

**SULIT**

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First Semester Examination  
2021/2022 Academic Session

February/March 2022

**EAG141 – Geology for Civil Engineers**

Duration: 2 hours

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Please check that this examination paper consists of **EIGHT (8)** pages of printed material including appendix before you begin the examination.

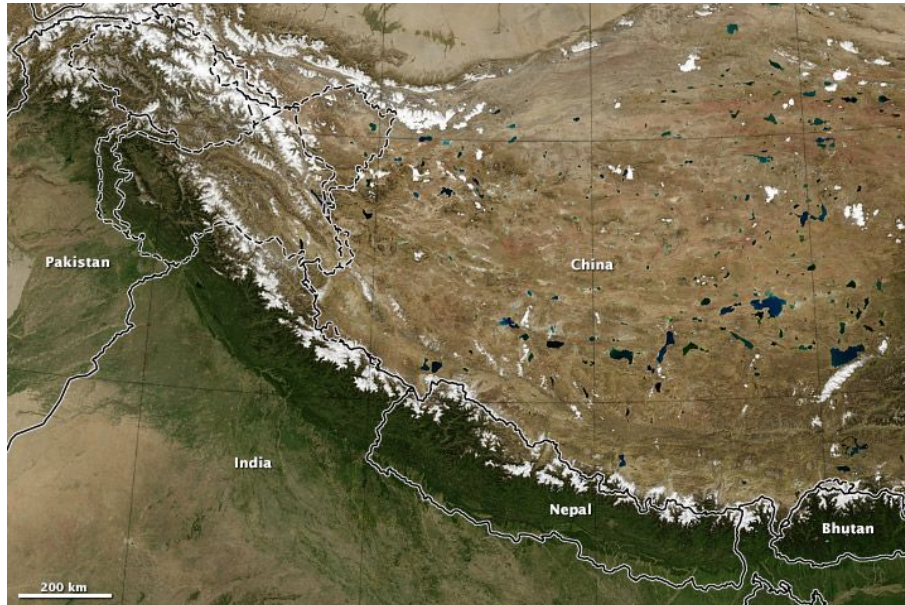
**Instructions** : This paper contains **FIVE (5)** questions. Answer **FOUR (4)** questions.

All questions **MUST BE** answered on a new page.

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**SULIT**

1. The Himalayas (**Figure 1**) are Asian mountain range that divides the plains near the Tibetan Plateau. There are over 100 peaks higher than 7,200 meters in elevation in the Himalayas, including the tallest, Mount Everest.



**Figure 1**

- (a). The Himalayas range connects China, Bhutan, Nepal, India, and Pakistan. Identify **TWO (2)** plates that are linked to the Himalayas.

[2 marks]

- (b). According to records, earthquakes are widespread in the Himalayas. With the help of a sketch, explain the type of plate boundary motion beneath the Himalayas.

[12 marks]

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- (c). Mantle convection is a slow process that causes movement beneath the tectonic plate. Explain the geological effect if this process occurs rapidly beneath the Himalayas with the help of a sketch.

[11 marks]

2. (a). Over 2000 minerals have been categorized as having the ability to form rock. Any rock can convert into another type of rock by going through one or more rock cycle process. Explain the formation of sedimentary and metamorphic rocks with the help of sketches.

[15 marks]

- (b). i) In **Figure 2**, units B and D are igneous rock. The large swirly unit on the bottom is metamorphic rock. A and F are faults. C and E are sedimentary rock layers. The wavy horizontal line is an unconformity. Explain the principle of Relative Time for **D** and **fault** that have been found in the rock layer.

[4 marks]

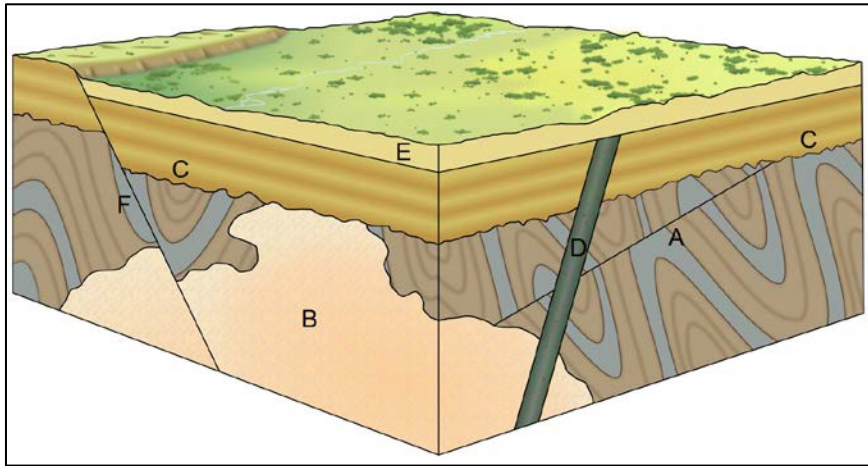
- ii) Examine whether the igneous rock (dike) D is older or younger than fault A. Justify your answer using the relevant geological principle.

