Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	ENGINEERING GEOLOGY
COURSE CODE	:	BFC 21303
PROGRAMME	:	BFF
DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 (a) Describe the following terminology:

(i) Stratosphere

(1 mark)

(ii) Asthenosphere

(1 mark)

(b) Explain divergent, convergent and transform boundaries with the aid of related diagrams.

(3 marks)

(c) Explain **TWO (2)** geological processes that change the earth's structure

(2 marks)

(d) Define the mineral.

(2 marks)

(e) Discuss the types of minerals which reacted with acid.

(2 marks)

(f) Describe the rock cycle

(4 marks)

(g) Igneous intrusive and extrusive are recognized based on their rock textures. Explain and illustrate the differences of the intrusive and extrusive rock textures.

(4 marks)

(h) Explain the following chemical sedimentary rocks:

(i) Organic sedimentary rock

(1.5 marks)

(ii) Inorganic sedimentary rock

(1.5 marks)

(i) Explain the characteristics of the regional metamorphism rocks.

(3 marks)

Q2 (a) Chemical weathering is one of the weathering reactions that changes a rock to became more stable material or known as soil. Explain **THREE (3)** types of chemical weathering that normally occur in tropical region.

(7 marks)

(b) High intensity of rainfall in tropical region like Malaysia has causing the formation of very thick weathered zone with complex combination of soil and rock beneath ground surface. Illustrate and classify the typical characteristics of weathering profile for granite rock.

(6 marks)

(c) Discuss with suitable illustrations (if needed) the differences between:

(i) Compression, tension and shear involve in deformation of rock.

(3 marks)

(ii) Dip angle, dip direction and strike.

(3 marks)

(iii) Strike-slip fault, reverse dip-slip fault and oblique-slip fault.

(3 marks)

(iv) Competent, incompetent strata and unconformity.

(3 marks)

Q3 (a) Laboratory test consist of direct and indirect tests which are commonly used in determining the properties of rocks for engineering design purposes. Identify the type of laboratory testing based on the given parameters:

(i) Uniaxial strength index.

(1 mark)

(ii) Shear strength parameters of discontinuities.

(1 mark)

(iii) Resistance index of rock.

(1 mark)

(iv) Degree of denseness of rock.

(1 mark)

(v) Tensile strength of rock.

(1 mark)

(vi) Degree of hardness of rock surface.

(1 mark)

(vii) Cohesion and basic friction based on surface roughness.

(1 mark)

(b) The main purpose of a site investigation (SI) is to identify the ground conditions which might affect the proposed development area. Briefly discuss and sketch the activities that involved in the following SI works:

(i) Drilling work using rotary wash boring.

(2 marks)

(ii) Soil sampling.

(2 marks)

(iii) Rock Sampling.

(2 marks)

(iv) Determination of rock mass quality.

(2 marks)

(c) Two core samples are shown in **FIGURE Q3(c)** from two different rocks with length of each sample are 1500 mm were drilled from two different locations at depth of 30 m. Granite rock denoted as BH1 and sandstone denoted as BH2 were drilled at Sedenak and Iskandar Puteri, respectively. Based on the **FIGURE Q3(c)**;

(i) Calculate the Solid Core Recovery (SCR %) of the sample BH1 and BH2.

(2 marks)

(ii) Compute the Rock Quality Designation (RQD %) for both samples and describe the rock quality based on **TABLE 1**.

(2 marks)

(iii) Based on information and the results from **Q3(c)(i),(ii)**, identify which borehole area is the most potential for ground water resource. Justify your answer and suggest further testing needs to be carried out in order to confirm the existence of ground water.

(6 marks)

Q4 The granite slope has four representative joint sets as listed in **TABLE 2.**

(a) The rock cut slope having a dip angle of 70° and dip direction of 360° and the upper slope dip angle of 0°. Via referring to **TABLE 3** and using the equatorial equal-area stereo-net in **FIGURE Q4(a)**, investigate the stability of the slope, by considering each of the possible modes of failures. Tabulate your answers.

(5 marks)

(b) Calculate the factor of safety of plane failure mode in dry and wet condition using formula given in **FIGURE Q4(b).** Comment the effect of water toward slope stability.

(5 marks)

(c) Proposed the required anchor force and length to stabilize the slope at factor of safety of 1.5.

(5 marks)

(d) Calculate the factor of safety of wedge mode in worst condition using formula given in **FIGURE Q4(d)** and comment about the rock slope stability.

