I 選擇題(五選一，只有一個答案是正確的，每題五分，不倒扣。若選二個或二個以上的答案，均不給分)(50%)

1. Which approach is the most suitable one to track the migration of an individual contaminant molecule in the flow space:
   a. Bernoullian
   b. Eulerian
   c. Lagrangian
   d. Laplacian
   e. Newtonian

2. The connective acceleration usually does not occur in the situation for
   a. converging flow
   b. flow between parallel plates
   c. flow through nozzle
   d. motion of river around bridge piers
   e. vortex flow

3. Which one is not a required condition for the Bernoulli equation relates the pressure, velocity, and elevation between any point in the flow field
   a. uniform
   b. steady
   c. incompressible
   d. nonviscous (inviscid)
   e. irrotational

4. Which one in the following condition is not required in the pipe network analysis
   a. the elevation of hydraulic grade line must be assumed for each junction
   b. the inflow must equal the outflow at each junction
   c. appropriate velocity and head-loss equation must be employed and satisfied for each pipe
   d. the sum of the pressure drops around each loop (or circuit) must be zero
   e. the head loss between any two junctions must be the same

5. Which instrument can be used to measure the flow velocity
   a. piezometer
   b. hydrometer
   c. manometer
   d. Pitot tube
   e. all of these instruments

6. Which two forces are most important in laminar flow between closely spaced parallel plates?
   a. inertia, viscous
   b. viscous, pressure
   c. capillary, inertia
   d. gravity, capillary
   e. body, friction

7. Which description is correct for the boundary layer flow
   a. the velocity of the fluid near to a boundary of an object is not diminished (i.e., approached to zero)
   b. inside the layer, the flow velocity may be described by the nonviscous flow theory
   c. it is uniform and mostly in transient state between laminar and turbulent
   d. the Prandtl's mixing - length theory is applicable only in laminar flow region
   e. none of these answers

8. Which equation can be used to calculate the turbulent flow velocity
   a. Chezy equation
   b. Darcy-Weisbach equation
   c. Hazen-William equation
   d. Manning equation
   e. all of these equations

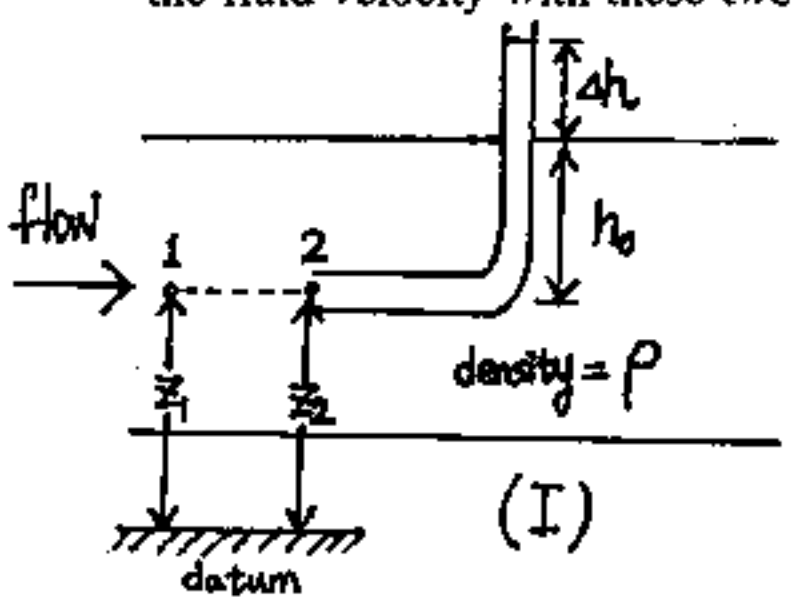
9. A function that satisfied the Laplace equation
   a. does not necessarily satisfied the continuity equation
   b. can be in either rotational or irrotational motion for fluid field
   c. can be a vector or tensor
   d. exists only in incompressible flow
   e. must be linear in x and y

