ALL QUESTIONS IN THIS EXAM REQUIRE YOU TO WRITE IN THIS BOOKLET. PLEASE ENSURE THAT YOU HAND IT IN.

Name:_______________________Student No:_________________________

This exam is composed of two sections: A: Multiple choice answers (50 marks). B: Short answers (50 marks)
Spend approximately 45 minutes on section A, 45 minutes on section B

Section A: Multiple Choice questions
Answer all the questions on the answer sheet provided at the end of this booklet.

1. Which of the following stratigraphic units would you most closely associate with a rifting event?
   (a.) Limpopo Belt (b.) Barberton Supergroup (c.) Chuniespoort Group (d.) Ventersdorp Supergroup

2. When oceanic crust is stacked up onto a continent as thrusted sheets, this is known as
   (a.) subduction (b.) reduction (c.) abduction (d.) obduction

3. Of what rock type would you expect the Archaean oceanic crust to be made?
   (a.) Basalt (b.) BIF (c.) Komatiite (d.) Mudstone

4. The lowermost unit of the Barberton Supergroup is called the
   (a.) Moodies Group (b.) Fig Tree Group (c.) Dominion Group (d.) Onverwacht Group.

5. The Moodies Group is comprises
   (a.) Obducted Oceanic crust (b.) ocean floor deposits (c.) continental sedimentary rocks (d.) island arc volcanic rocks

6. Komatiite is characterised by relatively high amounts of which element?
   (a.) Fe (b.) Si (c.) Mg (d.) O

7. If a komatiitic basalt erupts underwater, the process of serpentinisation will
   (a.) increase the density of the rock (b.) decrease the density of the rock
   (c.) unaffected the density of the rock (d.) produce pyroclastic deposits
8. Gold in the Witwatersrand Supergroup was most likely from which of the following sources? (a.) Sedimentary placer deposit associated with conglomerates and some hydrothermal mobilisation (b.) a purely hydrothermal source (c.) sedimentary placer deposits associated with mudstones (d.) from lavas at the base of the Witwatersrand Supergroup.

9. The Limpopo Belt represents (a.) high-grade metamorphism which, resulted from the collision between the Zimbabwe and Kalahari cratons. (b.) greenschist metamorphism caused by terrane accretion of greenstone belts (c.) a large sedimentary basin at granulite grade metamorphism (d.) granulite grade metamorphism resulting from the collision between the Kaapvaal and Zimbabwe cratons.

10. Pillow Basalts are signs of eruption under which of the following palaeoenvironments? (a.) effusive continental (b) fluvial (c.) marine (d.) explosive eruptions

11. The Central Zone of the Limpopo Belt represents (a.) The Zimbabwe Craton at high metamorphic grade (b.) the Kaapvaal Craton at high metamorphic grade (c.) the Kalahari Craton at high metamorphic grade (d.) None of the above; It is unrelated to any of the other cratons.

12. The oldest sedimentary basins preserved on the Kaapvaal craton are filled by: (a.) The Central Rand and Nzuse groups (b.) The Mozaan and Dominion groups (c.) The Ventersdorp and Pongola supergroups (d.) The Dominion and Nzuse groups

13. The volcanic and sedimentary rocks of the Nsuze Group are most likely to be related to which tectonic setting? (a.) Thermal sag basin (b.) rift basin (c.) island arc setting (d.) An obducted ophiolite sequence

14. Which of the following is closest to the oldest age for the Witwatersrand Supergroup? (a.) 3.1 Ga (b.) 2.7 Ga (c.) 2.0 Ga (d.) 2.9 Ga

15. The term 2.94 Ga means the same as: (a.) 294,000,000 years (b.) 29,400,000,000 years (c.) 2940 Ma (d.) 294,000 years

16. Which of the following descriptions best fits that of an disconformity: (a.) a gap in the sedimentary record (b.) a gap in the sedimentary record with tectonism (c.) a gap in the sedimentary record with tectonism and erosion (d.) a gap in the sedimentary record with tectonism, erosion and renewed deposition (e.) a gap in the sedimentary record with erosion and renewed deposition.

