



UNIVERSITY  
OF  
JOHANNESBURG

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| <b><u>FACULTY</u></b>    | : Science  |
| <b><u>DEPARTMENT</u></b> | : Geology  |
| <b><u>CAMPUS</u></b>     | : APK  |
| <b><u>MODULE</u></b>     | : APG2B01/APG02B2<br>APPLIED ENGINEERING AND ENVIRONMENTAL GEOLOGY |
| <b><u>SEMESTER</u></b>   | : Second/First   |
| <b><u>EXAM</u></b>       | : SSA Jan 2019   |

|                           |                                |                       |               |
|---------------------------|--------------------------------|-----------------------|---------------|
| <b><u>DATE</u></b>        | : 7 Jan 2019                   | <b><u>SESSION</u></b> | : 08:00-11:00 |
| <b><u>ASSESSOR(S)</u></b> | : DR C VORSTER<br>MR M MOROENG |                       |               |
| <b><u>MODERATOR</u></b>   | : PROF B CAIRNCROSS            |                       |               |
| <b><u>DURATION</u></b>    | : 3 HOURS                      | <b><u>MARKS</u></b>   | : 180         |

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NUMBER OF PAGES: 6 PAGES

INSTRUCTIONS:

1. Answer ALL THE QUESTIONS.
  2. Number your answers clearly
  3. Answer section A and section B in separate books
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- b) The two erosional surfaces above and below the \_\_\_\_\_ (at the end of the Cretaceous) were grouped together as the African Surface.
- c) A major uplift event which occurred during the Pliocene (5 – 3 Ma) resulted in the replaning of the Southern African landscape, later resulting in the \_\_\_\_\_ surface.
- d) At present day, \_\_\_\_\_ such as Ferricrete, Calcrete and Silcrete cap the surviving remnants of the African Surface.
- e) Xenoliths that occur in \_\_\_\_\_ have been used to estimate the original distribution of sedimentary units in an area and to reconstruct the erosional history of Southern Africa.

**QUESTION 7 (4 MARKS):**

State whether the following statements are **true or false (1 MARK EACH)**:

- a) Oligotrophic lakes are typically deep, contain clear water with a low nutrient content, have a low fish population and are therefore good sources of drinking water.
- b) The most common technique for creating a large, reliable freshwater source is by damming rivers to create artificial lakes known as aqueducts.
- c) When groundwater is withdrawn from a well, the water table in the area surrounding the well is lowered, thereby forming a cone of depression.
- d) Springs that discharge from relatively shallow aquifers usually have a high salinity and are considered to be a poor source of drinking water.

**QUESTION 8 (7 MARKS):**

Briefly discuss what **Darcy's Law** tells us about the flow of groundwater. Make a sketch to support your answer.

**QUESTION 9 (5 MARKS)**

**Saltwater incursion** (or intrusion) often affects the quality of fresh groundwater sources along coastal areas. Briefly discuss the **balance between fresh groundwater and saltwater bodies** along coastal regions **AND** the **reasons why saltwater incursions occur**.

**QUESTION 10 (6 MARKS)**

Explain why the **acid mine drainage (AMD)** problem associated with the **Mpumalanga coal mines** could be considered to be more severe than the **AMD** associated with the **Witwatersrand gold mines**.

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**SECTION B: ENGINEERING GEOLOGY (90 MARKS)****QUESTION 1 (20 MARKS)**

- 1.1. Compare chemical and physical weathering. (5 marks)
- 1.2. Discuss the various parameters that can be deduced from a grain-size distribution curve, and provide examples for a well-graded soil (10 marks).
- 1.3. What are expansive soils? And give examples of South African lithological units associated with these soil types. (5 marks)

**QUESTION 2 (20 MARKS)**

- 2.1. Compare and contrast between rock mass and rock mass structure. (5 marks)
- 2.2. The strength of a discontinuity may be determined using the Barton-Choubey criterion, expressed as follows:

$$T = \sigma \tan \left[ \text{JRC} \log \left( \frac{\text{JCS}}{\sigma} \right) + \phi \right]$$

Discuss why the JCS (the joint wall compressive strength) of a discontinuity may vary at the discontinuity wall and further away. (5 marks)

- 2.3. With the aid of illustrations, discuss the impact of the orientation of a rock fabric on the uniaxial compressive strength (UCS). (10 marks)

**QUESTION 3 (20 MARKS)**

- 3.1. Differentiate between porosity and effective porosity. (5 marks)
- 3.2. Write brief notes on how the particle size distribution determines the porosity of a sedimentary rock. (5 marks)
- 3.3. Give any five aquifer types found in South Africa and provide a brief description for each. (10 marks)

**QUESTION 4 (30 MARKS)**

- 4.1. You are appointed as the consulting engineering geologist on a project. However, before you are able to perform a site investigation, you are asked to provide your expert opinion on the engineering geology characteristics of the site listed below using only the limited information given:

**Bushveld Complex** (consists of various lithological units which includes granites, gabbros, norites, etc). For the site identified, the Weinert number (N) is 2.

Discuss the engineering geological properties associated with the different rock types.