

الجامعة التكنولوجية

قسم هندسة البناء والإنشاءات

المرحلة الأولى



العدد: ٥٢

التاريخ: ٨ / ٧ / ٢٠١٦

الى / السيد معاون رئيس القسم

م/ الاجابة النموذجية لمادة (الجيولوجيا الهندسية 2)

تحية طيبة

نرفق لكم طياً نسخة من الأسئلة الخاصة بمادة الجيولوجيا الهندسية 2 و للإمتحان النهائي للفصل الدراسي الثاني - الدور الأول و للعام الدراسي 2015 - 2016 و الذي تم اجراءه بتاريخ 2016/6/7 مع الاجابة النموذجية الخاصة بها.

مع التقدير

أ.م.د. قيس جواد فريح

مسؤول المرحلة الأولى

٨ / ٦ / ٢٠١٦

عليه لاشتبك / السيد
٢٠١٨

نسخة منه الى /

• ملف اللجنة الامتحانية



University of Technology
Engineering Department of Building and Construction
Final Exam First Attempt 2015-2016



Subject: Engineering Geology (2)
Examiner: Engineering Geology Committee
Date: 07 / 06 / 2016

Year: 1st Year
Time: 3 Hours

Answer FOUR Questions Only

Q1. State whether each of the following statements is TRUE or FALSE and correct the FALSE one. (25 Mark)

1. ~~Contour lines do not cross or divide.~~ **TRUE**
2. Specific elevations are shown on topographic maps in different ways, e.g., bench mark.
3. $V_{\text{soild}} = V_{\text{void}} + V_{\text{total}}$
4. In shallow depths from earth surface, the horizontal stresses are smaller than the vertical stresses.
5. The river meandering increases river gradient and also its velocity.
6. A youth stage in river is usually near the estuaries and characterizes by its high water velocity.
7. Turbulent flow of groundwater movements is not controlled by Darcy's Law.
8. The Infiltration phenomena when water that evaporate from the ground.
9. A sediment with a large variation in grain size (a well graded sediment) has a lower porosity than a poorly graded sediment.
10. Rocks with porous and low permeability and no fissures are aquicludes.

Q2. A. Fill the blanks with the suitable words. (15 Mark)

1. Scale of the map is represented by four types; -----, -----, -----, and-----.
2. Rivers and streams transport their load of sediments in three ways: -----, -----and ----- loads.
3. Stages of river development are: -----, ----- and -----stages.
4. The formation, or layer, of permeable rock is called an -----, whereas a layer of impermeable rock is an -----.

B. Choose the correct answer: (10 Mark)

1. For most rocks, Poisson's ratio values are ranging between: a) 0.0-0.5 b) 0.0-0.4 c) 0.1-0.5 d) 0.2-0.3
2. Porosity is: a) the percentage of a rock's volume that is voids b) the capacity of a rock to transmit a fluid c) the ability of a sediment to retard water d) none of the preceding
3. Which rock type would make the best aquifer? a) shale b) mudstone c) sandstone d) all of the preceding
4. The broad strip of land built up by sedimentation on either side of a stream channel is: a) flood plain b) delta c) an alluvial fan d) a meander
5. The subsurface zone in which all rock openings are filled with water is called the: a) saturated zone b) water table c) unsaturated zone d) aquiclude

Q3. A. Draw two geologic maps: one for horizontal layers and the second for dipping layers.

For a topographic map, it is required to construct a contour map with closely spaced lines in the West and widely spaced lines in the East with decreasing values toward the West. The map must show a river flowing in the area. Knowing that contour interval **25 m**; the minimum and maximum heights are **25 m** and **250 m** respectively. **(13 Mark)**

B. Define the followings items with sketches if present: (12 Mark)

1. Old stage of river characteristics.
2. Unconfined (uniaxial) compressive strength.
3. Define water table. What are the main characteristics of water table?

Q4. A. If the discharge of a river is $490 \text{ m}^3/\text{s}$, this channel is subdivided into two channels. The 1st channel with discharge $163 \text{ m}^3/\text{s}$ and the 2nd channel with width 18.2 m and its velocity is 3.1 m/s. Find the depth in the 2nd branch. Find the volume of water passing through each branch in 2 hrs. **(13 Mark)**

B. Answer the following items: (12 Mark)

1. For water movement in rivers, prove that the friction per unit area: $F_A = \rho S (A/P)$
2. List the main physical properties of rocks affecting design and construction in rocks. Then depending upon the type of loading and the stresses, give a list only for the strength classification.
3. List the classification of rocks according to their ground water studies with examples. Then list the main factors controlling the porosity of sedimentary rocks and soil.

