



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012**

COURSE NAME : ENGINEERING GEOLOGY
COURSE CODE : BFC 21303/BFC 3013
PROGRAMME : 2 BFF/3 BFF
EXAMINATION DATE : JUNE 2012
DURATION : 3 HOURS
INSTRUCTION : ANSWER ANY **THREE (3)**
QUESTIONS IN **PART A** AND
QUESTION **Q5** IN **PART B**

THIS QUESTION PAPER CONSISTS OF **THIRTEEN (13)** PAGES

PART A

- Q1** (a) List **THREE (3)** compositional layers of earth. (3 marks)
- (b) Illustrate with an appropriate diagram the compositional layers and mechanical layers of earth. (5 marks)
- (c) Define the term “tectonic plate”. (2 marks)
- (d) Explain **THREE (3)** types of plate boundaries with the aid of suitable diagrams (6 marks)
- (e) Describe briefly what types of minerals that react with acid test. (2 marks)
- (f) Explain the use of Moh’s hardness scale in geology. (5 marks)
- (g) Differentiate silicate and non-silicate minerals. (2 marks)
- Q2** (a) Discuss the rock cycle and associated processes. (9 marks)
- (b) Describe the following classifications in igneous rocks based on the silica content (SiO_2):
- (i) Acid
 - (ii) Intermediate
 - (iii) Basic
 - (iv) Ultrabasic
- (4 marks)

- (c) Evaluate the relationship between silica content, minerals and weathering rate. (4 marks)
- (d) Explain **FOUR (4)** major processes involved in making sedimentary clastic sedimentary rocks. (4 marks)
- (e) The chemical sedimentary rocks are named on the basis of its chemical contents.
- (i) Define '*chemical sedimentary rocks*'.
- (ii) Discuss the classification of the chemical sedimentary rocks with relevant examples. (4 marks)

- Q3** (a) Describe **THREE (3)** types of metamorphic textures and give relevant examples. (3 marks)
- (b) Based on answer **Q3(a)**, explain how metamorphic textures influence the rock's integrity and rock mass strength. (3 marks)
- (c) Erosion is one of the important agents of removal and transportation of surficial materials which are the product of physical and chemical breakdown of rocks by the process of weathering.
- (i) Compare and describe the textures and properties of residual soil and transported soil. (3 marks)
- (ii) Describe **THREE (3)** different types of load carried by streams. (3 marks)

(iii) Explain **FOUR (4)** types of sediment that accumulate in continental environment with their important individual characteristics. (4 marks)

(d) Explain oxidation and hydrolysis in chemical weathering (3 marks)

(e) Differentiate between rock materials of weathering grade 1 and 6. (3 marks)

(f) Explain, with suitable illustrations the differences between:

- (i) Normal and lateral faults
- (ii) Joint and faults
- (iii) Strike and dip direction

(3 marks)

Q4 (a) Rock Mechanics and Soil Mechanics are branches of Geotechnical Engineering that look at the mechanical properties and behavior of rocks and soils respectively.

(i) Explain the difference in the definitions of rock and soil. (2 marks)

(ii) List **FOUR (4)** physical / mechanical properties that help differentiate rocks from soils and explain how they have become different. (4 marks)

(b) Explain, with suitable illustrations the differences between:

(i) Direct and indirect tests

(ii) UCS and JCS

(iii) Brazilian test and PUNDIT test

(4 marks)

- (c) The Young's modulus of Granite is very much larger (nearly 20 times) than that of Coal and the Poisson's ratio of Coal is nearly double that of Granite. Explain why this is so and also define the terms Young's Modulus and Poisson's ratio. (5 marks)
- (d) With the aid of related diagram, differentiate Rock Quality Designation (RQD) and Solid Core Recovery (SCR). (3 marks)
- (e) Ground investigations are necessary for engineering geologists to carry out in preparing their recommendations for construction work on civil engineering site.
- (i) Discuss **TWO (2)** limitations commonly associated with a borehole investigation. (2 marks)
- (ii) Explain, indicating any limitations, **ONE (1)** geophysical method that can be used to complement a bore hole investigation. (2 marks)
- (f) Discuss briefly the difference between resistivity and seismic refraction methods of ground investigation. (3 marks)

PART B

Q5 (a) A rock slope can fail due to different mechanism. Explain these mechanisms of failure. (4 marks)

(b) Investigations at a rock slope site gave the following information.

Height of rock slope	= 40m
Proposed Slope face angle	= 45°
Critical discontinuity angle	= 40°
Depth of tension cracks	= 2m
Unit weight of the rock	= 26 kN/m ³
Unit weight of water	= 9.81 kN/m ³
Cohesion of the discontinuity	= 20 kPa
Friction angle for the discontinuity	= 35°

Using the information given in Figure **Q5(b)** for a planar failure, examine the factor of safety:

(i) When the tension crack and the slope is dry, and (4 marks)

(ii) When the tension crack is completely filled with water. (3 marks)

(c) A rock cut slope has a dip direction 160° and dip angle of 60°. A discontinuity survey was conducted along the proposed cut slope and results for the discontinuity sets orientations are given in Table 1. A study of the joint sets showed that all joint surfaces had a friction angle of 35°.