(10 marks)

END OF QUESTIONS

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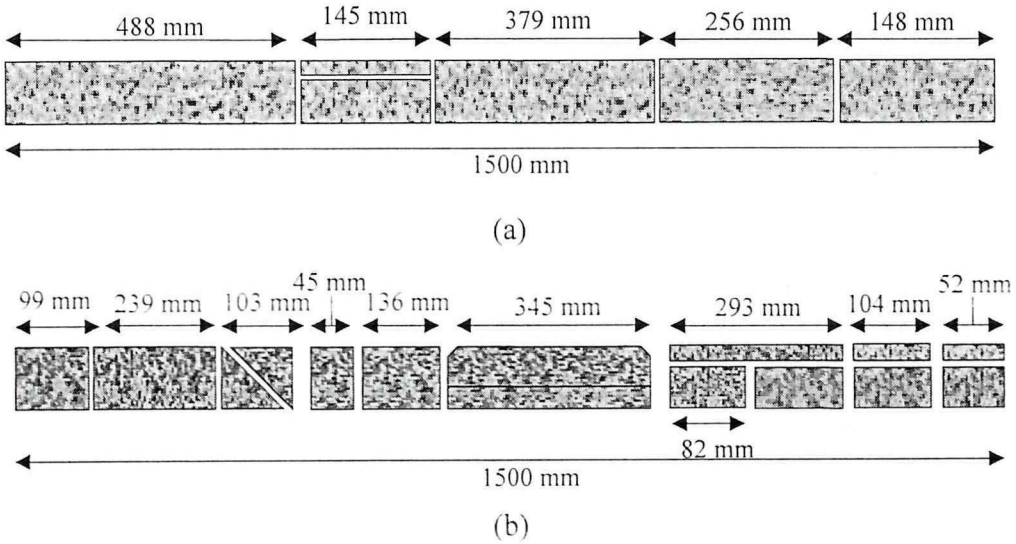

FIGUREQ3(c): Rock core samples a) Sample BH1 (Sedenak), and b) Sample BH2 (Iskandar Puteri)

TABLE 1: Rock quality designation description (Deere, 1989)

RQD (%)	Description of RQD
0-25	Very Poor
25-50	Poor
50-75	Moderate
75-90	Good
90-100	Very Good

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TABLE 2: Joint sets and rock slope information

Joint set	Dip direction (°)	Dip angle (°)
J1	10	34
J2	290	70
J3	180	70
J4	190	20

Note:
Friction angle for all the joints is 20°.

The following additional and relevant information was obtained from both field and laboratory study for the slope.

1. Unit weight of rock = 25 kN/ m^3
2. Unit weight of water = 9.81 kN/m^3
3. Slope height = 50 m
4. Tension crack depth = 5 m
5. Cohesion of the clay infill = 50 kPa
6. Inclination of anchor bars = 20°
7. Yield stress for one (1) anchor bar = 100kN

TABLE 3: Criterion table for the mode of rock slope failure

Modes of failure	Criteria are met
Circular	i. Very weak material, highly jointed or fractured or weak soil ii. Homogenous soil
Planar	i. The joint set dip direction lie within ± 20^0 from the slope dip direction. ii. $\psi_f > \psi_p > \phi$ (slope angle> plane angle > friction angle) iii. Release surfaces must be present to define the lateral boundaries of the slide.
Wedge	i. $\psi_f > \psi_i > \phi$ (slope angle > intersection of 2 plane angle > friction angle) ii. Driving force due to the weight of wedge must exceed the frictional resistance of the planes.
Toppling	i. The joint set dip direction must lie between ±10° of opposite slope dip direction. ii. $(90^0 - \psi_f) + \phi \leq \psi_t$

