

DEPARTMENT OF GEOLOGY

MODULE CODE	APG2B01
MODULE NAME	APPLIED ENGINEERING AND ENVIRONMENTAL GEOLOGY
CAMPUS	APK
EXAM	November 2015

Date	5 November 2015
Assessor(S)	Dr Michiel de Kock Dr Clarisa Vorster
Internal Moderator	Prof Bruce Cairncross
External Moderator	
Duration	180 minutes
Marks	180

Number of pages	5 (including front page)
Instructions	Answer all the questions

SECTION A: ENVIRONMENTAL GEOLOGY

QUESTION 1 (8 MARKS)

Define the following **chemical weathering processes** and give an example for each process

- a) Carbonation
- b) Hydrolysis
- c) Oxidation
- d) Leaching

QUESTION 2 (12 MARKS)

Discuss how the following factors can have play a role in **formation of soil**

- a) Climate
- b) Topography
- c) Nature and composition of the parent material
- d) The amount and type of living organisms.

QUESTION 3 (12 MARKS)

Discuss the **three different mechanisms of mass movement of soil**, namely **heave, slide and flow**, by referring to the amount of water that is usually present in each case and the speed of movement. (You may make use of a sketch to simplify your answer)

QUESTION 4 (5 MARKS)

Explain why **Kimberlite Diatremes** can be studied in order to estimate how much material have been removed (eroded away) from the top of South Africa since the Cretaceous.

QUESTION 5 (8 MARKS)

- a) Make use of a **sketch** to explain the difference between **hydraulic head and hydraulic gradient**. **(4)**
- b) Discuss how hydraulic conductivity and hydraulic gradient can influence the flow of groundwater. **(4)**

QUESTION 6 (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 7 (5 MARKS)

Briefly discuss the cause of the **Bangladesh groundwater arsenic poisoning disaster** as well as the steps that can be taken to remediate the groundwater and alleviate the problem.

QUESTION 8 (10 MARKS)

- a) 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**. (6)
- b) Briefly discuss any **four steps** that have been taken in order to remediate the AMD problem in the Mpumalanga coal mining region.

QUESTION 9 (15 MARKS)

- a) Briefly explain why **shale gas** is considered to be **different from traditional oil and gas**. (5)
- b) Define the term **“hydraulic fracturing”** and explain how this process can be applied to extract shale gas. Make use of a sketch to support your answer. (10)

QUESTION 10 (10 MARKS)

Discuss the potential for carbon **storage** in South Africa by referring to following potential storage options:

- Depleted oil and gas fields
- Abandoned coal and gold mines
- The sediments of the Karoo Supergroup
- Ocean storage

TOTAL SECTION A: 90 MARKS

SECTION B:

The cross-section below (Figure 1) illustrates the geology as developed below Johannesburg. Answer all questions in reference to the figure.

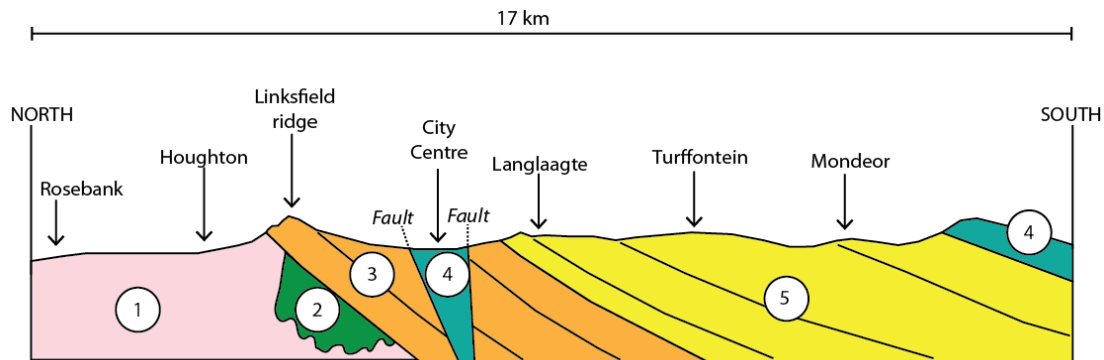


Figure 1. Cross-section across the geology of Johannesburg.

QUESTION 1. Complete the provided table below

Unit	Stratigraphic Name (Group and <u>NOT</u> SUPERGROUP)	Approximate Age (e.g. 250 Ma)	Dominant rock type(s)
1	-		
2	-		
3			
4			
5			

2 marks each

2 marks each

2 marks each

26 marks

QUESTION 2

What is indicated by the Weinert's number, and how is it calculated?

6 marks

QUESTION 3

3.1. Sketch and discuss the 6 zones that would be present in a general weathering profile that would be expected to develop on unit 1 in the cross-section shown in Figure 1?

12 marks

3.2. What are the problems that can be expected when building on residual soils developed on unit 1?

4 marks

3.3. Name and briefly explain what characteristics of a residual needs to be described for it to be a complete description?

12 marks

QUESTION 4

4.1. Discuss percussion drilling and diamond drilling methods of investigation, and list the pro's and con's of each.

10 marks

4.2. What is the meaning and geological significance of "air loss" during DTH drilling?

2 marks

QUESTION 5

5.1. Explain what sinkholes and dolines are and how they form

8 marks

5.2. How would you estimate the risk of a sinkhole affecting the Gautrain? How was this risk mitigated by careful design?

10 marks

TOTAL SECTION B: 90 MARKS