Table 1

Joint set 1	Joint set 2	Joint set 3	Joint set 4	Joint set 5
175°/52°	240°/70°	145°/30°	320°/80°	350°/70°

(i) Analyze the entire failure mode for both proposed rock slope as well as the criterion as an evidence using Figure **Q5(c)**. (8 marks)

(ii) Recommend a new and suitable rock slope dip angle in order to avoid potential any rock slope failure. (3 marks)

(iii) Suggest the consequences of the above recommendation. (3 marks)

BAHAGIAN A

- S1** (a) Senaraikan **TIGA (3)** lapisan komposisi bumi. (3 markah)
- (b) Dengan gambarajah yang sesuai, lukiskan lapisan komposisi dan lapisan mekanikal planet bumi. (5 markah)
- (c) Berikan definisi terma tektonik keping. (2 markah)
- (d) Jelaskan **TIGA (3)** jenis *sempadan tektonik keping* dengan bantuan gambarajah yang sesuai. (6 markah)
- (e) Terangkan secara ringkas jenis mineral yang bertindak balas dengan asid. (2 markah)
- (f) Terangkan secara ringkas kegunaan skala kekerasan mineral Moh didalam geologi. (5 markah)
- (g) Terangkan perbezaan antara mineral silikat dan bukan silikat. (2 markah)
- S2** (a) Bincangkan kitaran batuan dan setiap proses yang terlibat. (9 markah)
- (b) Terangkan pengkelasan batuan igneus yang berikut berdasarkan kandungan silika.
- i) Asid
 - ii) Pertengahan
 - iii) Basik
 - iv) Ultrabasik
- (4 markah)

- (c) Berikan penilaian hubungan diantara kandungan silika, mineral dan kadar luluhawa.
(4 markah)
- (d) Jelaskan **EMPAT (4)** proses utama yang terlibat didalam pembentukan batuan sedimen klastik.
(4 markah)
- (e) Batuan sedimen kimia dinamakan berdasarkan kandungan kimia.
- (i) Definisi batuan sedimen kimia.
 - (ii) Bincangkan pengelasan batuan sedimen kimia dengan memberikan contoh batuan yang bersesuaian.
(4 markah)
- S3** (a) Terangkan **TIGA (3)** jenis tekstur batu metamorf dan berikan contoh yang bersesuaian.
(3 markah)
- (b) Berdasarkan soalan **S3(a)**, jelaskan bagaimana tekstur batuan metamorf mempengaruhi kekuatan sampel and jasad batuan.
(3 markah)
- (c) Hakisan merupakan agen utama dalam melemah dan mengangkut hasil luluhawa fizikal dan kimia.
- (i) Banding dan bincangkan tekstur dan kandungan luluhawa tanah baki dan tanah terangkut.
(3 markah)
 - (ii) Terangkan **TIGA (3)** jenis beban berlainan yang dibawa oleh arus sungai.
(3 markah)
 - (iii) Jelaskan **EMPAT (4)** jenis sedimen yang terkumpul di persekitaran daratan dan sifat-sifat utamanya.
(4 markah)

- (d) Jelaskan pengoksidaan dan hidrolisis didalam luluhawa kimia (3 markah)
- (e) Terangkan perbezaan antara bahan luluhawa gred 1 dan 6. (3 markah)
- (f) Jelaskan dengan ilustrasi yang sesuai perbezaan diantara:
- i) Sesar normal dan mendatar
 - ii) Kekar dan sesar
 - iii) Jurus dan Arah kemiringan
- (3 markah)
- S4** (a) Mekanik batuan dan mekanik tanah merupakan cabang kejuruteraan geoteknik yang mengkaji sifat-sifat mekanikal batuan dan tanah.
- i) Jelaskan perbezaan definasi antara batuan dan tanah. (2 markah)
- ii) Senaraikan **EMPAT (4)** sifat-sifat fizikal / mekanikal yang membantu membezakan batuan dan tanah dan jelaskan bagaimana ia boleh berbeza. (4 markah)
- (b) Jelaskan dengan ilustrasi yang sesuai perbezaan diantara:
- i) Ujian langsung dan tak langsung
 - ii) UCS dan JCS
 - iii) Test Brazil dan PUNDIT
- (4 markah)

