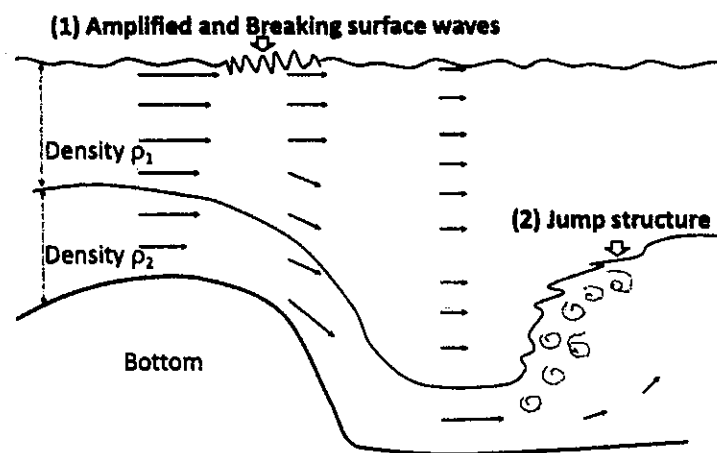


1. A fluid flow field is given by  $\vec{V}(x, y, z, t)$  with fluid property expressed as  $P(x, y, z, t)$ . (20%)
  - (a) Write down the material derivative of  $\vec{V}$  and explain the meaning of each term.
  - (b) Please explain the physical meaning of  $\nabla P$ ,  $\nabla \cdot \vec{V}$ , and  $\nabla \times \vec{V}$ .
  - (c) Prove that  $\nabla \times (\nabla P) = 0$ .
  - (d) Prove that  $\nabla \cdot (\nabla \times \vec{V}) = 0$ .
2. Please derive the 2-D streamfunction and velocity potential and explain their physics. (20%)
3. Explain the following terms (20%). (a) Boussinesq approximation; (b) Inviscid flow; (c) Newtonian fluid (d) Reynolds number; (e) Richardson number; (f) Lagrangian method; (g) Eulerian method; (h) Laminar flow; (i) Turbulent flow; (j) Reynolds stress.
4. For a 2D flow in  $x$ - $y$  plane, the  $y$  component of velocity is given by  $v = x^2 - 2x + 2y$ . Determine a possible  $x$  component of velocity  $u$  for steady, incompressible flow. (20%)
- 5.



The above figure shows ocean current flowing over an abrupt topography, as characterized by the arrow vectors. The current is a two-layer stratified flow. Please provide some thoughts about the formation of (1) the amplified and breaking surface waves and (2) the jump structure. (20%)

試題隨卷繳回