17. The presence of Pyrite in association with the gold in the Witwatersrand Supergroup (a.) has led to increased amounts of oxygen in the atmosphere (b.) tells us that there was oxygen in the Archaean atmosphere (c.) leads to a solution of sulphuric acid in present-day groundwater (d.) Can be economically mined as an iron (Fe) deposit

18. Stromatolites are indicative of what palaeoenvironment? (a.) deep marine environments (b.) fluvial (c.) aeolian (wind-blown) (d.) shallow marine

19. Which of the following characteristics is necessary for stromatolite growth?
A. Oxygen present in the atmosphere
B. The absence of predators
C. Dissolved Oxygen present in seawater
D. Land cover exposed to sunlight
E. Deep water conditions devoid of sunlight
F. Shallow marine conditions exposed to sunlight
(a.) A, B, and F (b.) B, C and D (c.) B and F (d.) B, C and E

20. Which of the following is an appropriate age for the Pretoria Group?
(a.) 2350-2100 Ma (b.) 2450-2250 Ma (c.) 2000-1920 Ma (d.) 3.1-2.9 Ga

21. The Hekpoort Formation underlies campus. It is made up of
(a.) quartzite (b.) ignimbrite (c.) basaltic andesite (d.) shale

22. It has been suggested that the Pretoria Group has been deposited in an ‘Epeiric Sea’. This can be defined as
(a.) a deep intracontinental ocean (b.) a shallow sea underlain by oceanic crust (c.) a narrow rift opening along a spreading center (e.g. the Red Sea) (d.) a shallow intracratonic seaway (e.g. the Black Sea)

23. A diamicite is indicative of what palaeoenvironment?
(a.) fluvial (b.) lacustrine (c.) glacial (d.) deep marine

24. Which process was responsible for the layering of the Rustenburg Layered Suite
(a.) Metamorphism (b.) Diagenesis (c.) Fractional Crystallization (d.) Sedimentation

25. What is the approximate age of the intrusion of the Rustenburg Layered Suite?
(a.) 2100 Ma (b.) 2053 Ma (c.) 2.053 Ma (d.) 2.65 Ga

26. Anorthosite is a common rock in the Rustenburg Layered Suite
It is dominantly made up of which mineral?
(a.) pyroxene (b.) olivine (c.) feldspar (d.) quartz

27. The intrusion of the Bushveld Complex is thought to be caused by
(a.) plate collision (b.) meteorite impact (c.) mantle plume (d.) subduction volcanics

28. With which South African lithology would you associate Platinum Group Elements?
(a.) Ecca Group (b.) Lebowa Granite Suite (c.) Central Rand Group (d.) Rustenburg Layered Suite

29. The Silverton Formation is often described as ‘hornfels’. Which of the following is the best description of hornfels?
(a.) a coarse-grained plutonic rock (b.) a fine-grained metamorphic rock with a sandstone protolith (c.) a fine-grained metamorphic rock with a shale protolith (d.) a fine-grained sedimentary rock

30. Which of the following stratigraphic units most commonly forms the floor to the Rustenburg Layered Suite?
(a.) the Rooiberg Group (b.) the Magaliesberg Formation (c.) the West Rand Group (d.) the Vermont Formation

31. Which of the following economic mineral reserves is NOT associated with the Bushveld Complex?
   (a.) Platinum  (b.) Gold  (c.) Vanadium (d.) Chrome (e) Tin (f.) Fluorite

32. Shatter cones and Pseudotachylite in the rock record are good evidence for what event?
   (a.) Rifting  (b.) Meteorite Impact (c.) Thrust faulting (d.) Magma Intrusion

33. The area around Parys, in the northern Free State has been proposed as a World Heritage Site. This is based on:
   (a.) the presence of fossil hominids (b.) the world’s largest layered intrusion in the area (c.) the site of a large-scale meteorite impact (d.) the presence of dinosaur fossils.

34. Which of the following set of times equates to the Mokolian Era?
   (a.) Earlier than 2500 Ma (b.) 2500-1600 (c.) 2050 Ma to 1080 Ma (d.) 1080-570 Ma (e.) 570 Ma-present

35. Which of the following set of times equates to the Archaean Eon?
   (a.) Earlier than 2500 Ma (b.) 2500-1600 (c.) 2050 Ma to 1080 Ma (d.) 1080-570 Ma (e.) 570 Ma-present

36. Which of the following set of times equates to the Phanerozoic Eon?
   (a.) Earlier than 2500 Ma (b.) 2500-1600 (c.) 2050 Ma to 1080 Ma (d.) 1080-570 Ma (e.) 570 Ma-present

37. Which of the following set of times equates to the Namibian Era?
   (a.) Earlier than 2500 Ma (b.) 2500-1600 (c.) 2050 Ma to 1080 Ma (d.) 1080-570 Ma (e.) 570 Ma-present

