University of Technology
Building and Construction Eng. Dept.
Final Exam – First Attempt – 2013/2014

Subject :Engineering Geology | Class: First Year
Branch: All Engineering Branches | Time : 3 hours
Examiner: Engineering Geology Committee | Date: 27 / 05 / 2014

Answer FOUR Questions

Q1. Answer the following items as required (Note: For True or False, correct the false) (25%)

1. ---------- science deals with the study of the physical properties of soil and the behavior of soil masses subjected to various types of forces.**(Fill)**
2. The hot molten mineral matter below the surface of the earth known as ----------**(Fill)**
3. Erosion is called when rock or its products are removed. **(T or F).**
4. Rocks used for facing stones should have a high tensile strength in order to resist cracking. **(T or F).**
5. Unconformities record a period of deposition. **(T or F).**
6. Kaolinite group consists of layers with ratio of silicate: gibbsite as 2:1. **(T or F).**
7. Sedimentary rocks represent about 5% of earth surface and about 75% of earth crust volume. **(T or F).**
8. Horst and graben are central blocks bounded by normal faults**. (T or F).**
9. Bench marks are land locations which indicate specific elevations and are shown on topographic maps. **(T or F).**
10. In geologic map, the geologic boundaries intersect the contours for horizontal beds but are parallel for inclined beds. **(T or F).**

Q2. Choose the correct answer for the following items: (25%)

1. The component refers to the vertical displacement of fault plane is:
   a) Heave b) Throw c) Slip d) Fault plane
2. Sills and dykes are structures belong to:
   a) Sedimentary rocks b) Minerals c) Igneous rocks d) Metamorphic rocks
3. Any horizontal line on the rock plane along which all points are at equal elevation: a) Contour line b) True dip c) Strike line d) Apparent dip
4. We refer to the separating surface between solid earth interior envelopes as:
   a) Boundary b) Discontinuity c) Bedding d) Stratification.
5. Which of the following words is associated with the formation of limestone?
   a) Deposition b) Lithification c) Compaction d) Cementation e) Crystallization
6. The single most characteristic feature of sedimentary rocks is:
   a) Presence of fossils b) Porous c) Presence of bedding planes d) Containing cavities
7. Metamorphic rocks with a planar texture (the constituents of the rock are parallel to one another) are said to be: a) Concordant b) Foliated c) Discordant d) Non-foliated
8. Windborne deposits (soils) are called:
   a) Alluvium b) colluviums c) Aeolian d) Glacial
9. -------are folds with horizontal axial planes.
   a) Recumbent b) Symmetrical c) Inclined d) Asymmetrical

10. One of the following rock is not sedimentary rocks:
a) Shale b) Marble c) Sandstone d) Limestone

Q3. A. A sample of saturated rock has a mass of 126 kg, when oven-dried its mass became 109.57 kg. The mass of water 16.43 kg. The following data were obtained from laboratory tests on the sample: volume of solid grain $V_s = 0.04058\ m^3$, wet density $\rho_{sat} = 2.1 g/cm^3$, $G_s = 2.7$, water content W_c=15%. Determine (i) dry density, ρ_{dry},(ii) porosity, (iii) void ratio, and (iv) degree of saturation. **(16%)**

B. Answer the following items with drawings if available: (9%)

1. Show the effect of both weathering (physical and chemical) on the following minerals from high resistant to low resistant: 1. Feldspar 2. Silicates 3. Ferromagnesian minerals

2. List 3 construction uses for each of the following: **1.** Clays **2.** Rock aggregates

3. What are the main components of a fold?

Q4. A. Answer the following items: (10%)

1. Show what each of the following statements indicates?
i. The closely spaced contour lines. **ii.** The widely spaced contour lines.

2. Draw a topographic map which shows a hill between two valleys with steeply side in the west and gently side in the east. Knowing that the minimum and maximum elevations are 5m and 40m respectively. (Use contour interval 5m).