- (c) Modulus Young batuan granit lebih besar (sebanyak 20 kali) berbanding dengan arang batu dan nisbah Poisson arang batu hamper sekali ganda tinggi dari batuan granit. Jelaskan kenapa dengan memberi definisi Modulus Young dan nisbah Poisson.
(5 markah)
- (d) Bincangkan dengan bantuan diagram perbezaan diantara RQD dan *solid core recovery*.
(3 markah)
- (e) Penyiasatan tapak adalah perlu sebagai ahli geologi kejuruteraan didalam menyediakan cadangan pembinaan kejuruteraan awam di tapak bina
- i) Bincangkan **DUA (2)** kelemahan yang berasosiasi dengan lubang jara.
(2 markah)
- ii) Jelaskan tanpa mengambil kira sebarang limitasi, **SATU (1)** kaedah geofizik yang dapat dilaksanakan didalam membantu lubang jara untuk penyiasatan tapak.
(2 markah)
- (f) Bincangkan perbezaan di antara kaedah kerintangan dan seismik biasan didalam penyiasatan tapak.
(3 markah)

BAHAGIAN B

- S5 (a) Cerun batuan mengalami kegagalan dengan berbeza mekanismanya. Jelaskan jenis-jenis mekanisma kegagalan batuan. (4 markah)

- (b) Penyiasatan cerun batuan memberikan maklumat seperti berikut:

Tinggi cerun	= 40m
Cadangan sudut kecerunan cerun	= 45°
Kritikal sudut satah ketakselajaran	= 40°
Kedalaman rekahan tegangan	= 2m
Unit berat batuan	= 26 kN/m ³
Unit berat air	= 9.81 kN/m ³
Jelekitan satah ketakselajaran	= 20 kPa
Sudut ricih satah ketakselajaran	= 35°

Menggunakan maklumat yang diberi didalam Rajah kegagalan satah, analisa faktor keselamatan

- i) Bila rekahan tegangan dan cerun kering, dan

(4 markah)

- ii) Bila rekahan tegangan dan cerun sepenuhnya diisi oleh air.

(3 markah)

- (c) Cerun batuan mempunyai arah kemiringan 160° dan sudut kemiringan 60°. Pemetaan ketakselajaran dilakukan disepanjang cerun potongan dan keputusannya mendapati set ketakselajaran seperti dalam Jadual 1. Kajian dilakukan mendapati semua ketakselajaran mempunyai sudut jelekitan 35°.

Jadual 1

Set 1	Set 2	Set 3	Set 4	Set 5
175°/52°	240°/70°	145°/30°	320°/80°	350°/70°

- (i) Analisa mod kegagalan cerun batuan dengan menyatakan kriteria sebagai bukti. (8 markah)

- (ii) Cadangkan sudut baru cerun batuan agar dapat mengelakkan potensi kegagalan cerun batuan.

(3 markah)

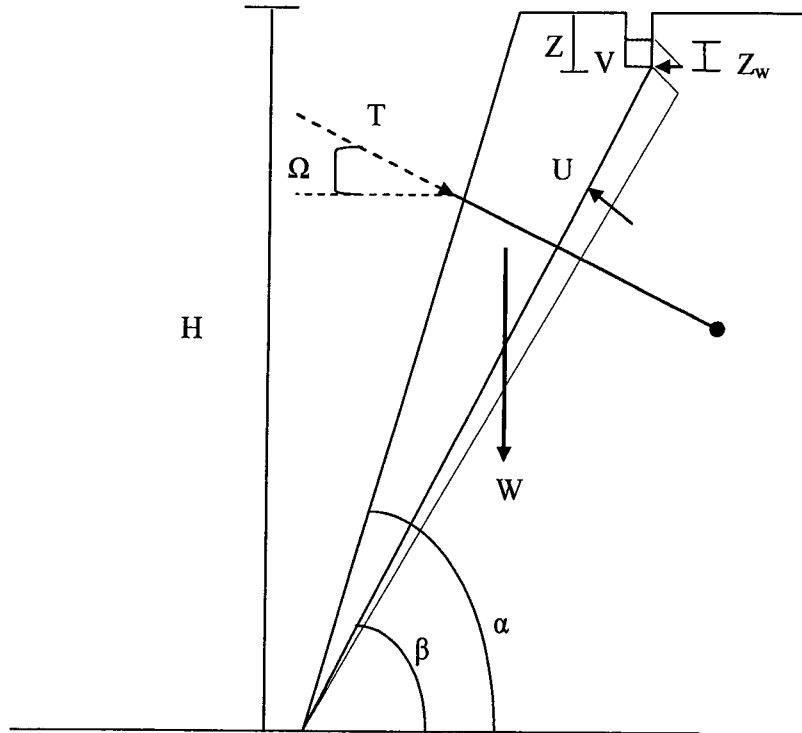
- (iii) Mencadangkan kesan akibat cadangan ini.