[4 marks]

- iii) If igneous rock (dike) D is determined by the radioactive decay method to be 1.2 million years old, estimate the age information for layer C.

[2 marks]

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**Figure 2**

3. (a). Faults are fractures in the earth's crust along which displacement occurs. With the help of sketches and complete labeling, describe **THREE (3)** types of faults together with the forces involved.

[6 marks]

- (b). Rock mass consisting of faults can have a potentially significant impact to the tunnel construction and the safety of the workers involved. From your point of view as a civil engineer, interpret the potential effects of faults zone to the tunnel construction site with the help of sketches.

[6 marks]

- (c). **Figure 3** illustrate groundwater system and the estimated time for the groundwater to flow along various paths from recharge to discharge areas.

- i) Discuss two (2) differences between unconfined aquifer and confined aquifer.

[4 marks]

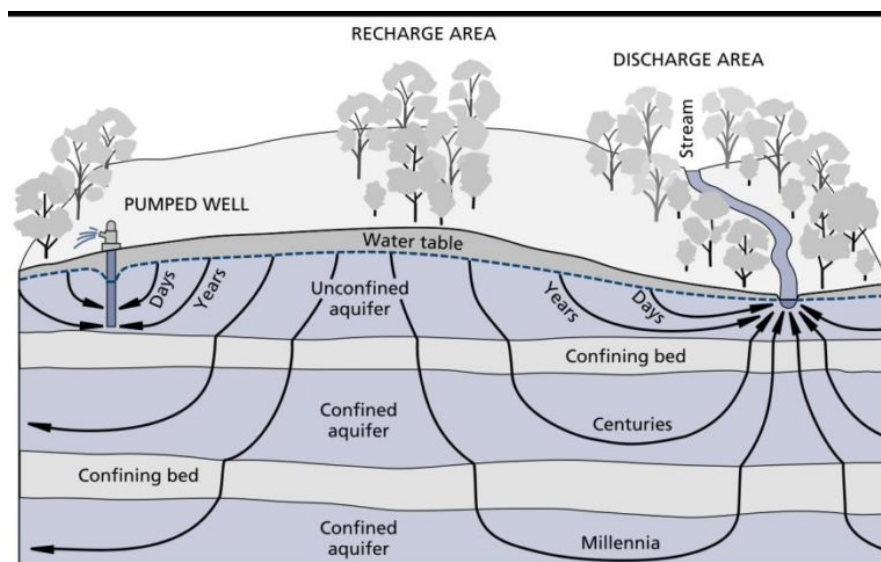
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- ii) Identify **TWO (2)** types of aquitards presence in the ground water system with their terminology.

[2 marks]

- iii) Assume that the dam will be built on the ground level as shown in **Figure 3**. The lithology underlying the dam foundation is a metamorphic rock called gneiss. This rock type is known to be relatively impermeable. Interpret the impact on the stability of the dam site based on the rock type underlying the dam foundation.

[7 marks]



**Figure 3: Groundwater System**

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4. (a). With the help of sketches, explain the definition and mechanism of earthquake.

[8 marks]

- (b). Explain the nature of different types of waves generated during an earthquake and which waves cause the most damage and destruction to the civil engineering infrastructure.

[5 marks]

- (c) On 28 September 2018, a magnitude of 7.5 earthquake shook Sulawesi Island in Indonesia and triggered a tsunami that battered Palu, the provincial capital. The quake and the resulting tsunami, with waves that topped 5 meters in Palu Bay, wreaked extensive damage on one of Indonesia's largest and most populous islands.

- i) Examine the effects of the earthquake on the alluvium and coastal deposits (refer to the geological map **Figure 4**) and justify the main reasons for the significant destruction in central Palu City.

[6 marks]

- ii) The Palu earthquake occurred principally on land and exhibited a strike-slip mechanism that is usually not associated with the generation of large tsunamis. Discover the possible sources for the generation of the tsunami that struck central Palu.

