

Homework 10

Due Dec 10th (Thursday).

- (1) Consider the boundary layer on the hood of your car (1.5 meters long).
 - (a) How far along the hood is the flow laminar when traveling at 60 mph?
 - (b) Compute all three boundary layer thicknesses when the flow has reached the windshield assuming the flow is laminar the whole way.
 - (c) Compute all three boundary layer thicknesses when the flow has reached the windshield assuming the flow is turbulent the whole way.
 - (d) Estimate the total drag due to the car hood when driving at 60 mph? What power is required to overcome the drag on a car hood?

- (2) A person acts like a bluff body when falling. At terminal velocity the drag balances the force of gravity. (Note that the table values include the area of a person – scale the area down for the child by 1/5).
 - (a) What is the terminal velocity of a 10 kg child falling in a horizontal position (standing in the table)?
 - (b) What if the child falls in a vertical position (crouching in the table)?
 - (c) Repeat (a) and (b) for a 100kg person.

- (3) Approximate a submarine by a cylinder and ignore what is happening at the ends. The rest of the cylinder acts like a rolled up flat plate.
 - (a) Is the flow laminar or turbulent on the sub if it cruises at 35 mph?
 - (b) What is the 99% thickness at the end of a 80m long sub?
 - (c) Estimate the drag on the sub?
 - (d) How much power does it take to move the sub at cruise speed?

- (4) Book 9.93

- (5) Book 9.29

- (6) Book 9.107