(3 markah)

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Given:

$$\text{FOS} = \frac{cA + [W \cos\beta - U - V \sin\beta + T \sin(\Omega+\beta)] \tan \phi}{W \sin\beta + V \cos\beta - T \cos(\Omega+\beta)}$$

$$A = (H-Z) \cdot \text{cosec } \beta$$

$$W = \frac{1}{2} \gamma_r H^2 \left[\left(1 - \left(\frac{Z}{H} \right)^2 \right) \cot \beta - \cot \alpha \right]$$

$$U = \frac{1}{2} \gamma_w Z_w \cdot (H-Z) \cdot \text{cosec } \beta$$

$$V = \frac{1}{2} \gamma_w Z_w^2$$

$$\text{cosec } \beta = \frac{1}{\sin \beta}$$

$$\sec \beta = \frac{1}{\cos \beta}$$

$$\cot \beta = \frac{1}{\tan \beta}$$

FIGURE Q5 (b)

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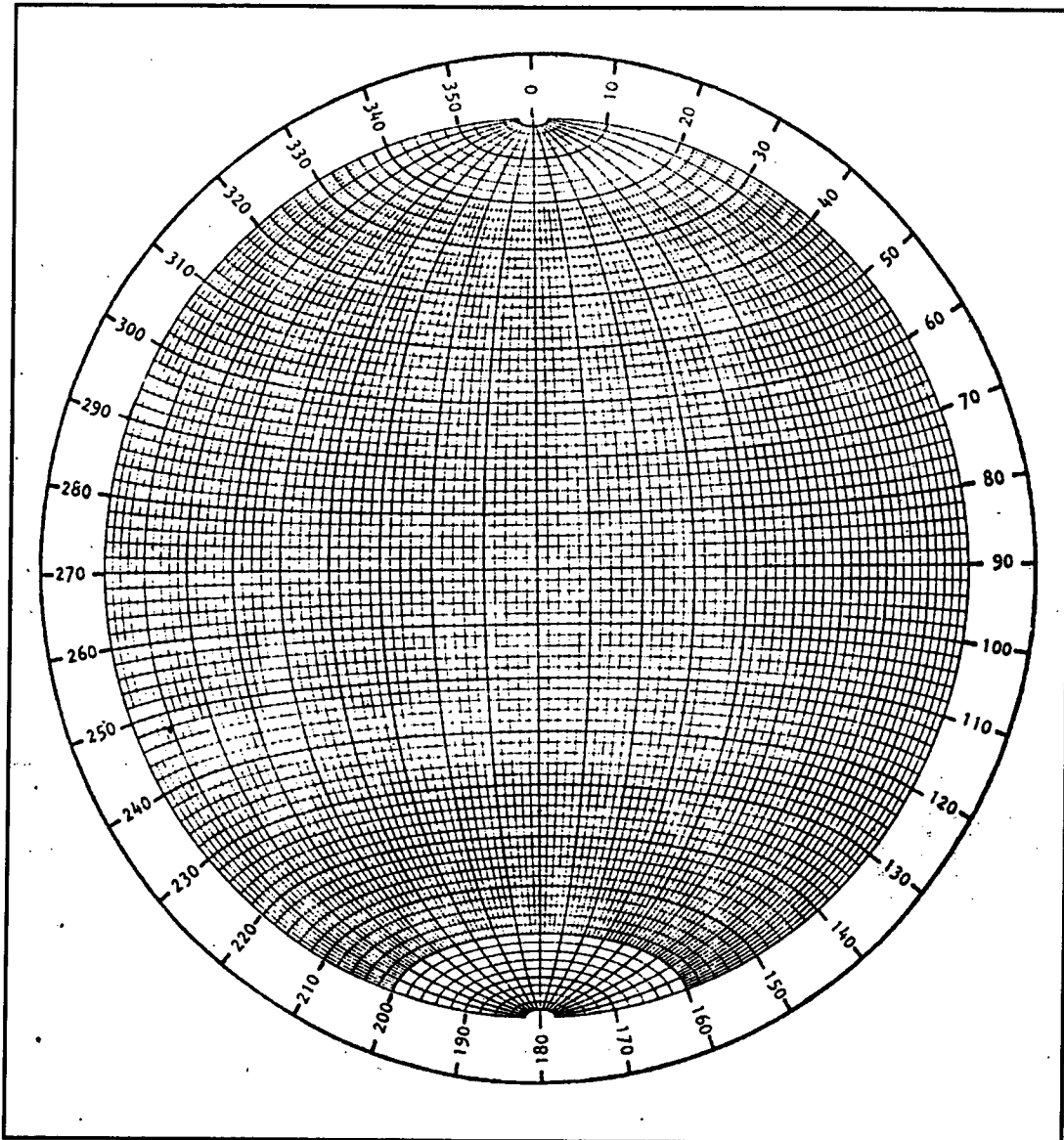


FIGURE Q5(c): Equatorial equal-area stereo-net marked in 2° intervals