B. Answer the following items with drawings: (15%)

1. Define the term unconformity. What conditions favor for its formation. List 2 types with sketches.

2. Compare with sketches between normal and reverse faults with respect to:
i. Displacement; **ii.** Layers repetition or omission and; **iii.** Type of force produces each.

3. Show by sketch the effect of grade of metamorphism on foliated metamorphic rocks.

Q5. A. A block of shale rock has edge lengths 45.0 cm, 37.2 cm and 12.8 cm. The rock consists of 34.1% chlorite and 65.9 % pyrite, and has a porosity of 38.8 % knowing that the density of the chlorite is 2.8 gm/cm^3 and for pyrite is 5.05 gm/cm^3. Find: 1. Its volume of pores 2.The bulk density of the rock. **(9%)**

B. Give a list only for the following items: (16%)

1. Solid Earth envelopes with its discontinuities.

2. Characteristics of residual soil.

3. Igneous textures and sedimentary structures.

4. Crystallographic systems of crystal forms showing their relative lengths and the angles between them.

….. BEST WISHES…..

Useful Relations

$\gamma_{dry} = G\gamma_w(1-n)$; $\gamma_{dry} = \gamma_{wet}/(1+W_c)$; $\gamma_{dry} = G\gamma_w/(1+e)$; $\gamma_{sat} = (G+e)\gamma_w/(1+e)$;

$\gamma_{sat} = \gamma_{dry} + n.\gamma_L$; $n = \frac{W_c . G}{1+W_c . G}$; $n = V_v/V$; $e = n/(n-1)$; $\rho_g = \rho/(1-n)$

$W_c = \frac{W_w}{W_s}$; $S = \frac{V_w}{V_v}$

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Answer FOUR Questions Only

Typical Answers for Final Exam in Engineering Geology 1st Attempt 2013-2014

Q1. Answer the following items as required (Note: For true or False, correct the false) (25%)

1. **Soil Mechanics** science deals with the study of the physical properties of soil and the behavior of soil masses subjected to various types of forces.**(Fill)**
2. The hot molten mineral matter below the surface of the earth known as **Magma. (Fill)**
3. Erosion is called when rock or its products are removed. **(T or F correct the false): True**
4. Rocks used for facing stones should have a high tensile strength in order to resist cracking. **(T or F, correct the false): True**
5. Unconformities record a period of deposition. **(T or F correct the false): F: Period of erosion**
6. Kaolinite group consists of layers with ratio of silicate: gibbsite as 2:1. **(T or F, correct the false): False , Kaolinite 1:1, or Montmorillonite 2:1**
7. Sedimentary rocks represent about 25% of earth surface and 95% of earth crust volume. **(T or F, correct the false): F, about 75% of earth surface and about 5% of earth crust volume.**
8. Horst and Graben are central blocks bounded by normal faults. **(T or F), True**
9. Bench marks are land locations which indicate specific elevations and are shown on topographic maps. **(T or F), True**
10. In geologic map, the geologic boundaries intersect the contours for the horizontal beds but are parallel for inclined beds. **(T or F). False, the reverse is true. Intersect contours for dipping; parallel for horizontal beds**

Q2. Choose the correct answer for the following items:

1. The component refers to the vertical displacement of fault plane is: **(Choose)**

1. Heave **b) Throw** c) Slip d) Fault plane
2. Sills and dykes are structures belong to: a) Sedimentary rocks b) Minerals **c) Igneous rocks** d) Metamorphic rocks
3. Any horizontal line on the rock plane along which all points are at equal elevation:

a) Contour line b) True dip **c) Strike line** d) Apparent dip

4. We refer to the separating surface between **solid** earth interior envelopes as:
a) Boundary **b) Discontinuity** **c) Bedding** **d) Stratification**

5. Which of the following words is associated with the formation of limestone?
a) Deposition b) Lithification c) Compaction d) Cementation
e) Crystallization

