1. (20%) Briefly answer the following questions:
   (i). What is non-Newtonian fluid? (4%)
   (ii). What is the physical meaning of Reynolds number? (4%)
   (iii). What is the Hagen-Poiseuille Equation? (4%)
   (iv). What is a Karman vortex street? (4%)
   (v). What is a'Alembert's paradox? (4%)

2. (15%) Green energy is highly desirable to limit carbon emission. You are an engineer with the job of designing the most efficient wind turbine in the world.
(a) (10%) For a location with wind velocity V and a wind turbine with diameter D, calculate the maximum power the wind turbine can generate from the wind.
(b) (5%) If you want to build a wind farm (with many turbine units) in an area A, what are some key factors for consideration? Please explain your answers in detail.

3. (35%) Compare two flow situations below. All flow conditions are incompressible and steady. Figure 1 shows inviscid flow in a diverging cone. Figure 2 presents a sudden expansion with a long distance between the inlet and outlet where mixing of flow occurs in-between. The inlet and outlet areas in the two figures are the same, and ρ is the fluid density and V_1 is the flow inlet velocity.
(a) (10%) For Figure 1, calculate the pressure coefficient $C_p = (p_2-p_1)/(0.5\ \rho V_1^2)$ in terms of inlet and outlet areas.
(b) (20%) For Figure 2, use suitable analysis to derive an equation for C_p in terms of inlet and outlet areas. (Be sure you clearly draw the control volume otherwise points will be subtracted.)
(c) (5%) Compare and explain your answers in (a) and (b) based on flow physics.

Figure 1

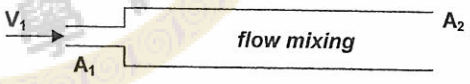

Figure 2

4. (30%) A liquid drop is falling from the tip of a straw and then impacts to the free surface of a glass cup filled with the same liquid.
(a) Sketch and state all the influential variables in the problem before the drop impacting onto the liquid and then derive the dimensionless groups of the system by Buckingham pi theorem. (10%)
(b) Please sketch and write all the influential variables involved in the problem at the moment of producing a maximum cavity in the liquid cup; and then make necessary assumptions and briefly describe this system with governing equations. (15%)
(c) If the liquid drop is changed to a solid ball, what will be different in your answer in (a)? (5%)

試題隨卷繳回