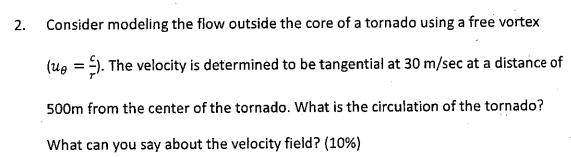所別： 大氣科學學系大氣物理 碩士班 不分組(一般生)　　　共3頁 第1頁
　　　 大氣科學學系大氣物理 碩士班 不分組(在職生)

科目： 流體力學

本科考試禁用計算器　　　　　　　　　　　　＊請在答案卷　內作答

1. Assume a raindrop can be approximated as a sphere of diameter D falling with velocity W, Use dimensional analysis to obtain an expression for the drag force F_D, as it falls through air of Viscosity μ and density ρ. (10%)

2. Consider modeling the flow outside the core of a tornado using a free vortex $(u_\theta = \frac{c}{r})$. The velocity is determined to be tangential at 30 m/sec at a distance of 500m from the center of the tornado. What is the circulation of the tornado? What can you say about the velocity field? (10%)

3. Show that volumetric strain rate is zero for incompressible flow. Discuss the physical interpretation of volumetric strain rate for incompressible and compressible flows. (10%)

4. Consider the steady, two-dimensional, incompressible velocity field, namely

$$\vec{V} = (u, v) = (ax + b)\vec{i} + (-ay + cx)\vec{j}$$

Calculate the pressure as a function of x and y. (10%)

5. If you are requested to design an experiment to evaluate a mountain-valley wind, which has a strong diurnal cycle, discuss the point you must consider to obtain a good ensemble of measurement. (10%)

注意：背面有試題

6. Given　　$u=3x+2yz+u_0$

$v=4xy+3t+v_0$

$w=0$

Where u_0, v_0 are constant.

(a) Is this an Eulerian or a Lagrangian description? (5%)

(b) What is the local acceleration? (5%)

(c) What is the advective acceleration? (5%)

(d) What is the Eulerian derivative? (5%)

7. An airplane flies along a warm front northward at a speed of 360 km/hr. The temperature at a ship anchored in the vicinity shows an increase of 12°C/day. A satellite measures a horizontal temperature gradient in the weather system of -0.06°C/km northward. What is the temperature gradient measures in the airplane? (10%)

8. Consider steady, incompressible, laminar flow of a Newtonian fluid in the narrow gap between two infinite parallel plates. The top plate is moving at speed U, and the bottom plate is stationary, the distance between these two plates is h, and gravity acts in the negative z-direction. There is no applied pressure other than hydrostatic pressure due to gravity. Calculate the velocity and pressure fields, and estimate the shear force per unit area acting on the bottom plate. (10%)

注意：背面有試題

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9. Consider the following steady, incompressible, two dimensional velocity field

$$\vec{V} = (u, v) = x^2 \vec{i} + (-2xy - 1)\vec{j}$$

Is the flow rotational or irrotational? Sketch some streamlines in the first

quadrant and discuss. (10%)