Building and Construction Engineering Department university of Technology
Typical Answer for Engineering Geology 1St Attempt
1st Year 2012-2013

Q1 A- Fill the blanks with the suitable word (s). (12.5%)

1. **Crystallization** is the process by which igneous rocks originate from magma.
2. All the crystallographic systems consist three axes except **hexagonal (trigonal)**.
3. **Structural geology** is the science that deals with the distribution and deformation of rocks.
4. Many **metamorphic rocks**, because of their cleavage and schistosity, are suitable as facing stones.
5. **Throw** refers to the vertical displacement of fault plane.

B. State whether each of the following statements is TRUE or FALSE and correct the FALSE one. (12.5%)

1. We call each group of sedimentary rocks deposited in the same geologic time as a layer.
F, as a formation
2. Sial layer is made up of dense, dark colored materials rich in silica and alumina. **F, Sima**
3. At high grade metamorphism, all rocks are transformed to gneiss. **T**
4. Seismic velocities increases with decreasing depth from earth surface. **F, increasing**
5. Igneous rocks are rarely used for roadstone. **F, commonly**

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

1. Marble is a metamorphic rock derived from :
   a- Shale b- Sandstone c- Limestone d- Claystone
2. One of the following is NOT related to continental crust:
   a- Sial   b- Granitic   **c- Basic**   d- Acidic.
3. Dolomite is similar in its composition to calcite but with the presence of:
   a- Sodium **b- Magnesium** c- Potassium d- Calcium
4. We call a structure in which sediments containing a grain sizes sorted vertically from coarse at the bottom to fine at the top is : **a- Graded bedding** b- Ripple marks c- bedding planes d- Cross bedding
5. What is the approximate radius of the earth in km?
   a- **6,400**   b- 40,000   c- 25,000   d- 12,800
6. The rock mass below the fault plane is called:
   a) Heave   b) Hanging wall   c) Throw   **d) Foot wall**
7. The color of the powder of a mineral is called:
   a) Lustre   **b)Streak**   c) Color   d) Cleavage
8. The science related to soil mechanics is: a- Engineering geology
   b- Geotechnical engineering   c- Stratigraphy   d- Physical geology.
9. The soil in which the grains are very sharp and lack roundness:
   a) Transported soil   b) Aeolian soil   **c) residual soil**   d) Glacial soil   e) Aqueous soil
10. Which of the following groups of elements is most abundant in the earth's crust?
    a- Iron, oxygen, sodium.   b- Oxygen, silicon, hydrogen   **c- Aluminum, silicon, oxygen.**

Q3 A. Answer the following items with drawings: (12%)

1. Classify folds according to their axis(Give 5types).

   1- Symmetrical fold 2- Asymmetrical fold 3- Overturned (or Overfolded) fold 4- Recumbent fold 5- Isoclinal fold 6- Plunging Fold 7- Dome and Basin
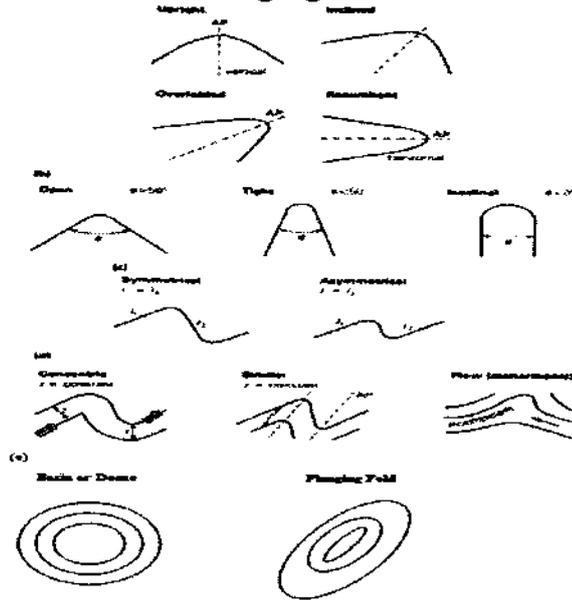
**2. What make clay minerals important? Structurally, what are their two basic units. List with sketches their different types.**

Clay minerals are important rock forming minerals since they constitute shales and make up a large percentage of the soil. Because of the importance of soil in agriculture and as a supporting material for buildings, clay minerals are extremely important to for geologists and civil engineers. Structurally, their two basic units are: 1) silica tetrahedron and 2) Alummina octahedron (Gibbsite) unit.Types: 1) Kaolinite Group: Its structure 1silica:1 gibbsite 2) Montmorillonite Group: Its structure 2:1. 3) Illite Group: Its structure 2:1

3. Define outcrop, strike and dip. Then give a sketch for a geologic layer showing its outcrop, strike and apparent and true dip.

