

國立中央大學104學年度碩士班考試入學試題

所別：水文與海洋科學研究所碩士班 不分組(一般生)
水文與海洋科學研究所碩士班 不分組(在職生)

科目：流體力學 共 / 頁 第 / 頁

本科考試禁用計算器

*請在答案卷(卡)內作答

參考用

1. The velocity potential of a steady flow is given by the equation:

$$\phi = x^2 + y^2 - 2z^2$$

- (1) (10%) Find the velocity components (u, v, w) for the flow field as

$$u = \partial\phi / \partial x, v = \partial\phi / \partial y, w = \partial\phi / \partial z$$

- (2) (10%) Show that this field represents a possible incompressible, irrotational flow.

- (3) (20%) The temperature of the field is described by the following expression:

$$T = x + xy + z^2 + 2xyz$$

Based on the chain rule,

$$\frac{DT}{Dt} = \frac{\partial T}{\partial t} + u \frac{\partial T}{\partial x} + v \frac{\partial T}{\partial y} + w \frac{\partial T}{\partial z}$$

please determine the time rate of change of the temperature of a fluid element as it passes through the point $(1, -2, 3)$.

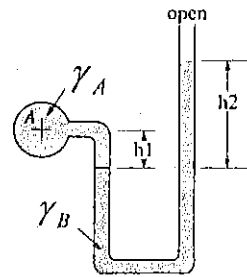
2. (20%) The manometer is open to the atmosphere. What is the specific weight γ_A of the fluid in pipe A? Your answer may include some or all of the following variables:

h_1 and h_2 , the height as indicated

γ_B , the specific weight of the manometer fluid

P_A , the pressure in pipe A

P_{ATM} , atmospheric pressure



3. The pressure distribution of a steady incompressible flow is given as

$$P = x^3 + 2y + z^2 + 3 \text{ (Pa)}$$

- (1) (10%) Calculate the pressure gradient of a fluid particle at the position

$$\vec{r} = \vec{i} + \vec{j} - \vec{k} \text{ (m)}$$

- (2) (10%) Calculate the acceleration of fluid particle with a mass density of 1000 kg/m^3 at the same position.

4. (20%) A tube is used to drain liquid from the tank with one end immersed into water in a large open tank, and the other end open to the ambient. All friction losses are assumed to be neglected and the flow is steady. Find the speed of the jet issuing from the open end of the tube.

