Homework 1

Due September 18

1. Velocity field (u,v,w) in a certain part of ocean is given by $u = 6ye^{3z}\cos 3x$ and $v = 2e^{5z}\sin 3x$. If potential flow is valid, obtain w.

2. You need to know the resistance on a large ship of 300-m at Froude number 0.2. To this end, you carried out a towing-tank test for 1/100 scale model and measured 10 KN.

(1) What was the velocity of the model test?
(2) How much is the resistance of real ship if only the Froude number is considered?
(3) What are the Reynolds numbers in the model test?
(4) Ideally both the Froude and Reynolds numbers should be equal in the model test and real ship. However, in reality, it is almost impossible. Explain why?

3. Let's define a velocity field (u,v,w).
(1) Write the condition of mass conservation for ideal flow.
(2) Write the condition of irrotational flow.
(3) From (1) and (2), derive the Laplace equation for potential flow.

4. Consider a 2-D source of strength m in a uniform flow of velocity U.

(1) Write the total velocity, Φ .
(2) Show that Φ satisfies the Laplace equation.
(3) There is a stagnation point that the velocity is zero. Find the coordinate of the stagnation point if the origin is assumed at the source point.
(4) What is the pressure at the stagnation point.

5. Derive the Bernoulli equation. Use your own definition. Explain briefly the physical meaning of each terms involved.

Solve by yourself. Copying other's solution will have negative score of both copier and provider.