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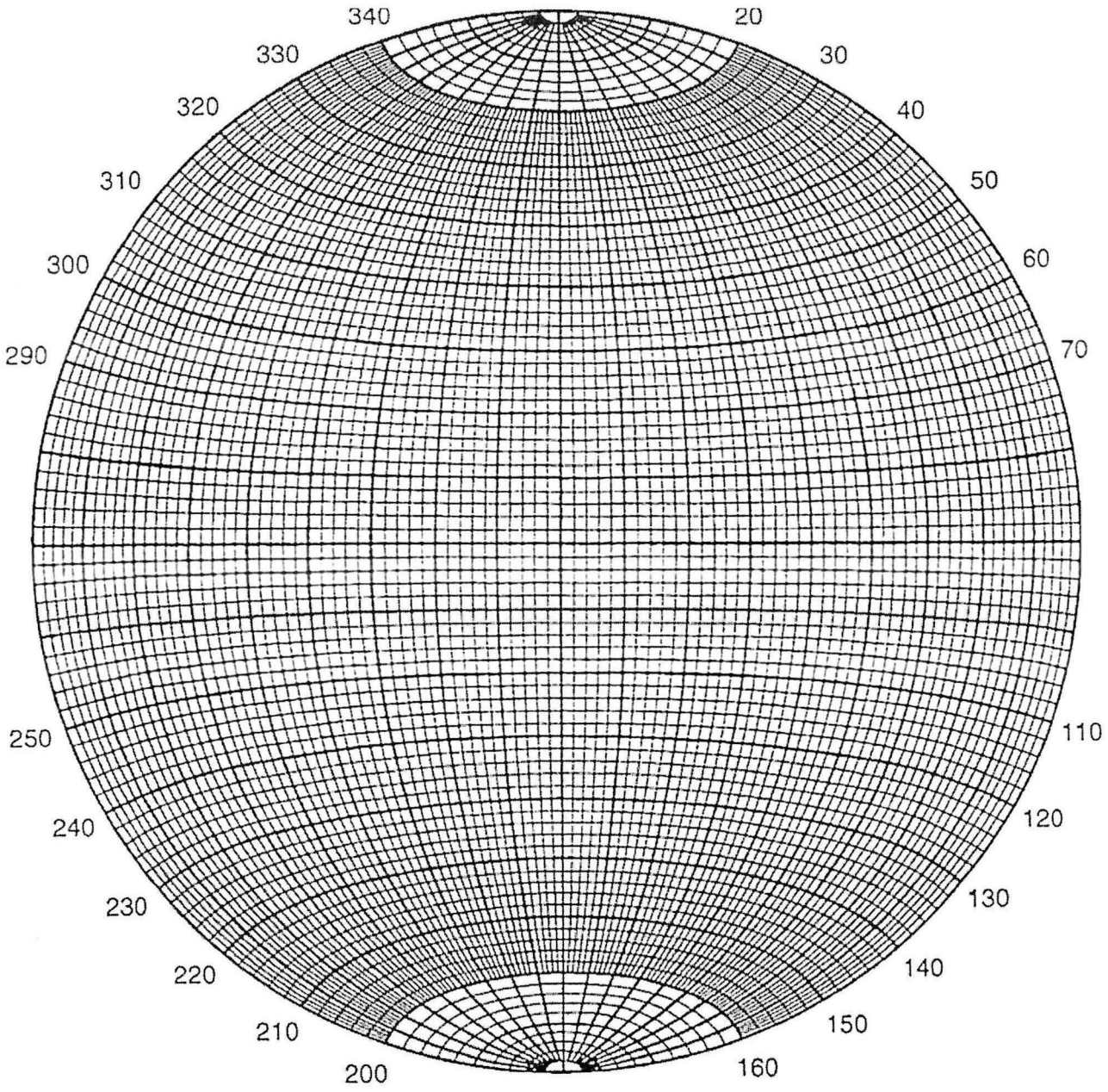

FIGURE Q4(a): Equatorial equal-area stereo-net marked in 2° intervals

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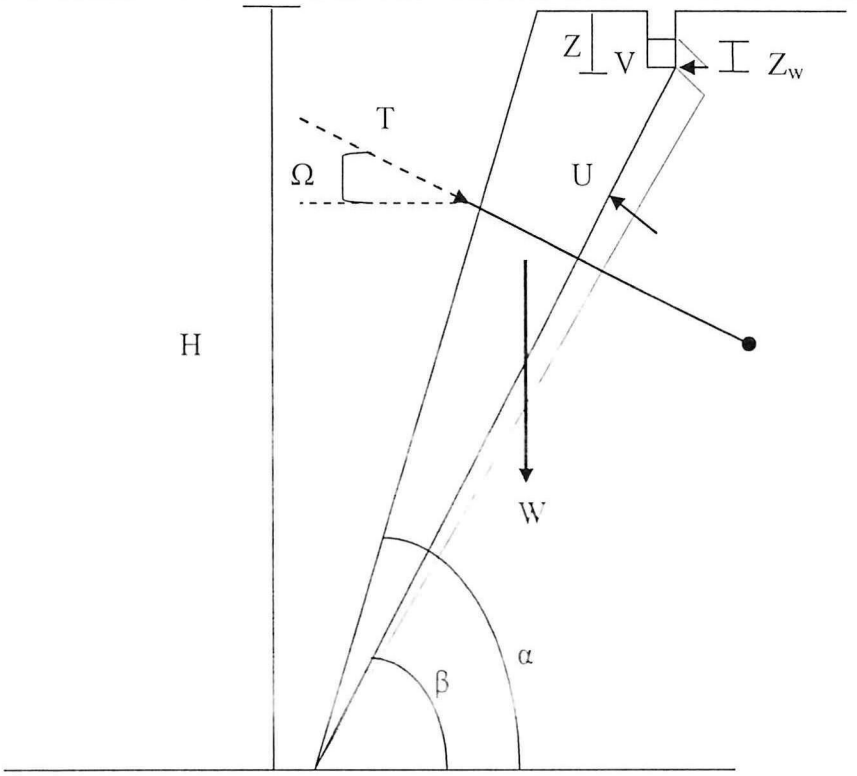

