Fundamentals of Fluid Mechanics B Questions and Answers

Ask your questions related to Fundamentals of Fluid Mechanics B in this thread. Use LaTeX to typeset mathematics. See LaTeX mini-HOWTO here:

https://overbrace.com/bernardparent/vie ... =13&t=1179

Question by AME536B Student

*in the note, why v*v=q^2 and what dose q represent at here.*

Use LaTeX when typesetting mathematics. It's not v*v but $v \cdot v$. It's not q^2 but q^2. Retype your question using LaTeX and I will answer it below.

Question by AME536A Student

When answering question 2.D on homework 1, is it necessary to make the assumption that the flow is inviscid, such that the viscous term:

$$\frac{\mu}{\rho}(\nabla \cdot \nabla)v$$

is zero? Or, are we unable to assume inviscid flow?

This can not be assumed. If you want to make such statement, it needs to be proven.

Question by AME536B Student

The majority of students in this class are also taking AME500B, which has a midterm on Friday. I also know that many of us are struggling with the various quiz questions that we are trying to correct (Gibbs question, mean free path question). I believe that most of us have prioritized this midterm over these questions/current assignment. I wanted to ask if you would consider postponing the quiz until Tuesday to allow us to better study for our midterm in 500B?

OK. The assignment will be due on Tuesday the 25th at 11:00 am.

Question by AME536B Student

Are both assignments $(4\,\&\,5)$ due on the 25^{th}? and if so; are all the problems from both assignments need to be solve?

No, I will make an announcement soon on the D2L.

Question by AME536B Student

For the assignment #4 question #4. By using the mass conservation equation and the theta momentum equation on cylindrical coordinates and by making some assumptions, we can obtain the following differential equation.

$$\frac{\mu}{r}\frac{\partial}{\partial r}\left(r\frac{\partial v_\theta}{\partial r}\right) - \mu\frac{v_\theta}{r^2} = 0$$

This leads to a different result than the suggested one. I can understand that if we drop the term $\mu\frac{v_\theta}{r^2}$ *we will finally obtain the suggested solution, but I can't see a reason to drop that term. Is there a problem with the given solution?*

If you can integrate analytically your equation then do so. If you decide to neglect a term, then you need to justify your assumptions.

Question by AME536A Student

In assignment #2 question #4, could you give us a hint how to get from

$$\overline{q_{rel}^2} = \overline{\vec{v}_{rel}} \cdot \overline{\vec{v}_{rel}} = \overline{(\vec{v_1} - \vec{v_2})} \cdot \overline{(\vec{v_1} - \vec{v_2})}$$

to a definition of average relative molecular speed:

$$\overline{q_{rel}} = \sqrt{\overline{q_1^2} + \overline{q_2^2}}$$

where q's are the magnitudes of v's. Based on your hint in class, it seems like we can't just take the square root of $\overline{q_{rel}^2}$ *because this would not yield what we are looking for.*

OK, here's another hint. In your tables on the first page, notice that $\bar{q}$ 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.

Another hint. For two streamlines near each other and at a certain location, one has a temperature T, and the other the temperature $T + dT$. Expand terms and get rid of the terms that are necessarily much smaller than the others.

Question by AME536B Student

Do we need to memorize proofs for this midterm?