編號： 160

國立成功大學 107 學年度碩士班招生考試試題

系　　所：生物醫學工程學系

考試科目：流體力學

考試日期：0205，節次：2

※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (a) Define the term, Newtonian fluid. (5%)

   (b) Name one example for Newtonian fluid, shear thickening, and shear thinning fluids, respectively. (6%)

2. Archimedes is well known for discovering the law of buoyancy in determining the volume of an irregular object. He once helped King Hiero II of Syracuse examine the purity of a golden crown made by a dishonest goldsmith. Assume you are in a similar situation and also need to determine the composition of an unknown object using the same way (see the setup in Fig. 1). Given that the object is known to be made by only gold (ρ_g=19.3 g/cm^3) and silver (ρ_s=10.5 g/cm^3). Please calculate:

   (a) The volumes of gold and silver portions, respectively? (10%)

   (b) The weights of gold and silver portions, respectively? (10%)

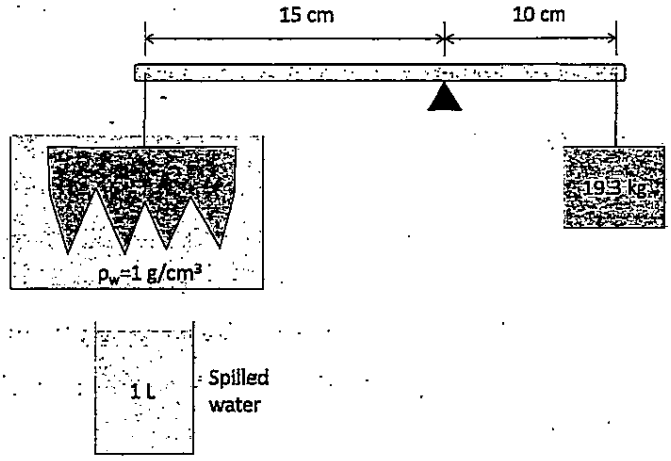

Fig. 1

3. A manufacturer is planning to redesign a giant fish tank (Fig. 2) by **<u>replacing the square window with an equilateral triangle window.</u>** The triangle window is the same size as the square one. Assume the new window is installed with its flat side touching the bottom of the fish tank. **Determine the resultant force F acting on the new window and its location (h)** (ρ_{water}=1000 kg/m^3). (25%)

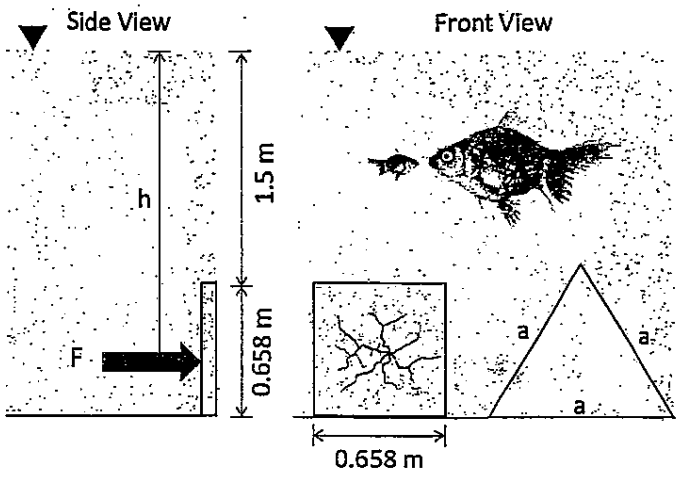

Fig. 2

4. Assume weir flow is similar in many respects to an orifice-type flow with a free streamline (Fig. 3). We expect the average velocity to be proportional to $\sqrt{2gH}$, where g is the gravitational acceleration. Please **show** the **<u>average velocity</u>** and **<u>flowrate</u>** in terms of b, g, and H. (Hint: Bernoulli equation) (24%)

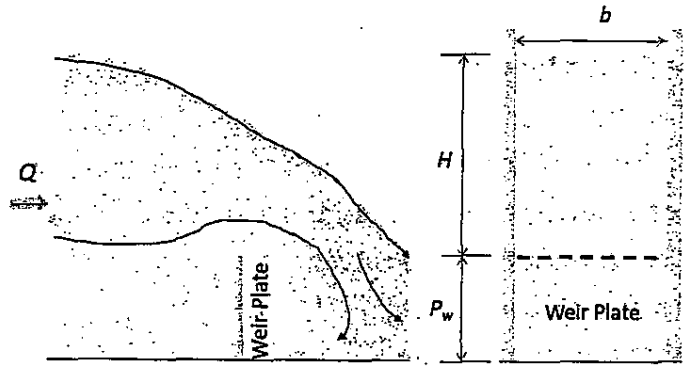

Fig. 3

5. An incompressible, viscous fluid density, ρ, flows past a solid flat which has a depth, b, into the paper (Fig. 4). The flow initially has a uniform velocity, U_∞, before contacting the plate. After contacting with the plate at a distance x downstream from the leading edge, the flow velocity profile is altered due to the no-slip boundary. The velocity profile at location x is estimated to have a parabolic shape, $u=U_\infty((2y/\delta)-(y/\delta)^2)$, for $y\le\delta$ and $u=U_\infty$ for $y\ge\delta$ where δ is the "boundary layer thickness". **Determine the upstream height from the plate, h**, of a streamline which has a height, δ, at the downstream distance. <u>Express your answer in terms of δ</u>. **(Note:** Control Volume must be shown!) (20%)

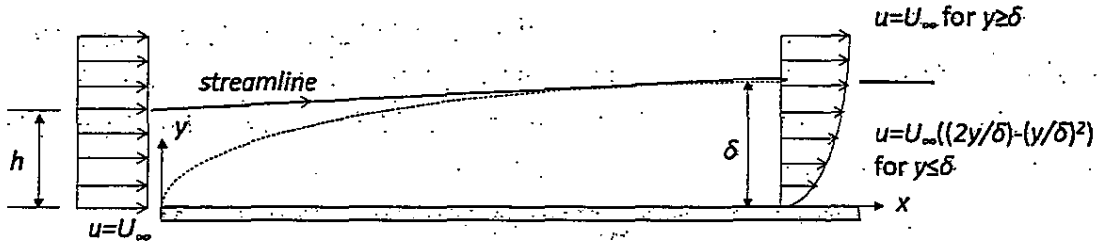

Fig. 4