Q5. A. Dry weight of rock sample = 20N, and the volume of solid part = 23 cm^3 , If the saturated weight with oil = 24 N. Find the moisture content and porosity of the sample, if you know the oil density = 0.8 N/cm^3 . **(10 Mark)**

B. Find the porosity of aquifer rock if its retained porosity is 23.3% and the true velocity is 3.4 times its Darcys' velocity. **(6 Marks)**

C. Give sketches ONLY for the following items: (9 Marks)

1. Confined and unconfined aquifers.
2. Vertical distribution of groundwater.
3. The phase relationship between rock constituents.

Best Wishes.....



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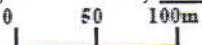

Answer FOUR Questions Only

Typical Answers for Final 1st Attempt Engineering Geology 2, 2015-2016

Q1. State whether each of the following statements is TRUE or FALSE and correct the FALSE one. (25 Mark)

1. ~~Contour lines do not cross or divide.~~ **TRUE**
2. Specific elevations are shown on topographic maps in different ways, e.g., bench mark. **TRUE**
3. $V_{\text{solid}} = V_{\text{void}} + V_{\text{total}}$ **FALSE: ($V_t = V_s + V_v$)**
4. In shallow depths from earth surface, the horizontal stresses are smaller than the vertical stresses. **F, greater**
5. The river meandering **increases** river gradient and also its velocity. **FALSE** (reduces)
6. A youth stage in river is usually near the **estuaries** and characterizes by its high water velocity. **FALSE** (river head)
7. Turbulent flow of groundwater movements is not controlled by Darcy's Law. **F (controlled)**
8. The Infiltration phenomena when water that evaporate from the ground. **F (Move or flow inside ground)**
9. A sediment with a large variation in grain size (a well graded sediment) has a lower porosity than a poorly graded sediment. **TRUE**
10. Rocks with porous and low permeability and no fissures are aquicludes. **TRUE**

Q2. A. Fill the blanks with the suitable words. (15 Mark)

1. Scale of the map is represented by four types; **Simple fraction scale:** such as, 1/100 000, **Proportion scale:**  such as 1:100 000, **Absolute scale:** (1cm=1000m), and **Bar scale:** for example .
2. Rivers and streams transport their load of sediments in three ways: **dissolved, suspended and bed loads.**
3. Stages of river development are: **youth; maturity and old** stages.
4. The formation, or layer, of permeable rock is called an **aquifer**, whereas a layer of impermeable rock is an **aquiclude**.

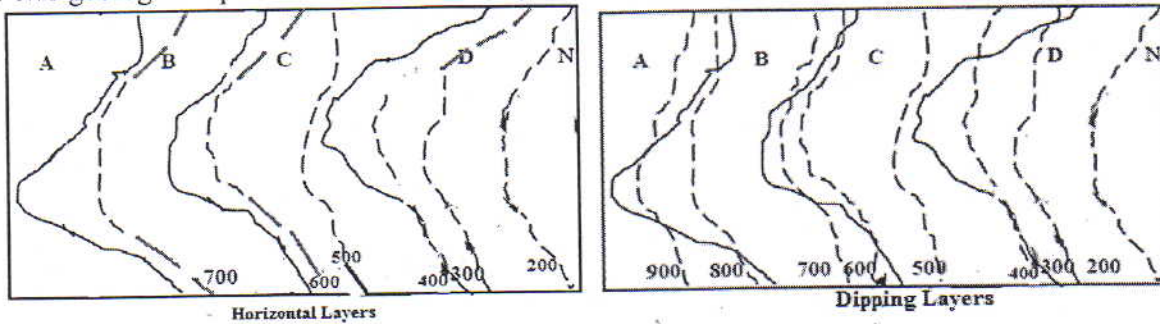
B. Choose the correct answer: (10 Mark)

