UNIVERSITY
OF
JOHANNESBURG

FACULTY	: Science
DEPARTMENT	: Geology
CAMPUS	: APK
MODULE	: APG2B01/APG02B2 APPLIED ENGINEERING AND ENVIRONMENTAL GEOLOGY
SEMESTER	: Second
EXAM	: Nov 2018

DATE	: 16 NOV 2018	**SESSION**	: 08:30-11:30
ASSESSOR(S)	: DR C VORSTER MR M MAROENG		
MODERATOR	: PROF B CAIRNCROSS		
DURATION	: 3 HOURS	**MARKS**	: 180

NUMBER OF PAGES: 7 PAGES

INSTRUCTIONS:

1. Answer ALL THE QUESTIONS.
2. Number your answers clearly
3. Answer section A and section B in separate books

SECTION A: ENVIRONMENTAL GEOLOGY (90 MARKS)

QUESTION 1 (7 MARKS)

Complete the following sentences regarding weathering (1 marks each):

a) Weathering is considered a very important natural process because it leads to the production **of** _____ .

b) The processes that causes rocks to disintegrate into smaller particles by some mechanical means is known as _____ .

c) _____.is the process during which rocks break apart after being exposed to a fire due to the outer surface of the rock being exposed to much greater temperatures compared to the interior.

d) The growth and expansion of foreign substances along open spaces in rocks is known as _____ .

e) When water in raindrops combine with_____ in the atmosphere, carbonic acid is formed, which is capable of breaking down minerals during a process called carbonation.

f) Carbonic acid can react with silicate minerals in a reaction called _____.

g) _____.is the chemical weathering process during which soluble elements such as sodium and potassium are removed from bedrock by water, leaving insoluble compound behind.

QUESTION 2 (5 MARKS)

Explain the difference between a *soil profile* and a *soil horizon*. Make use of a sketch to support your answer.

QUESTION 3 (6 MARKS)

Explain how the characteristics of quartz and clay particles play a role in the following properties of soil:

a) Porosity

b) Plasticity

c) Strength and sensitivity

QUESTION 4 (6 MARKS)

Briefly discuss the following mechanisms of erosion:

a) Water
b) Wind
c) Glaciers

QUESTION 5 (8 MARKS)

There are three mechanisms by which mass movement events can occur namely *heave, slide and flow.* Name the different types of mass movement events which can occur following one of these mechanisms and rank when according to the speed of the occurrence and the amount of water required. You may make use of a sketch to help explain your answer.

QUESTION 6 (6 MARKS)

Briefly explain the difference between the ***African-, Post African I and Post African II erosional land surfaces.***

QUESTION 7 (5 MARKS)

State whether the following statements the Earth's water resources are **TRUE or FALSE:**

a) The hydrological cycle is driven by solar radiation (energy from the sun) which causes water to evaporate from the oceans and land surface.
b) The balance exists between global rates of precipitation, evapotranspiration, surface runoff and the amount of water available to soil and groundwater is also known as the hydrologic budget .
c) Most of South Africa's fresh water supply goes towards urban development.
d) The generation of hydroelectric power is an example of outstream use of river water.
e) When the balance between precipitation(P) and runoff (R) into a lake and the evaporation (E) and outflow (O) from the lake can be expressed as **P + R = E + O,** the lake is revered to as a salt lake

QUESTION 8 (6 MARKS)

Comment on the groundwater potential of the following subsurface material by referring to their porosity and hydraulic conductivity

a) Granite
b) Sandstone
c) Limestone

QUESTION 9 (8 MARKS):

Explain the difference between **miscible and immiscible groundwater contaminants** and give an example of each. Also explain the steps that can be followed to treat groundwater containing miscible and immiscible contaminants.

QUESTION 10 (10 MARKS):

Discuss the **acid mine drainage problem associated with coal mining in Mpumalanga** as well as the measures that have been taken in order to remediate the problem.

QUESTION 11 (7 MARKS)

Briefly discuss how the **process of hydraulic fracturing** is used for shale gas extraction. Use a sketch to support your discussion.

QUESTION 12 (6 MARKS)

Complete the following sentences regarding climate change (1 marks each):

a) _____. is the term/word used to refer to the climate that predates the instrumental period of direct weather observations.
b) A study of _____ growth layers may reveal evidence for the ocean experiencing annual or seasonal variations in past climate conditions.
c) The present day climate is considered to show an overall increase in both global land and_____temperatures.
d) An increase in global temperature has led to widespread melting of snow and ice-caps, which could result in a rise in _____.
e) Minor changes in the Earth's _____ could have an effect on the total amount of radiation from the sun reaching the Earth's surface, but is not considered to be the cause of the major change in climate experienced at present.
f) An asteroid or comet impacting with the Earth's surface could result in substantial quantities of _____ being ejected into the atmosphere which blocks solar radiation, ultimately killing plant life.

QUESTION 13 (10 MARKS)

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

a) Depleted oil and gas fields

b) Abandoned coal and gold mines

c) The sediments of the Karoo Supergroup

d) Ocean storage

END OF SECTION A

SECTION B: ENGINEERING GEOLOGY (90 MARKS)

QUESTION 1 (20 MARKS)

1.1. Discuss the effect of the Weinert number (N) on the mode of rock weathering. (5 marks)

1.2. Using the MCCSSO soil profiling parameters, compare a cohesive (clay) and a non-cohesive soil (sand). (10 marks).

1.3. Discuss the formation collapsible soils. Also, give examples of South African lithological units associated with these soil types.(5 marks)

QUESTION 2 (20 MARKS)

2.1. Compare and contrast between an intact rock and a rock mass. (5 marks)

2.2. The strength of a discontinuity may be determined using the Barton-Choubey criterion, expressed as follows:

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

Discuss the effect of the JRC (the joint roughness co-efficient) on the strength of a discontinuity. (5 marks)

2.3. With the aid of illustrations (stress-strain curve), compare the uniaxial compressive strength (UCS) of a brittle and a ductile rock. (10 marks)

QUESTION 3 (20 MARKS)

3.1. Briefly elaborate on the formation of perched aquifers. What is the relationship, if any, between these and the formation of wetlands? (5 marks)

3.2. Differentiate between aquitard, aquiclude, and aquifuge, giving examples of hydraulic conductivity (K) values in each case. (5 marks)

3.3. Schematically depict the distribution of subsurface water and explain the different zones. (10 marks)

QUESTION 4 (30 MARKS)

4.1. Two major rock types are found within the Transvaal Supergroup. Discuss the engineering geological properties associated with each rock type and propose solutions to the problems identified. (10 marks)

4.2. Write short notes on the engineering geological properties and problems associated with the rocks and/or residual soils and of the following lithostratigraphic units:

4.2.1. Ventersdorp Supergroup, where N<5. (10 marks)

4.2.2. Witwatersrand Supergroup. (10 marks)

END OF SECTION B