Fundamentals of Fluid Mechanics B Questions and Answers

Question by AME536B Student

Concerning question 4, the velocity at the wake was obtained by assuming that x goes to infinity. Why we can't say that $\frac{u_w}{u_{inf}} = 0.99999$ at the edge of the wake in order to find its height, as this strategy causes problems only close to the cylinder.

It's because far away from the cylinder, u_w will be almost exactly equal to u_∞ everywhere within the profile. As $x \to \infty$, $u_w \to u_\infty$. Thus, the point $u_w = 0.999999u_\infty$ won't lie anywhere on the profile! The way you determine the height must work equally well close to the cylinder and when x is very large. Think about this more.

Question by AME536B Student

For Q#2,I am able to reach this point:

$$\frac{\partial}{\partial t}\int_{C\forall}\rho V_i d\forall + \oint_{CS}\left(V_{C\forall}\cdot\hat{n}\right)\rho V_i dS = -\oint_{CS}\left(P\cdot\hat{n}_i\right)dS + \oint_{CS}\tau_{ij}\hat{n}_j dS + \int_{C\forall} f_i d\forall$$

But I am not sure about the 2nd term on the LHS of the equation, would you provide a hint for this please?

$$\oint_{CS}\rho V_i\left(V_{C\forall}\cdot\hat{n}\right)dS \stackrel{?}{=} \oint_{CS}\rho V_i\left(V - V_{C\forall}\right)\cdot\hat{n}dS$$

Note: I started by contracting the momentum eq in conservative form to its vector form

$$\frac{D}{Dt}\Big(\rho V\Big) = -\nabla\cdot P + \nabla\cdot\tau + f_b$$

I applied the Reynolds transport on the LHS and the Divergence theorem to the pressure gradient term and the shear gradient

I do not agree with your last equation. How can you have a pressure vector? Pressure is a scalar. Also, you shouldn't transform the momentum equation convection terms as a substantial derivative. I don't see how this can help you. Simply substitute the time derivative of the momentum equation within the first term on the RHS of the Reynolds transport theorem listed on the last page of the tables. Then, there'll be several integrals you need to rewrite using Gauss's theorem. The ones involving the velocity are easy. The ones involving pressure and the shear stress are more challenging.

Question by AME536B Student

Is it possible to give us a hint on how to find the wake height on question 4?

Well I think I gave you many examples of what not to do in class. This is sufficient. You need to formulate the definition of the wake height in a way that is fool proof, that will work equally well in the near or the far field.

Question by AME536B Student

Per university policy, I am not sure if a homework applies Under, Policy Memo: Final Examination Regulations and Information 4. It is Faculty Senate policy that all forms of exams (quizzes, take homes, etc.) are prohibited on any scheduled class or reading day during the calendar week in which regularly scheduled final exams begin. Specific exceptions for certain courses may be made with approval from the appropriate academic unit head and academic dean. Students shall be informed of any such exceptions in the class syllabus.
https://www.registrar.arizona.edu/cours … pring-2020

Assignment 10 definitely does not qualify as an exam. You won't receive a grade for it and it doesn't count towards the final score. The purpose of the assignments in this course is to help you learn the material and give you feedback. The material for the final exam includes the last lecture hence the need for assignment 10. The submission of the assignment 10 can take place anytime between Wednesday 6 pm and Sunday 11 am. If you don't submit it, you don't lose any point. If you do, I'll give you feedback. It's up to you.

Question by AME536A Student

I have a problem with question 3. As we did in class, I found the velocity u from the streamfunction through:

$$u = \frac{\partial \Psi}{\partial y}$$

Then I integrated u over y in the limits from 0 to $x^{\frac{2}{3}}$ *. The second x-term cancels out, but I still end up with an expression that contains* $\frac{1}{x}$ *, which I think should not be the case. Is there something wrong with this approach?*

This is possible. Then if this happens, you need to explain what this entails. Answer the other parts of the Q3 carefully. You need to think about this.

Question by AME536A Student

I believe you mentioned this in class, but I wanted to double check — Is the final

exam open note? If not, will we be expected to do proofs of equations for the final exam? Are there any that might be excluded from being on the exam?

Yes it's open notes, and the exam will be designed in consequence. I could ask you part of a proof that I didn't finish in class. No assignment problem is excluded. You should make sure you understand and remember the proofs and other problems in the assignments. I may ask you the same problem as in the assignment or a very similar problem that builds upon the assignment problem. Thus, I expect you to have finished all your assignment problems correctly. I recommend not to open your notes during the exam — most likely this will end up being detrimental. You should have all the theory and assignments well understood and inside your brains.