1. For most rocks, Poisson's ratio values are ranging between: a) 0.0-0.5 b) 0.0-0.4 c) 0.1-0.5 **d) 0.2-0.3**
2. Porosity is: a) the percentage of a rock's volume that is voids b) the capacity of a rock to transmit a fluid c) the ability of a sediment to retard water **d) none of the preceding**
3. Which rock type would make the best aquifer? a) shale b) mudstone **c) sandstone** d) all of the preceding
4. The broad strip of land built up by sedimentation on either side of a stream channel is: **a) flood plain** b) delta c) an alluvial fan d) a meander
5. The subsurface zone in which all rock openings are filled with water is called the: **a) saturated zone** b) water table c) unsaturated zone d) aquiclude

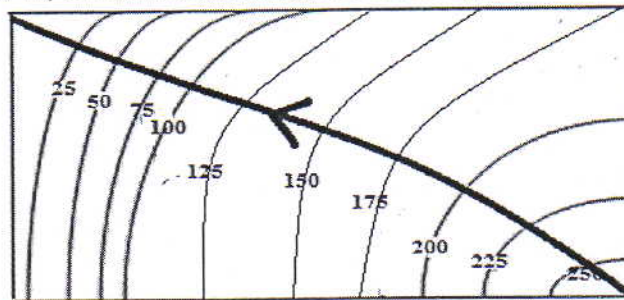
Q3. A. Draw two geologic maps: one for horizontal layers and the second for dipping layers.

For a topographic map, it is required to construct a contour map with closely spaced lines in the West and widely spaced lines in the East with decreasing values toward the West. The map must show a river flowing in the area. Knowing that contour interval **25 m**; the minimum and maximum heights are **25 m** and **250 m** respectively. (13 Marks)

Draw two geologic maps: one for horizontal layers and the second for dipping layers.



For a topographic map, it is required to construct a contour map with closely spaced lines in the West and widely spaced lines in the East with decreasing values toward the West. The map must show a river flowing in the area. Knowing that contour interval 25 m; the minimum and maximum heights are 25 m and 250 m respectively.



B. Define the followings items with sketches if present: (12 Marks)

1. Old stage of a river characteristics

This stage is usually occurred near estuaries with decreasing erosion and increasing deposition. The river valley is wide with low gradient and the main channel dividing into several smaller ones. This stage is characterized by the

followings:

1- very wide valleys with flat floors ; 2- the presence of food plains and river deposits ; 3- the complete absence of rapids and waterfalls ; 4- decrease in gradients and erosion with an increase in deposition ; 5- the appearance of several smaller branches (distributaries) and formation of delta.

2. Unconfined (uniaxial) compressive strength

Unconfined (Uniaxial) Compressive Strength It is one type of compressive strength. It is the stresses that are resulted from compressive forces causing contraction in the volume of rocks.

It is the most frequently used strength test for rocks in which a load on the rock acts in one direction only. There is no loading along an axis perpendicular to the loading axis. Rocks under compressive stresses fail in tension or shear depending on several factors such as moisture content and the associated swelling and many other factors.

The compressive strength q_u is expressed as the ratio of peak load F , causing failure, to initial cross-sectional area A :

$$\sigma = q_u = F / A = N / m^2$$

2. Define water table. What are the main characteristics of water table?

It is the upper surface of groundwater is often referred to (not in strict usage of the term) as the *water table* (Fig.). The saturated zone persists downwards until the compaction of the rock under the pressure of overburden reduces porosity to zero. This depth varies with local geological conditions and seasonal changes.

1. The water table is shaped like a subdued replica of the topography above it.

2. It is not static, as groundwater in a permeable rock is continually in motion. Highs in the water become flatter, and gradients are reduced, at a rate controlled mainly by the permeability of the rock.

3. Definition of the water table and of its variation seasonally and over longer periods is important for groundwater supply and other practical purposes.
4. It can be located and monitored by wells, and less accurately by *geophysical surveys* (such as electrical resistivity and seismic refraction techniques).
5. Natural discharge of groundwater takes place where the ground surface intersects the water table. If the flow from the hydrologic unit is spread diffusely over an area of marshy ground, it is usually referred to as *seepage*. If it is concentrated, say by a fissure acting as a channel, it is called a *spring*.