38. Which landmass lay immediately east of Durban during the Carboniferous?
   (a.) Australia (b.) India (c.) Antarctica (d.) South America (e.) North America

39. What is the correct order in which the following events took place (from oldest to youngest) on the Kaapvaal Craton?
   5. Pretoria Group 6. Klipriviersberg Group
   (a.) 123456 (b.) 321645 (c.) 321465 (d.) 213645 (e.) 431265

40. You encounter the following sequence of sedimentary rocks from the bottom to the top:
   Conglomerate, Granulestone, Sandstone, Limestone, Shale. This sequence could best be interpreted as:
   (a.) marine transgression (b.) marine regression (c.) onset of glacial conditions (d.) oxygenation of he atmosphere (e.) An orogenic event nearby

41. The process by which placer deposits are enriched by steady removal of fine, less dense material by flowing water is known as:
(a.) Willowing  (b.) Widowing  (c.) Minnowing  (d.) Winnowing  (e.) Windowing

42. The onset of the break-up of West Gondwana is marked by the Etendeka basalts in Namibia. This event took place at approximately:
(a.) 100Ma  (b.) 110Ma  (c.) 120 Ma  (d.) 130 Ma  (e.) 160 Ma  (f.) 180Ma

43. The onset of the break-up of Gondwana is marked by the Drakensberg basalts in South Africa. This event took place at approximately:
(a.) 100Ma  (b.) 110Ma  (c.) 120 Ma  (d.) 130 Ma  (e.) 160 Ma  (f.) 180Ma

44. The development of the Falklands-Agilhas Fracture Zone is associated with which of the following events?
(a.) the opening of the Indian Ocean  (b.) the opening of the Adamastor Ocean  (c.) the opening of the Atlantic Ocean  (d.) the closure of the Adamastor Ocean  (e.) the closure of the Khomas Sea

45. The development of the Gariep Belt is associated with which of the following events?
(a.) the opening of the Indian Ocean  (b.) the opening of the Adamastor Ocean  (c.) the opening of the Atlantic Ocean  (d.) the closure of the Adamastor Ocean  (e.) the closure of the Khomas Sea

46. The development of the Damara Belt is associated with which of the following events?
(a.) the opening of the Indian Ocean  (b.) the opening of the Adamastor Ocean  (c.) the opening of the Atlantic Ocean  (d.) the closure of the Adamastor Ocean  (e.) the closure of the Khomas Sea

47. Put the following Periods/Epochs in the correct order, from oldest to youngest:
(a.) 123456  (b.) 321645  (c.) 321465  (d.) 213645  (e.) 431265

48. Southern Africa experienced uplift about 5 million years ago. Approximately how much uplift took place along the Drakensberg mountain area?
(a.) 50m  (b.) 300m  (c.) 800m  (d.) 1200m  (e.) 2000m

49. Southern Africa experienced uplift about 20 million years ago. Approximately how much uplift took place along the Drakensberg mountain area?
(a.) 50m  (b.) 300m  (c.) 800m  (d.) 1200m  (e.) 2000m

50. The Aesvoëlkop, Makgabeng and Mogalakwena Formations fall into which group?
(a.) Central Rand Group  (b.) West Rand Group  (c.) Pretoria Group  (d.) Waterberg Group  (e.) Ecca Group

(50 marks)
Section B; Short answers
Write your answers to this section in the spaces provided:

Examine the following geological map, and answer the questions in the spaces provided below (dotted lines are contour lines in metres):

51. What is the strike of the bedding?

52. What is the dip of the bedding?

53. What is the dip direction of the bedding?

54. In the box below, draw a sketch section along AB, showing the geology and topography

(10 marks)
55. In the box below draw a sketch geological map of southern Africa, which should show the following features:


56. In the box below draw-up a table with each of the above features (those in question 55) in the order in which they formed (i.e. 1=oldest, 10=youngest).

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57. In the space below, draw a sketch cross-section through the Bushveld Complex indicating the relative position of the major rock units (including the floor and roof rocks). Your cross-section should also show what lithologies (rock-types) are characteristic of each section of the Bushveld, and should show where you would expect to find what economic minerals or rock types.

(10 marks)

Total: 100 marks.
## SECTION A ANSWER SHEET.

**INDICATE YOUR ANSWER BY PLACING AN ‘X’ OVER THE APPROPRIATE LETTER**

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