

- 一、Consider the velocity field given by $\vec{V} = x^2 \vec{i} - xy \vec{j}$.
- (a) Find an equation for the streamline passing through the point (2,1). (7%)
 - (b) How long does it take a particle of fluid to move from this point to the point where $x=4$? (8%)
- 二、For the Cartesian velocity field $\vec{V} = 2x^2y \vec{i} + 3 \vec{j} + 4y \vec{k}$, ρ is the density of fluid.
- (a) Find $\frac{1}{\rho} \frac{D\rho}{Dt}$. (8%)
 - (b) Find the acceleration of the flowfield. (7%)
 - (c) Find the pressure gradient if the fluid is inviscid and gravity can be neglected. (5%)
- 三、The velocity components of a steady flowfield are $u=2xy$ and $v=4+x^2-y^2$.
- (a) Is the flow incompressible? (3%)
 - (b) Is the flow rotational or irrotational? (4%)
 - (c) Find the velocity potential. (4%)
 - (d) Find the stream function. (4%)
- 四、A golf ball manufacturer wants to study the effects of dimple size on the performance of a golf ball. A model ball four times the size of a regular ball is installed in a wind tunnel.
- (a) What parameters must be controlled to model the golf ball performance? (15%)
 - (b) What should be the speed of the wind tunnel to simulate a golf ball speed of 200ft/s? (5%)
 - (c) What rotational speed must be used if the regular ball rotates at 60 revolutions per second? (5%)
- 五、Consider a laminar and a turbulent boundary layer at the same Reynolds number.
- (a) How do the velocity profiles compare? (4%)
 - (b) Which boundary layer grows faster? (4%)
 - (c) Which boundary layer has the larger ratio of displacement thickness to momentum thickness? (3%)
 - (d) When subjected to the same adverse pressure gradient, which boundary layer will separate sooner? (4%)
- 六、
- (a) What is the Moody diagram? (5%)
 - (b) What is the Magnus effect? (5%)