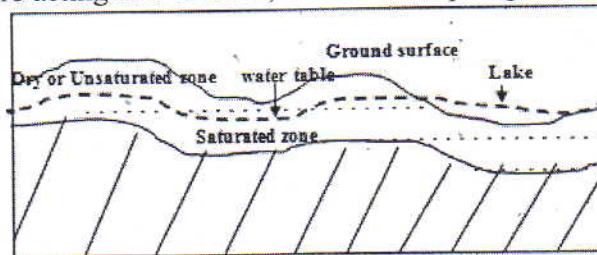


Fig. Groundwater table and its relation to topography.

Q4. A. If the discharge of a river is $490 \text{ m}^3/\text{s}$, this channel is subdivided into two channels. The 1st channel with discharge $163 \text{ m}^3/\text{s}$ and the 2nd channel with width 18.2 m and its velocity is 3.1 m/s . Find the depth in the 2nd branch. Find the volume of water passing through each branch in 2 hrs. (13 Marks)

Solution:

$$Q = Q_1 + Q_2$$

$$Q = Q_1 + (w.d)V_2$$

$$490 \text{ m}^3/\text{s} = 163 \text{ m}^3/\text{s} + (18.2 \text{ d}) \times 3.1$$

$$490 = 163 + 56.42d$$

$$490 - 163 = (18.2 \text{ d}) \times 3.1$$

$$327 = 56.42 d$$

$$d = 5.796 \text{ m} \cong 5.8 \text{ m}$$

$$Q_1 = \frac{V_1}{T}$$

$$V_1 = Q_1 \cdot T = 163 \text{ m}^3/\text{s} \times 2 \times 3600 \text{ s} = 1173600 \text{ m}^3$$

$$Q_2 = Q - Q_1 = 490 - 163 = 327 \text{ m}^3/\text{s}$$

$$\text{or } Q_2 = AV = (18.2 \times 5.8) \times 3.1 = 327 \text{ m}^3/\text{s}$$

$$V_2 = Q_2 \cdot T = 327 \text{ m}^3/\text{s} \times 2 \times 3600 \text{ s} = 2354400 \text{ m}^3$$

B. Answer the following items: (12 Mark)

1. For water movement in rivers, prove that the friction per unit area: $F_A = \rho S (A/P)$

The *driving force* of a river equals water mass (M) times the gradient (S), where the water mass M is the product of the multiplication of the river cross-sectional area (A), length of the river (L) and water density (ρ). Thus:

$$M = AL\rho$$

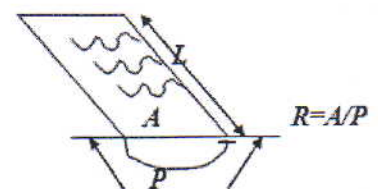
$$\text{The driving force} = AL\rho S$$

The other force which acts as the opposite force to the driving force is the *total friction force* which is equal to the friction per unit area (F_A) times the area of the river bottom. The later is equal wetted perimeter (P) times the length of the river, $F_A PL$. The two forces become equal when the flow is at a constant velocity then:

$$AL\rho S = F_A PL$$

Thus the friction per unit area is:

$$F_A = \rho S (A/P)$$



A cross-section for a river.

2. List the main physical properties of rocks affecting design and construction in rocks.

The main physical properties of rocks affecting design and construction in rocks are:

- 1- Bulk density
- 2- Unit weight
- 3- Specific gravity
- 4- Porosity and void ratio
- 5- Dry and saturated unit weight
- 6- Moisture content
- 7- Degree of saturation

Depending upon type of loading and stresses, rocks may be classified into: 1- Compressive strength 2- Tensile strength 3- Shear strength

3. List the classification of rocks according to their ground water studies with examples. Then list the main factors controlling the porosity of sedimentary rocks and soil.

Rocks are classified according to their ground water studies as follows:

1. Porous and permeable rocks: They are called *aquifers*, such as sands.
- 2- Non Porous and pervious: They are called *aquifer pervious*, such as limestones.
- 3- Porous and Impermeable rocks: They are called *aquicludes*, such as clays.
- 4- Non porous and non- pervious: Such as quartzites and porcellaneous limestones.

The main factors controlling the porosity of sedimentary rocks and soil are:

1. the grain size variation, 2. the shape of the grains, 3. the packing of the grain and 4. the degree of cementation.

