Fundamentals of Fluid Mechanics B Questions and Answers

OK, here's another hint. In your tables on the first page, notice that $\overline{q}$ can be obtained from $q_{\rm RMS}$ by multiplying it by a constant. Further note that $q_{\rm RMS}$ is obtained from the definition of the temperature..

Question by AME536B Student

I would like to solve HW4 Problem 3 using axisymmetric coordinates instead of cartesian coordinates. The shear stresses are not defined on our tables for axisymmetric coordinates. Is it correct to define:

$$\tau_{rx} = \mu * \frac{du_x}{dr} = \tau_{xr}$$

This will probably work in this case but is dangerous in the general case. The correct way is to start with the strain rates in the tables and obtain the shear stresses from the strain rates. Explain how to do that, and list the assumptions.

Question by AME536B Student

For problem 4 in Assignment 5; will it be legal to calculate the velocity using unit analysis in the following way, instead of using the darcy factor f?

$$u = \frac{\dot{m}}{\rho A} = \frac{\dot{m}}{\rho \pi R^2} \left[\frac{m}{s}\right]$$

$$\therefore \tau_w = \mu \frac{\partial}{\partial r}\left(\frac{\dot{m}}{\rho \pi R^2}\right) = -\frac{2\dot{m}}{\nu \pi R^3}$$

if you do it on this way you will end with the following:

$$\boxed{P_3 - P_1 = 4\frac{\dot{m}}{\nu\pi}\left[\frac{L_1}{R_1^4} + \frac{L_2}{R_2^4}\right]}$$

This result is off from the result in the assignment #5 by a factor of 2. However, I can not see why this approach will be ilegal.

Whether you use the friction factor in the tables or not, you should reach the same answer. Also, your answer is definitely not correct. I see at least three fundamental mistakes in your logic.

Question by AME536B Student

I have a question regarding the pressure distribution for assignment 5 question 3A. In your notes for a similar problem, we used the y momentum equation and found a distribution that was dependent on y. For this question, would we use the velocity equations we found in part B and C to find the pressure distribution with respect to x since there is a $\frac{\partial p}{\partial x}$ *term. Then use the y momentum equation to find the pressure with respect to y and combine both of these answers to get P=P(x,y)? Or does the x dependency come from boundary conditions? I tried it the first way but my answer approaches* ∞ *as I approach y=0.*

When solving part (a) you can simply state that dP/dx is a constant for fully-developed flow. Then, you can obtain $P = P(x, y)$. But subsequently, you'll need to demonstrate why this is.

Question by AME536A Student

In Assignment#3 Question#1(b) we had to prove that the strain rates S_{xy} *become zero for pure rotation. As we did in class, we started from:*

$$S_{xy} = \lim_{\Delta \to 0} \frac{1}{2\Delta t} \left(\frac{y_{A'} - y_{o'}}{\xi} + \frac{x_{B'} - x_{o'}}{\eta} \right)$$

Is this always true for rotation or angular distortion, or are there other assumptions?

No, there are no other assumptions. These strain rates can be used for any fluid. Also, the same applies with the strain rates in cylindrical and spherical coordinates in the tables. The strain rates can be used in the general case.

Question by AME536A Student

Could you also give us the final answers for Assignment 5 Question 3 (d) and (e)?

Let me see if I can find them.. If I do, I'll post them soon.

Question by AME536A Student

I'm still having problems to solve Assignment#1 Question#2(b), the prove of Crocco's theorem. In class you gave us this hint:
say $a = b - c$

$da = d(b - c)$

If $da = 0$
and if s-s and uniform properties at some point upstream:

$\nabla a = 0$

Then

$$db - dc = 0$$

and

$$\nabla(b - c) = 0$$

$$\nabla b = \nabla c$$

I don't understand how we can use this without ending up with a temperature gradient term in the equation.