

九十一學年度 生命科學院四所 碩士班研究生招生考試

科目 輸送現象與單元操作 科號 1004 共 1 頁第 1 頁 *請在試卷【答案卷】內作答

1. Discuss the following descriptions as complete as time and your knowledge allow. (30%)
 - (a) The Bernoulli equation for inviscid flow.
 - (b) Analysis of two-dimensional flows using stream function relations.
 - (c) Creeping flow.
 - (d) Conditions required for the validity of boundary layer theory.
 - (e) Conditions required for the validity of lubrication theory.
 - (f) Discuss the analogy between mass, heat, and momentum transport, referring to both its basis for existence and its usefulness in application. Use as examples specific problems that you have worked, if appreciate.
2. Describe the differences between Eulerian and Lagrangian descriptions of motion. Define velocity and acceleration. Given the velocity components $v_x = tx$, $v_y = -ty$, $v_z = 0$ in Eulerian form, determine the acceleration in Eulerian form and the velocity and acceleration in Lagrangian form. Find the path lines and streamlines for this flow. (20%)
3. What fundamental laws are associated with the continuity equation, Cauchy's first law of motion, and Cauchy's second law of motion? Derive the continuity equation using Reynolds transport theorem. What information is obtained from Cauchy's second law? (20%)
4. A spherical gas bubble rises very slowly in an immiscible fluid under the action of buoyancy. Due to the presence of trace surface contaminants (surfactants), the interfacial tension varies on the bubble surface according to

$$\sigma = \sigma_0 (1 + B \cos\theta)$$

Assuming the fluids are Newtonian and surface viscosity effects are negligible, determine the steady terminal velocity of the bubble in terms of difference in the densities $\Delta\rho$ (continuous phase minus bubble phase), the viscosity η of the continuous phase, the bubble radius R , the acceleration of gravity g , and the interfacial parameter σ_0 and B . (30%)