國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：流體力學【海下海物所碩士班選考】

題號：4161

1. A velocity field is given by $\mathbf{V} = (V_0/l)(x\hat{\mathbf{i}} - y\hat{\mathbf{j}})$ where V_0 and l are constants.
   (a) At what location in the flow field is the speed equal to V_0? (5 %)
   (b) Make a sketch of the velocity field in the first quadrant ($x \geq 0, y \geq 0$) by drawing arrows representing the fluid velocity at representative locations. (10 %)

2. Air flows steadily at low speed through a horizontal nozzle, discharging to atmosphere. The area at the nozzle inlet is 0.1 m^2, and 0.02 m^2 at the nozzle exit. Determine the gauge pressure required at the nozzle inlet to produce an outlet speed of 50 m/s. (15 %)

3. Water flows steadily through the 90° reducing elbow pipe. At the inlet to the elbow, the absolute pressure is 220 kPa and the cross-sectional area is 0.01 m^2. At the outlet, the cross-sectional area is 0.0025 m^2 and the velocity is 16 m/s. The elbow discharges to the atmosphere. Determine the force required to hold the elbow in place. (20 %)

4. A viscous fluid is contained between wide, parallel plates spaced a distance h apart as shown in Fig.1. The upper plate is fixed, and the bottom plate oscillates harmonically with a velocity amplitude U and frequency ω. The differential equation for the velocity distribution between the plates is:

$$\rho\frac{\partial u}{\partial t} = \mu\frac{\partial^2 u}{\partial y^2}$$

where u is the velocity, t is time, and ρ and μ are fluid density and viscosity, respectively. Rewrite this equation in a suitable non-dimensional form using h, U, and ω as reference parameters. (15%)

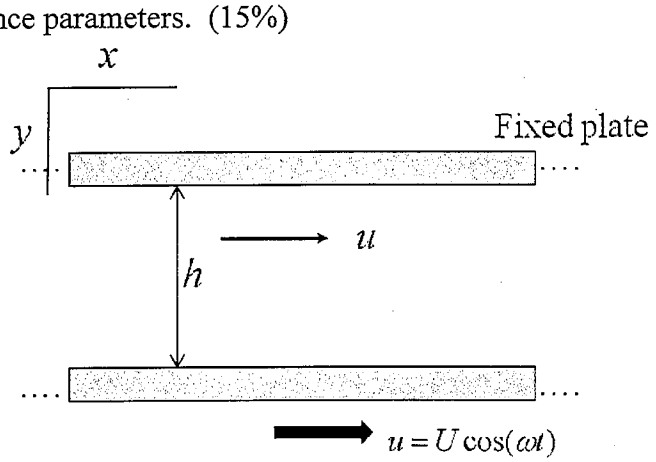

Fig. 1

5. A gate having the cross section shown in Fig.2 closes an opening 1.5 m and 1.2 m high in a water reservoir. The gate weighs 2.2kN and its center of gravity is 0.3 m to the left of AC and 0.6 m above BC. Determine the horizontal reaction that is developed on the gate at C. (20%)

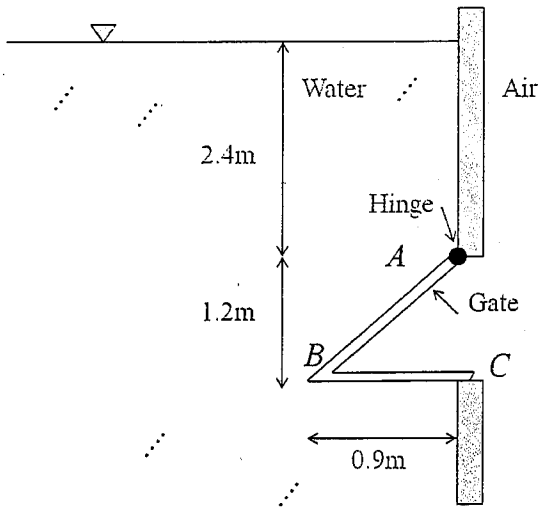

Fig. 2

6. A 1-m-diameter cylindrical mass, M, is connected to a 2-m-wide rectangular gate as shown in Fig. 3. The gate is to open when the eater level, h, drops below 2.5m. Determine the required value for M. Neglect friction at the gate hinge and pulley. (15%)

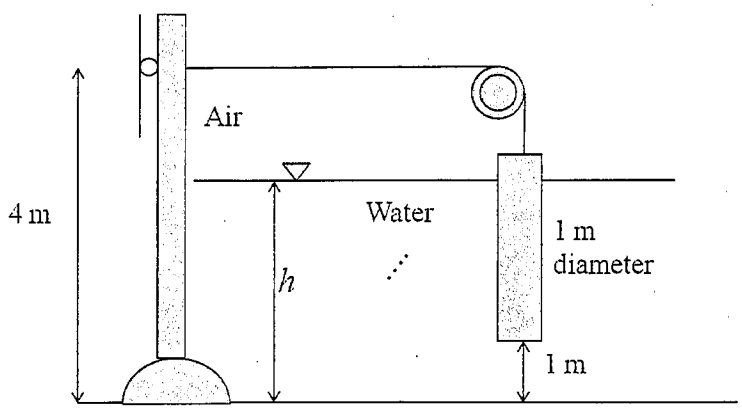

Fig. 3