Q5. A. Dry weight of rock sample = 20N, and the volume of solid part = 23 cm³, If the saturated weight with oil = 24 N. Find the moisture content and porosity of the sample, if you know the oil density = 0.8 N/cm³. (10 Marks)

Solution:

weight of oil = 24N - 20N = 4 N weight of oil

Volume of oil = $M/\rho = 4N / (0.8 N/cm^3) = 5 cm^3 = V_v$ because it is saturated

Total Volume = $V_v + V_s = 5 + 23 = 28 cm^3$

$n = V_v / V$

$n = 5/28 \% = 17.8 \%$

$W_c = W_w / W_s = 4N / 20N = 0.2 = 20\%$

B. Find the porosity of aquifer rock if its retained porosity is 23.3% and the true velocity is 3.4 times its Darcys' velocity. (6 Marks)

Solution:

$$v_D = V n_y$$

$$v_D = 3.4 v_D \cdot n_y$$

$$n_y = \frac{1}{3.4} = 0.294 = 29.4\%$$

$$n = n_r + n_y = 23.3 + 29.4 = 52.7\%$$

or

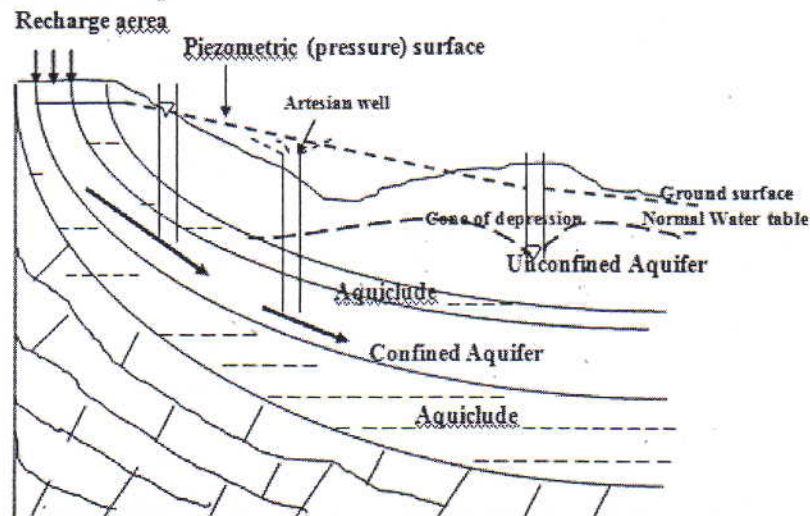
$$v_D = V n_y ; n_y = \frac{v_D}{v}$$

$$n = n_r + n_y = n_r + \frac{v_D}{v} = 0.233 + \frac{v_D}{3.14 v_D} = 0.233 + \frac{1}{3.14} = 0.233 + 0.294$$

$$n = 0.527 = 52.7\%$$

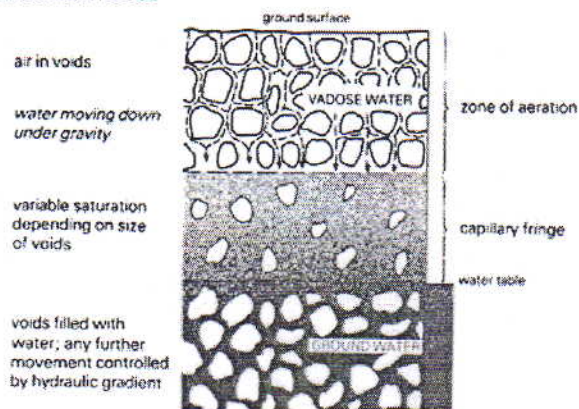
C. Give sketches ONLY for the following items: (9 Marks)

1. Confined and unconfined aquifers.

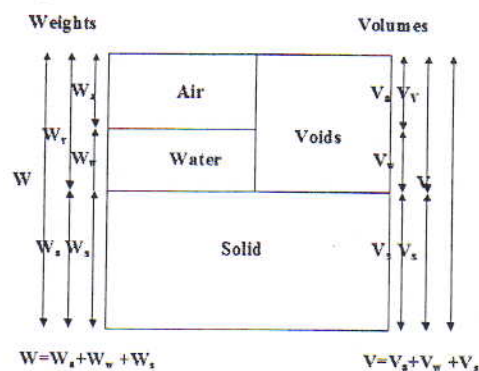


Unconfined and confined aquifers.

2. Vertical distribution of Groundwater



3. State by sketch the phase relationship between rock constituents.



Best Wishes....