[6 marks]

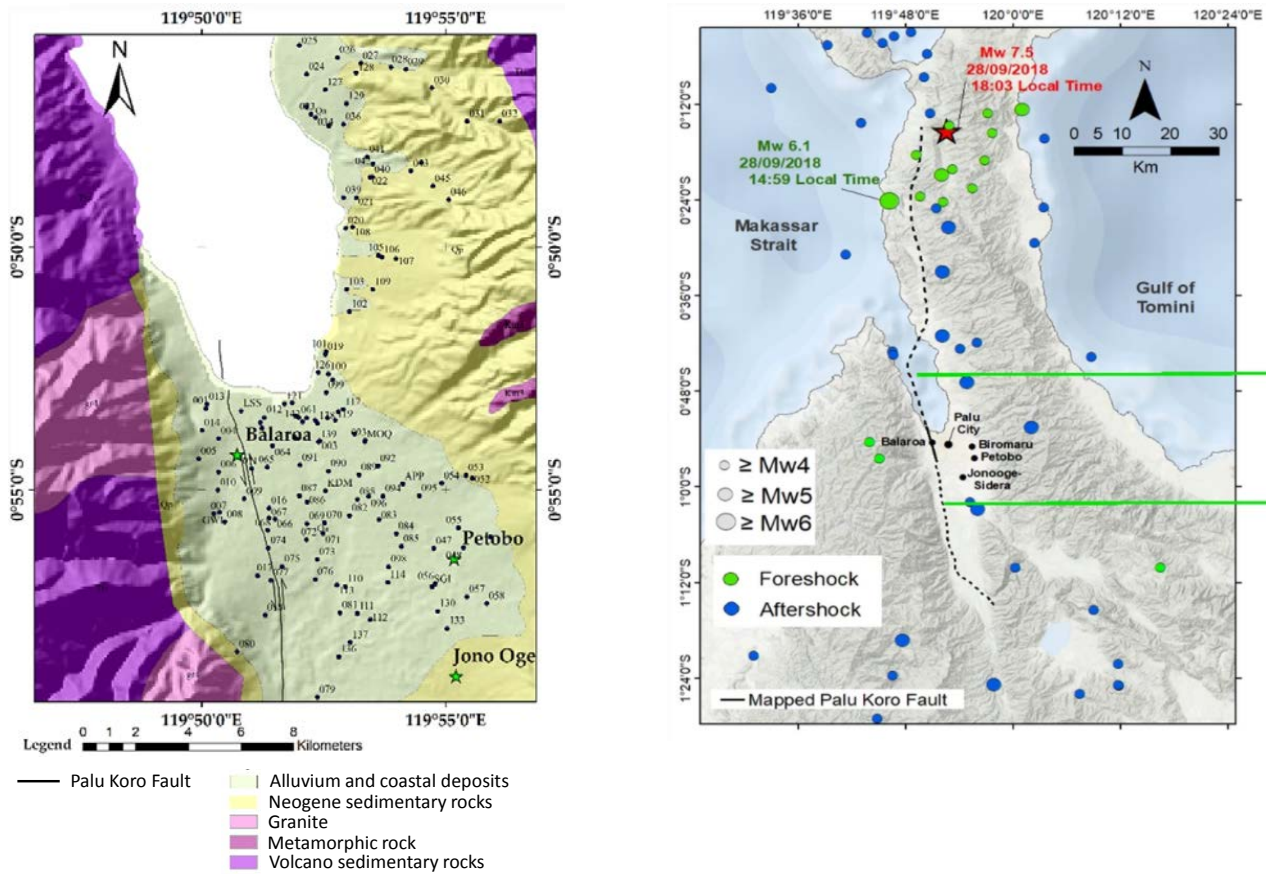


Figure 4

5. (a). The central portion of Penang Island underlain by granitic rock may pose a higher risk for hillside development mainly due to the granitic residual soil with core boulders.
  - i) With the help of sketches, describe the process that occurred to each mineral within granite during the complete chemical weathering under the tropical climate in Malaysia.

[5 marks]

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- ii) List the final products for each mineral after the chemical weathering and explain how they may affect the engineering properties of the residual soil.

[5 marks]

- iii) When weathered to the consistency of soil, the structural features of the granitic rocks are often preserved as relict discontinuities. With the help of sketches, describe the process that forms the relict discontinuities and its main effect on the slope stability in hillside development.

[7 marks]

- iv) As a weathering product, boulder is dominantly found in moderately to completely weathered zone of granitic rock mass (Grade III to V). Boulder consists of cornerstone Grade I or II and is surrounded by concentric sheets of weathered rock Grade III to V and silty, sandy to clayey soil. With the help of sketches, determine the main problem of the presence of the boulder in the underground excavations and constructions works.

[8 marks]

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