperature difference between the cooling water and the middle of the fuel rod?