Given:

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

A= failure plane area
c = cohesion
W = weight of failure block
β =failure plane angle
H = height of plane
T = tension of anchor
γ_r= unit weight of rock
ϕ = friction angle
U = vertical water pressure
V = horizontal water pressure
α = slope angle
Z = tensional cracks
Ω = inclined angle of anchor
γ_w= unit weight of water

A = (H-Z).cosec β

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

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

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

$$\text{cosec}\beta = \frac{1}{\sin\beta} \quad \sec\beta = \frac{1}{\cos\beta} \quad \cot\beta = \frac{1}{\tan\beta}$$

FIGURE Q4(b)

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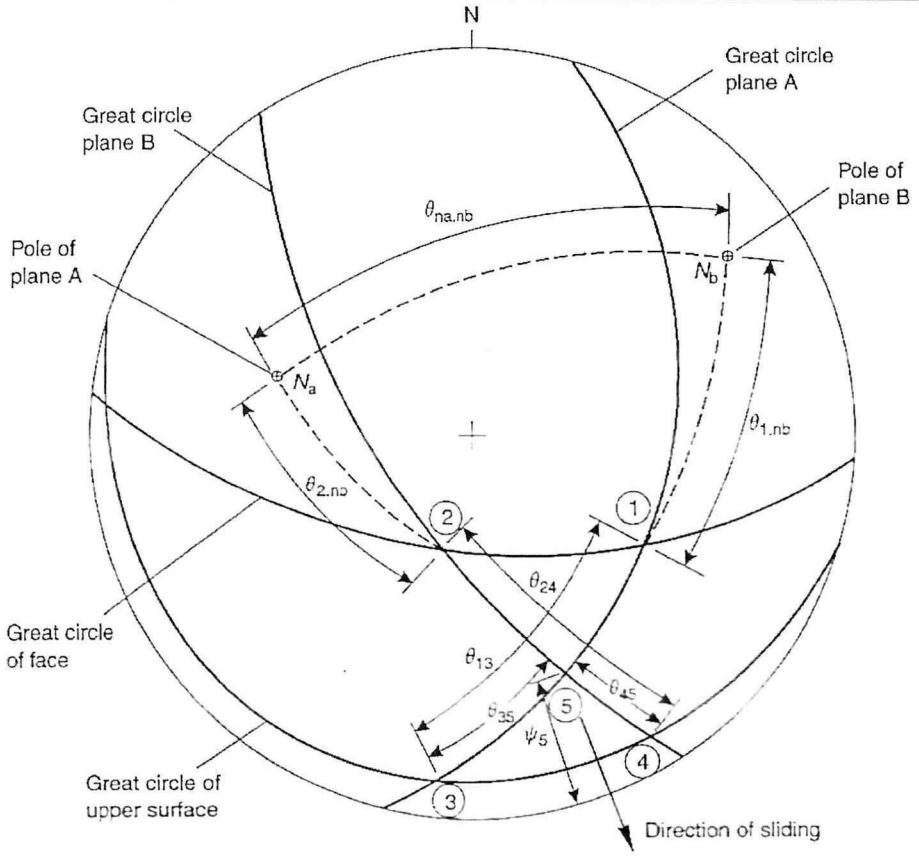

Given:

$$Fos = \frac{3}{\gamma H_t}(C_a.X + C_b.Y) + (A - \frac{\gamma_w}{2\gamma}.X)Tan\phi_a + (B - \frac{\gamma_w}{2\gamma}.Y)Tan\phi_b$$

C_a = Cohesion
ϕ_b = Friction angle
H_t = height of wedge
ψ_a = dip angle for plane a
ψ_b = dip angle for plane b
ψ_5= dip angle for wedge intersection
γ = unit weight of rock
γ_w = unit weight of water

X, Y, A, B is factor which depend upon the geometry of wedge

$$X = \frac{Sin\theta_{24}}{Sin\theta_{45}Cos\theta_{2.na}} \quad Y = \frac{Sin\theta_{13}}{Sin\theta_{35}Cos\theta_{1.nb}} \quad A = \frac{Cos\psi_a - Cos\psi_b Cos\theta_{na.nb}}{Sin\psi_5.Sin^2\theta_{na.nb}}$$

$$B = \frac{Cos\psi_b - Cos\psi_a Cos\theta_{na.nb}}{Sin\psi_5.Sin^2\theta_{na.nb}}$$

FIGURE Q4(d)