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

1. For hydraulic jump in a rectangular channel, please answer the following questions: (16%)

    (1) Sketch a water profile before and after the hydraulic jump.

    (2) Derive mathematical expressions for hydraulic jump in a rectangular channel.

    (3) Assuming that a jump occurs in a 5 m wide channel carrying 15 m^3/s of water at a depth of 300 mm. Determine the water level and flow velocity after the jump.

    (4) Based on (3), calculate the energy loses in power by the jump.

2. For linear stress variation over the base of the dam of Fig. 1 (the hydrostatic uplift was neglected). (16%)

    (1) Locate where the resultant crosses the base.

    (2) Compute the maximum and minimum compressive stresses at the base.
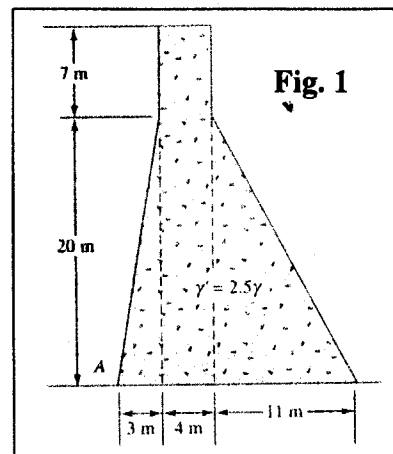
3. A trapezoidal earth canal (n=0.025), with a bottom width of 2.5 m and side slopes of 2 horizontal to 1 vertical, must carry 6 cms. The permissible maximum velocity to prevent eroding is 0.8 m/s with this material. What bottom slope is required ? (15%)

Fig. 1

4. Two incompressible fluids of the same density but different viscosities flow one on top of the other down an inclined plane, as shown on Fig. 2. Please derive mathematical expressions for the profiles of the velocity, by assuming that the flow on the plane is a steady-uniform state, one-dimensional flow, two fluid have the same density ρ, and the width is very large related to the depth. (20%)
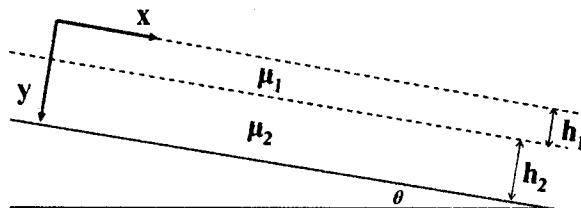

Fig. 2

5. Determine the average velocity and momentum correction factor for the velocity distribution in a pipe,

$$\frac{\upsilon}{\upsilon_{max}} = \left(\frac{y}{r_0}\right)^{1/n},$$

with y the wall distance and r_0 the pipe radius. (13%)

6. Determine the specific gravity of spherical particles, $D = 0.13$ mm, which drop through air at 0 °C at a speed U of 0.1 m/s. The drag force on a small sphere in laminar motion is given by $3\pi\mu DU$. (20%)