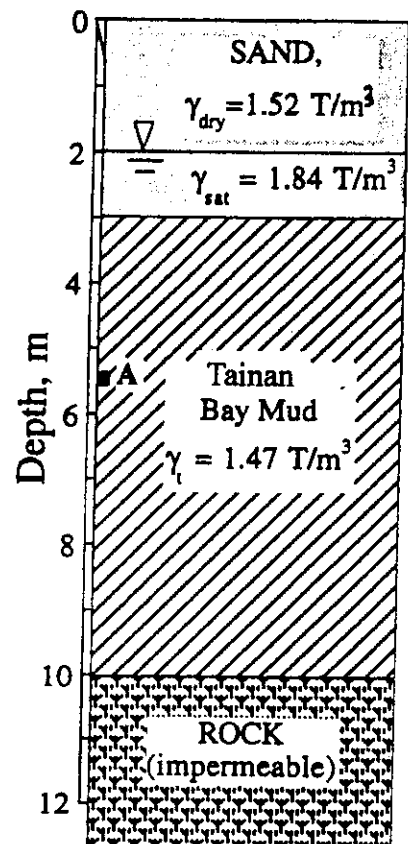本試題是否可以使用計算機： ☑可使用 ， □不可使用 （請命題老師勾選）

1. Translate following terminologies to Chinese and explain its meaning:
   (20%)
   (1) phreatic surface   (2) quick clay   (3) constrained modulus
   (4) hydraulic gradient   (5) sensitivity

2. An "undisturbed" sand sample obtained used the frozen soil technique
   was carefully taken from a boring and had the following properties:
   Specific Gravity, $G_s = 2.65$.   Total weight, $W_t = 150$ grams.
   Total volume, $V_t = 80.00$ cc   Water content, $\omega = 20\%$.
   Determine the following properties of the soil: (20%)
   (a) The total unit weight, γ_t
   (b) The dry unit weight, γ_d
   (c) Void ratio.
   (d) Degree of saturation.

3. For the soil profile indicated right (the capillary
   height for this sand is very small):
   (a) Compute the initial total vertical stress, vertical
       effective stress and pore water pressure at point A
       located at a depth of 5.5 m. The Tainan Bay Mud
       layer is normally consolidated for this conditions.
       (6%)
   (b) At the end of a long rainy season the water table
       goes up to the surface. The sand layer is
       completely saturated. Determine the total vertical
       stress, vertical effective stress and pore water
       pressure at point A. Is the soil at point A
       normally consolidated or overconsolidated for
       this condition? (8%)
   (c) If the Mud layer is expected to experience an
       ultimate settlement of 160mm due to a specific
       loading. After 3 years the average settlement was
       measured to be 56mm. How much longer will it
       take for the average settlement to be double (to
       112mm)? (9%) (Hint: $T_{35}=0.096$, $T_{40}=0.126$,
       $T_{50}=0.197$, $T_{65}=0.304$, $T_{70}=0.403$)

4. A cut is made in a stiff saturated clay that is underlain by a layer of sand (as shown in the figure below). (a) What should be the height of the water, h, in the cut so that the stability of the saturated clay is not lost? (b) What is the critical hydraulic gradient for the cut? (12%)
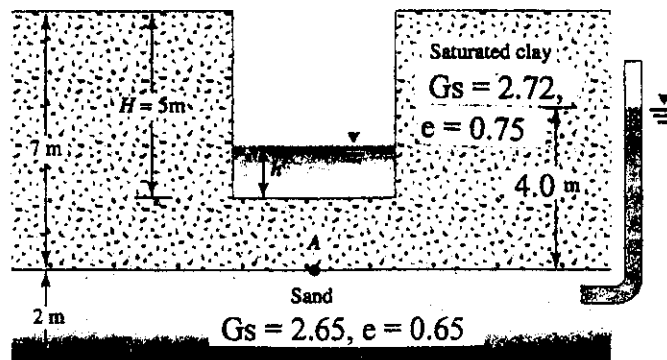
5. A direct shear test was performed on a specimen of dry sand using a vertical normal stress of 70 kPa. The value of ϕ for the sand is 35 degrees.　Assume that the horizontal plane is the failure plane for the following calculations:　(25%)

   (d) Calculate the horizontal shear stress which would be required to cause failure.

   (e) Using the results from part (a) construct the Mohr's circle for the stresses at failure.　Assume that the shear stress on the top of the specimen acts to the left. Show the location of the pole point.

   (f) Determine the major and minor principal stresses.

   (g) Show by means of a sketch the directions of the principal stresses and the directions of the two sets of failure planes.

   (h) Determine the horizontal normal stress at failure.