<u>Outcrop:</u> The exposed portion of the rock layers on the earth surface Which could be horizontal, inclined and vertical strata. **Strike** of a bed is the direction of its continuity on the surface. It is an imaginary horizontal line connects points of equal elevations. It is also expressed as the direction of a line of intersection which the layer makes with the horizontal plane. **Dip** of a bed is the angle which the bed makes with the horizontal plane. It is measured in the direction at right angles to the strike.

Outcrop

2
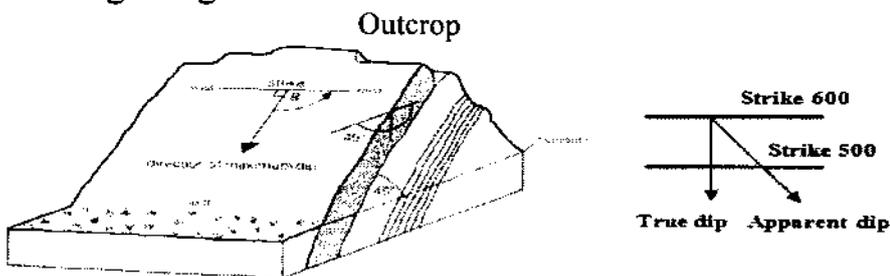
B. What do the following statements mean: **(13%)**
i. The closely spaced contour lines: Closely spaced contour lines represent steep slopes.
ii. The widely spaced contour lines: Contours spaced far a part represent gentle slopes.
Draw a topographic map which shows a valley between two hills with steeply side in the west and gently side in the east. Knowing that the minimum and maximum elevations are 10 and 80 m respectively. (Use contour interval 10 m.).
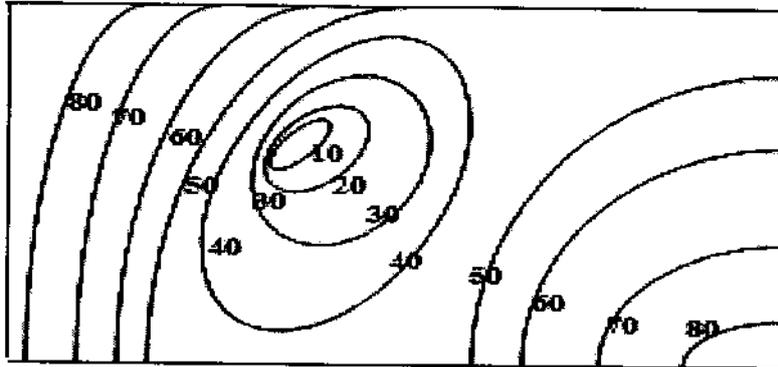
Q4 A. A 0.885 m^3 block of sandstone has a weight of 17.5 kN. When the bock is crushed just sufficiently to close all the pores , which are empty, the volume of the rock becomes 0.584 m^3. Find: (a) the porosity of the sandstone and (b) the density of the grains. (Assume that the density of the grains is not changed in the crushing process). **(13%)**

Answer
(a) $V = Vpores + Vgrains$
0.885 m $^3 = Vpores + 0.584$ m ^{3}
$Vpores = 0.301$ m ^{3}
$n = Vv / V = (0.301$ m $^3) / (0.885$ m $^3)$; $n = 0.340$ (34%)
$W_{grain} = g * M_{grain}$
$17500 N = 10 * M_{grain}$
$M_{grain} = 1750 kg$
$\rho g = Mgrain / Vgrain$; $\rho g = (1750$ kg$) / (0.584$ m $^3) = 3996.6$ kg $/$ m $^3 = 3.00$ gm/cm ^{3}