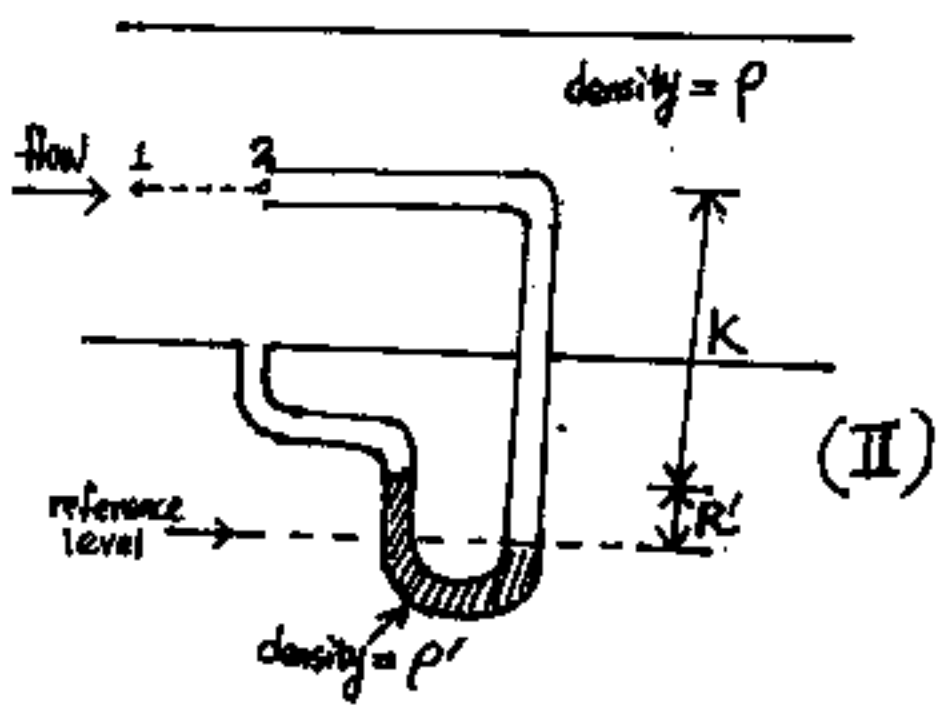
10. Which statement is not correct for the equation of motion
   a. is derived based on Newton's second law
   b. is also called as the Navier-Stokes equation for compressible fluids
   c. can be used to derive the Bernoulli equation for an irrotational fluid
   d. is applicable in either laminar or turbulent flow
   e. none of these answers

Ⅱ. 問答題 (50%)

(6%) 1. A flat plate is immersed in an incompressible fluid with uniform flow of velocity U at 20°C. The fluid systems being considered are air and water. Which fluid has a thicker boundary layer thickness at the plate surface? State your reason(s).

(14%) 2. The two devices shown below have long been used to measure the velocity of fluids. Device (I) is a simple pitot or total head tube; device (II) combines a pitot tube with a static pressure measurement and a differential manometer. Develop equations to predict the fluid velocity with these two devices.





(30%) 3. In cylindrical coordinates the axial (z) component of the Navier-Stokes equations is,

$$\rho\left(\frac{\partial u_z}{\partial t}+u_r\frac{\partial u_z}{\partial r}+\frac{u_\theta}{r}\frac{\partial u_z}{\partial \theta}+u_z\frac{\partial u_z}{\partial Z}\right)=-\frac{\partial P}{\partial z}+\rho g_z+\mu\left[\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial u_z}{\partial r}\right)+\frac{1}{r^2}\frac{\partial^2 u_z}{\partial \theta^2}+\frac{\partial^2 u_z}{\partial z^2}\right] \quad \cdots$$

(6%) (a). Show that the equation above reduces to

$$\frac{dP}{dz}=\frac{\mu}{r}\frac{d}{dr}\left(r\frac{du_z}{dr}\right)$$

for steady uniform flow parallel to the z axis (with no free surface). Explain specifically why each term either stays or vanishes.

(10%) (b).Solve the simplified equation for laminar flow in a capillary or narrow pipe to find u_z.

(8%) (c). What is the average velocity in the pipe?

(6%) (d). A liquid is flowing through a long narrow capillary tube of 0.5 cm diameter with an average velocity of 5 cm/s. The static pressure drop between the measuring stations is 204 Pa. What is the viscosity of the fluid? The density of the fluid is known to be 1.05×10^3 kg/m^3 (see figure below).