6. The single most characteristic feature of sedimentary rocks is:
a) Presence of fossils b) Porous **c) Presence of bedding planes** d) Containing cavities

7. Metamorphic rocks with a planar texture (the constituents of the rock are parallel to one another) are said to be:
a) concordant **b) foliated** c) discordant d) nonfoliated

8. Windborne deposits (soils) are called:
a) Alluvium b) colluviums **c) Aeolian** d) Glacial

9. -------are folds with horizontal axial planes.
a) **Recumbent** b) Symmetrical c) inclined d) Asymmetrical

10. One of the following rock is not sedimentary rocks: a- Shale **b- marble**
c- sandstone d- limestone

Q3. A. A sample of saturated rock has a mass of 126 kg, when oven-dried its mass became 109.57 kgm. The mass of water 16.43 kg. The following data were obtained from laboratory tests on the sample: volume of solid grain V_s = 0.04058 m^3, wet density ρ_{sat} = 2.1g/cm^3, G_s = 2.7, water content W_c=15%. Determine (i) dry density, ρ_{dry}, (ii) porosity, (iii) void ratio, and (iv) degree of saturation. **(16%)**

Solution:

Mass of sample M = 126 kg.

$$V = \frac{M}{\rho_{sat}} = \frac{126}{2.1 \times 10^3} = 0.06\ m^3$$

$$V_v = V - V_s = 0.06 - 0.04058 = 0.01942\ m^3$$

$$V_w = \frac{M_w}{\rho_w} = \frac{16.43}{1000} = 0.001643\ m^3$$

(i) *Dry density*

$$\rho_{dry} = \frac{M}{V} = \frac{109.57}{0.06} = 1826.2\ \text{kg/m}^3$$

(ii) *Porosity*

$$n = \frac{V_v}{V} = \frac{0.01942}{0.06} \times 100 = 32.37\%$$

(iii) Void ratio

$$e = \frac{V_v}{V_s} = \frac{0.01942}{0.04058} = 0.4786$$

(iv) *Degree of saturation*

$$S = \frac{V_w}{V_v} = \frac{0.001643}{0.01942} \times 100 = 84.6\%$$

B. Answer the following items with drawings if available: (9%)

1. Show the effect of both weathering (physical and chemical) on the following minerals from high resistant to low resistant: 1. Feldspar 2. Silicates 3. Ferromagnesian minerals.

1. Silicate minerals are highly resistant to both physical and chemical weathering. 2. Feldspar minerals are less. 3. Ferromagnesian minerals are the least resistant to weathering.

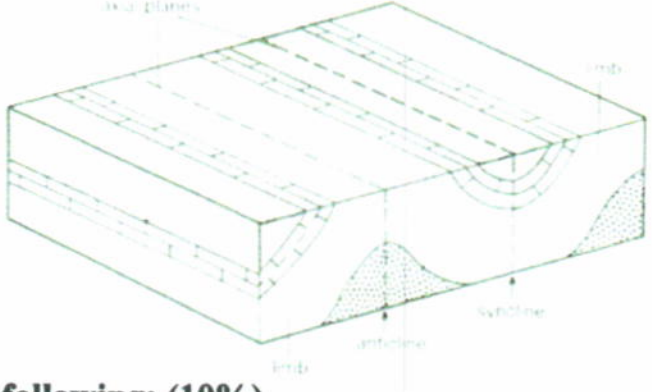
2. List 3 construction uses for 1. Clays 2. Rock aggregates

1. clays: Brick Making, Kaolin is used in the manufacture of white earthenware and stoneware, white Portland cement and for special refractories.

2. Rock aggregates: Concrete Aggregate, Road Aggregate, Railway ballast

3. What are the main components of a fold.

The main components of a fold are: Anticline, syncline, Amplitude, Wavelength, Crest, Trough, Axis and axial plane, limb, hinge.