B. Give a list ONLY for the following items: **(12%)**
    1. 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. Sedimentary structures.
1. Stratification or Bedding Planes
2. Mud Cracks
3. Ripple Marks
4. Cross Bedding (Current Bedding)
5. Graded bedding

3. Physical properties for minerals identification.
1- Color ; 2- Streak ; 3- Lustre; 4- Cleavage ; 5- Hardness; 6- Transparency
7- Specific Gravity; 8- Other Properties:*Taste, feel, optical properties* and *magnetic properties, Reaction with acids.*

2. What are the main factors affecting building rocks?
1. The volume of material that can be quarried
2. The ease with which it can be quarried:
3. The wastage due to quarrying
4. The cost of transportatio
5. Appearance:
6. Physical Properties: Texture and porosity, Strength, Durability

Q5 A. A sandstone rock has a volume in its natural state of 0.0093 m^3 and weighs 177.6 N. The oven-dried weight of this rock is 153.63 N. If the specific gravity is 2.67. Calculate: 1. Moisture content (%)   2. Moist and dry unit weights 3.Void ratio and porosity   4. Degree of saturation   **(16%)**

Solution

1) $W = (W_{sat} - W_{dry}) / W_s = (177.6 \text{ N} - 153.63 \text{ N}) / 153.63 \text{ N} = 0.156 = (15.6\%)$

2) $\gamma_{wet} = \frac{W}{V} = \frac{177.6 \text{ N}}{0.0093 m^3} = 19096.77 \text{ N}/m^3 = 19.1 \text{ kN}/m^3$

$\gamma_{dry} = \frac{\gamma_{wet}}{1+W_c} = \frac{19.1 \text{ N}}{1+0.156} = 16.52 \text{ kN}/m^3$

3) $e = \frac{V_v}{V_s}$;

$V_s = \frac{W}{\gamma_s} = \frac{W}{G.\gamma_w} = \frac{0.15363 \text{ kN}}{2.67 \times 10 \text{ kN}/m^3} = 0.00575 \ m^3$

$V_v = V - V_s = 0.0093 - 0.00575 = 0.00355 \ m^3$

$e = \frac{V_v}{V_s} = \frac{0.00355 m^3}{0.00575 m^3} = 0.62$

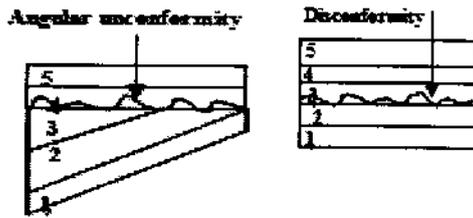$n = \frac{e}{1+e} = \frac{0.62}{1+0.62} = 0.3827 = 38.3\%$

4) $S = \frac{V_w}{V_v}$

$V_w = \frac{W_w}{\gamma_{wv}} = \frac{W_{wet} - W_{dry}}{\gamma_w} = \frac{177.6 \text{N} - 153.63 \text{ N}}{10000 \text{ N}/m^3} = \frac{23.97}{10000} = 0.002397 \ m^3$

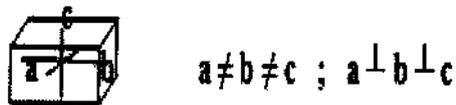$S = \frac{V_w}{V_v} = \frac{0.0024 \text{ N}}{0.00355 \text{ N}} = 0.675 = 68 \%$

B. Give sketches ONLY for the following items: (9%)

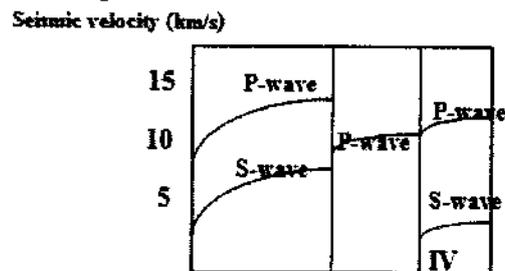### 1. Unconformity

2. Orthorhombic crystallographic system

$$a \neq b \neq c \; ; \; a \perp b \perp c$$

3. Variation of velocity with depth.

4. A geologic map for dipping layers.