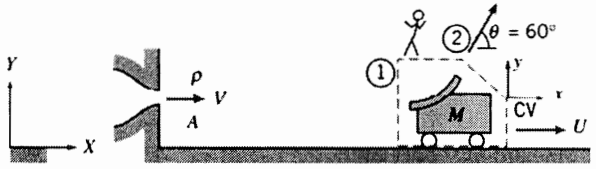
逢甲大學100學年度碩士班招生考試試題 編號：015 科目代碼：310

科目	流體力學	適用系所	航太與系統工程學系熱流組	時間	100 分鐘

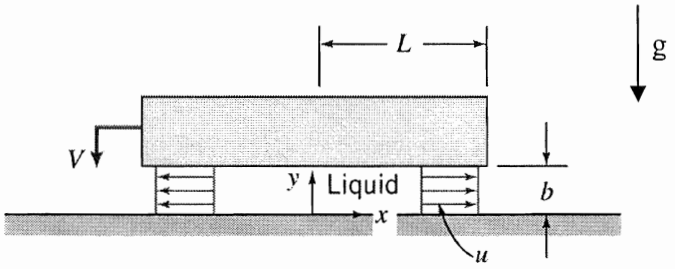
※請務必在答案卷作答區內作答。

1. Answer the following questions: (25%)
   (a) Give four restrictions of the Bernoulli equation.
   (b) If the three components of velocity in a velocity field are given by $u = x^2 + y + z^2$, $v = x - y + z$ and $w = -2xz + y^2 + z$, determine whether the velocity field is incompressible, or neither.
   (c) Explain two physical meanings of the stream function shortly.

2. A vane, with turning angle $\theta = 60^\circ$, is attached to a cart. The cart and vane, of mass $M = 65\,kg$, roll on a level track. Friction and air resistance may be neglected. The vane receives a jet of water, which leaves a stationary nozzle horizontally at $V = 30\,m/s$. The nozzle exit area is $A = 0.002\,m^2$. Determine the velocity of the cart as a function of time, $U(t)$. [$\rho_{H_2O} = 999\,kg/m^3$] (25%)



3. A Liquid Layer separates two plane surfaces as shown below. The lower surface is stationary; the upper surface moves downward at constant speed V., The moving surface has width w, perpendicular to the plane of the diagram, and $w>>L$. The incompressible liquid layer, of density ρ, is squeezed from between the surfaces. Assume the flow is uniform at any cross-section and neglect viscosity as a first approximation. Use a suitably chosen control volume to show that $u=Vx/b$ within the gap, where $b=b_0-Vt$. Please find general expressions for (a) the velocity component in y direction; (b) the acceleration $\vec{a}$; (c) the pressure p distribution; (d) the streaming function ψ; (e) the velocity potential ϕ in this flowfield; (f) If the mass of the object floating on the liquid layer is 1000 kg, please estimate the magnitude of V (m/s) for the conditions: ρ=1000 kg/m^3, g=9.81 m/s^2, b=1 mm, L=40 mm, w= 1m (30%)



4. The Power, P, required to drive a fan is assumed to depend on fluid density, ρ, volume flow rate, Q, impeller diameter, D, and angular speed, ω. If a prototype of fan with D_1=200 mm delivers Q_1=0.4 m^3/s of air at ω_1=2400 rpm, what volume flow rate conuld be expected for a model of fan with D_2=40 mm at ω_2=185 rmp? If the power required to drive the model is 0.01 W based on water tunnel test, estimate the power required of the prototype. (ρ_{air}=1.23 kg/m^3, ρ_{water}=1000 kg/m^3) (20%)