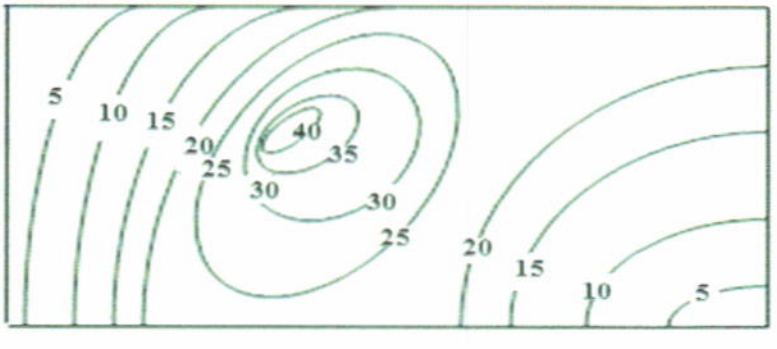
Q4. A. answer the following: (10%)

1. Show what each of the following statements indicates?

i. The closely spaced contour lines:
Closely spaced contour lines represent steep slopes.

ii. The widely spaced contour lines:
Contours spaced far apart represent gentle slopes.

2. Draw a topographic map which shows a hill between two valleys with steeply side in the west and gently side in the east. Knowing that the minimum and maximum elevations are 5m and 40m respectively. (Use contour interval 5m).



B. Answer the following items with drawings: **(15%)**

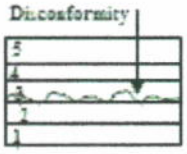
1. Define the term unconformity. What conditions favor for its formation. List 2 types with sketches.

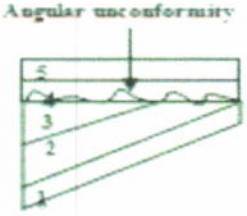
Unconformities: For a particular span of time, when rock layers do not have a complete sequence of rocks representing the entire period, such breaks in the rocks record are termed.

The conditions are: 1. Stopping in deposition and 2. Presence of erosion agents.

There are two main types of unconformities:

a- Disconformity b- Angular Unconformity

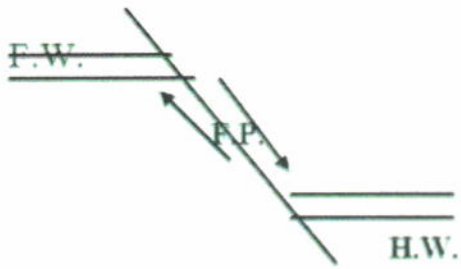




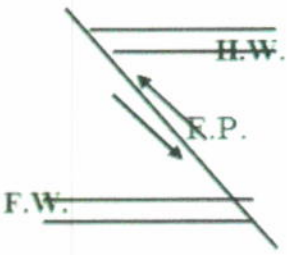
2. Compare with sketches between normal and reverse faults with respect to: displacement; layers repetition or omission; and type of force produces each.

Normal fault (or Dip-slip fault): They are resulted from the tensional stresses and created when the hanging wall moves down relative to the foot wall. If its dip is towards the lowered side (that is, the ***downthrown side***), the fault is ***normal*** in which the hanging wall moves down relative to the foot wall. There is Omission of layers.

Reverse fault: They are resulted from the compressional stresses and created when the hanging wall moves up relative to the foot wall. If the dip is towards the ***upthrown side***, the fault is ***reverse***. When reverse faults having a very low angle (about 30°) to the horizontal are also referred to as ***thrust fault***. There is Repetition in layers.

