1. An inclined gate of length L=3m and width W=1.5m holds beck water in an irrigation channel as shown in Fig.1. What is the force of the water on the gate when the channel is filled to height of H=1m? What is the net force on the gate? Express the forces in the x,y,z coordinate system; ($\rho_{water} = 998\,kg/m^3$). (15%)

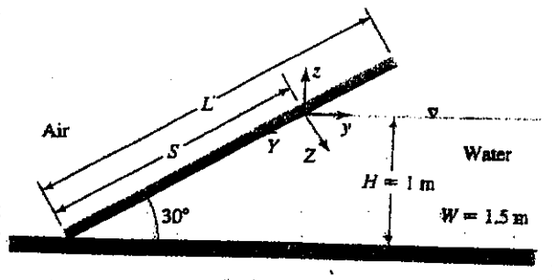

Fig.1

2. A system for collecting oysters from the bottom floor of the ocean has been attempted in the past. A pump on board ship passes $1500\,gal/\text{min}$ ($1\,gal/\text{min} = 0.002228\,ft^3/s$) of water into a 6-in pipe to a so-called ejector nozzle which is housed in a second large nozzle *E* open at *A* and connected to a 10-in pipe. The jet of water from the ejector nozzle at *B* entrains water in the larger nozzle *E* and draws $250\,gal/\text{min}$ of water and oysters into the larger nozzle at *A*. The combined specific gravity of water and oysters entering at *A* is 1.3. If we take the pressure at *A* to be that of the nearby hydrostatic pressure, what horsepower is needed for the pump? (20%)

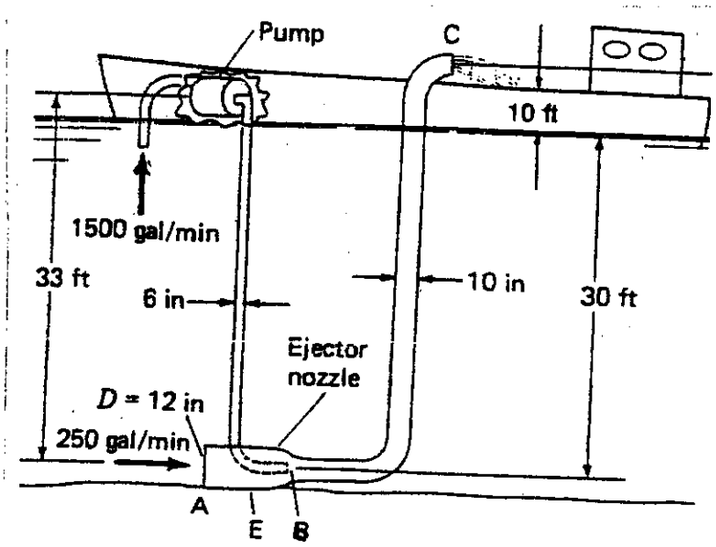

Fig.2

(背面仍有題目,請繼續作答)

3. A nozzle attached to the end of a vertical pipe discharges water against a small flat surface, ℓ=5m, below the exit. The diameter of tin pipe is D=10cm, and the nozzle exit is d=4cm. The pressure gage shows a gage pressure of 50,000 N/m^2. If frictional resistance of the atmosphere on the jet is neglected, what fluid force is exerted on the surface? (15%)

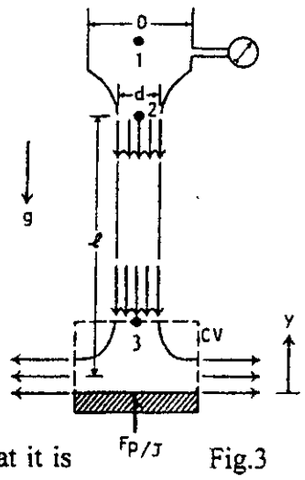

Fig.3

4. A thin rectangular plate having a width w and a height h is located so that it is normal to a moving stream of fluid. Assume the drag, D, that the fluid exerts on the plate is a function of w and h, the fluid viscosity and density, μ and ρ, respectively, and the velocity, V, of the fluid approaching the plate. Determine a suitable set of pi terms to study this problem experimentally. (15%)

5. Consider a steady, laminar, fully-developed flow through a horizontal circular tube of radius **R**. The axial velocity, **u**, is parallel to the walls and varied with the radial distance, **r**, away from the center line of the tube. Determine the velocity profile of **u(r)**, as a function of the fluid viscosity, μ, the tube radius, **R**, and the wall shear stress, τ_w. (15%)

6. (A) Describe the balance of pressure, viscous and inertia (acceleration) forces in (a) the entrance region and (b) the fully developed region of a pipe flow.

(B) Describe the balance of pressure, viscous and inertia (acceleration) forces within the boundary layer of (a) a flat plate, and (b) a blunt body.

(C) Describe the physical meanings of the boundary layer (a) thickness, (b) displacement thickness, and (c) momentum thickness.

(D) What is the reason for dimples on golf balls?

(20%)