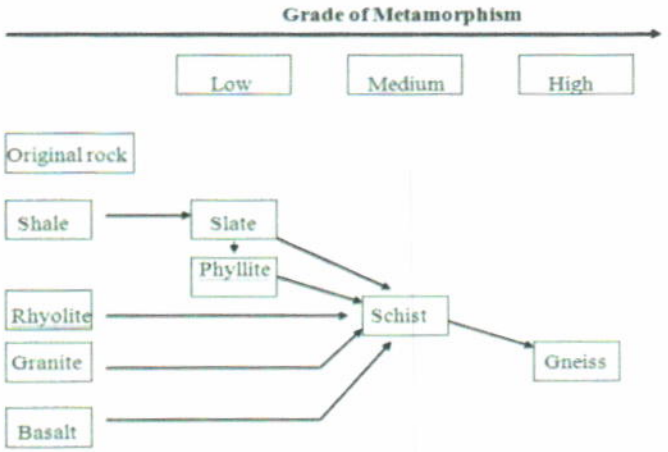


Normal fault



Reverse Fault

3. Show by sketch the effect of grade of metamorphism on foliated metamorphic rocks.



Q5. A. A block of shale rock has edge lengths 45.0 cm, 37.2 cm and 12.8 cm. The rock consists of 34.1% chlorite and 65.9 % pyrite, and has a porosity of 38.8 % knowing that the density of the chlorite is 2.8 gm/cm^3 and for pyrite is 5.05 gm/cm^3. Find: 1. Its volume of pores 2.The bulk density of the rock. **(9%)**

Solution:

1) $V = 45 \times 37.2 \times 128 = 21427.2\ cm^3$

$n = Vv / V$

$0.388 = Vv / 21427.2$

$Vv = 8313.75\ cm^3$

2) $\rho_g = c_1 \rho_1 + c_2 \rho_2 = (0.341)(2.80\ gm/cm^3) + (0.659)(5.05\ gm/cm^3)$

$\rho_g = 4.283\ gm/cm^3$

$\rho_g = \rho / 1 - n$

$\rho = \rho_g\ (1\text{-}n)$

$\rho = (4.283\ gm/cm^3)(1 - 0.388)$

$\rho = 2.62\ gm/cm^3$

B. Give a list only for the following items: (16%)

1. Solid Earth envelopes with its discontinuities.

1. Earth Crust
   - Continental Crust
     - Conrad Discontinuity
   - Oceanic Crust
     - Moho Discontinuity
2. Earth Mantle
   - Upper Mantle
   - Transition
   - Lower Mantle
     - Gutenberg Discontinuity
3. Earth Core: Outer Core (liquid) ; Inner Core (solid)

2. Characteristics of residual soil.

1. The mineralogical composition is closely related to the original bed rock beneath soil.
2. The soil grains are irregular, sharp and lack roundness.
3. The soil contains fragments of the original rock.
4. The soil thickness depends upon the depth of weathering, climatic conditions, nature of rocks, topography and time.
5. The presence of complete soil profile.

3. Igneous textures and sedimentary structures

Igneous Textures: 1. Fine- grained (Aphanitic) 2. Medium- grained 3. Coarse-grained (Phaneritic) 4. Porphyritic 5. Granular 6. Vesicular 7. Glassy

Sedimentary structures: 1. Stratification or Bedding Planes 2.Mud Cracks 3. Ripple Marks 4.Cross Bedding (Current Bedding) 5. Graded bedding

4. Crystallographic systems of crystal forms showing their relative lengths and the angles between them.

1. Cubic (or Isometric) System: $a_1=a_2=a_3$; $a_1 \perp a_2 \perp a_3$
2. Tetragonal System: $a=b \neq c$; $a \perp b \perp c$
3. Hexagonal System: $a_1= a_2= a_3 \neq c$; $a_1, a_2, a_3 \perp c$
4. Trigonal System: $a_1= a_2 =a_3 \neq c$; $a_1, a_2, a_3 \perp c$
5. Orthorhombic System: $a \neq b \neq c$; $a \perp b \perp c$
6. Monoclinic System: $a \neq b \neq c$; $c \perp b$
7. Triclinic System: $a \neq b \neq c$; Non perpendicular