National Exams May 2018

04-BS-14, Geology

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.

2. This is a CLOSED BOOK EXAM. Candidates may use one of two calculators, the Casio or Sharp-approved models.

3. Four (4) questions constitute a complete exam paper. YOU MUST ANSWER QUESTIONS 1 TO 3.

4. On Question 4, the first four (4) answers, as they appear in the answer book, will be marked. The only exception will be if the candidate clearly indicates that another question should be substituted for a specified question that was answered previously.

5. The marks assigned to the subdivisions of each question are shown for information.

6. The total number of marks for the exam is 100

Question 1. Multiple Choice / True and False 20 Marks

****NOTE** write your answers in the Exam Booklet (ie not on this page).**

1. Which of the following is a mafic rock?
   a. Granite
   b. Rhyolite
   c. Basalt
   d. Andesite

2. The furthest south glaciers have advanced in North America (from evidence of end moraines) was:
   a. North edge of Texas
   b. North edge of Mexico
   c. 49th parallel
   d. Southern edge of Illinois
   e. Southern tip of Ontario

3. Following an earthquake a seismograph detects Body Waves and Surface Waves in the order of:
   a. P-wave→S-wave→L-wave
   b. S-wave→P-wave→L-wave
   c. L-wave→P-wave→S-wave
   d. S-wave→P-wave→L-wave→T-wave

4. _____ is one of the three ways a glacier can move over its bed.
   a. Frost heaving
   b. Basal slip
   c. Morainal sliding
   d. Crevassal slip

5. The most widespread metamorphic rocks exposed at the Earth's surface are formed by:
   a. Regional metamorphism
   b. Hydrothermal metamorphism
   c. Contact metamorphism
   d. Burial metamorphism
   e. Meteorite impact metamorphism

6. During mountain building episodes, originally flat lying sedimentary and volcanic rocks are often bent into a series of _____.
    a. Folded anticlines and synclines
    b. Box pleats
    c. Horsts and grabens
    d. Heaves and sags

7. The physical removal of dissolved or disaggregated rock from the site of weathering by wind, water, or ice is termed _____.
    a. ablation
    b. recidivism
    c. solifluction
    d. erosion

8. _____ is the dissolution or decomposition of minerals and rocks.
    a. Mechanical weathering
    b. Chemical weathering
    c. Hydrolysis
    d. Rendering

9. Plutonic rocks are emplaced at depth yet they can be seen at the Earth's surface due mainly to _____.
    a. Widespread igneous inversion
    b. Erosion of overlying rocks due to uplift
    c. Catastrophic violent upheavals that bring them to the surface
    d. Continual ongoing intrusion after the magma solidifies

10. The principal causes of mechanical fragmentation of rocks *in place* are _____.
    a. erosion and transport by moving wind, water, or ice
    b. the relentless actions of Sisyphus
    c. always inscrutable because they happened at some time in the past
    d. biologic activity, expansion from unloading, frost wedging

11. The three major processes involved in chemical weathering are _____.
    a. dissolution, hydrolysis, and oxidation
    b. precipitation, ion exchange reactions, and degasification
    c. carbonation, dissimulation, and salinization
    d. recrystallization, pitting, and rinsing

12. A(n) _____ is a depositional feature composed primarily of till and usually associated with continental glaciation, not with alpine glaciers.
    a. Moraine
    b. drumlin
    c. cirque
    d. outwash deposit

13. The _____ was the most recent Pleistocene glacial episode in North America.
    a. Wisconsinan
    b. Kansan
    c. Indianan
    d. Dakotan

14. The _____ of the geologic time scale occurs within the time of Earth's most recent "Ice Age."
    a. Proterozoic Eon
    b. Pleistocene Epoch
    c. Permian Period
    d. Pliocene Epoch

15. Most crustal deformation occurs in active tectonic zones _____.
    a. deep within old plate interiors
    b. at the base of sedimentary basins
    c. in thick piles of unconsolidated sedimentary strata
    d. along plate margins

16.) A syncline is _____.
    a. a fold with only one limb
    b. a fold in which older flanking strata dip toward the axis
    c. a paralytic drunken fold characterized by recumbent limbs
    d. a fold in which the older central strata dip away from the axis

17. Which of the following best defines a mineral and a rock?
    a. A rock has an orderly, repetitive, geometric, internal arrangement of minerals; a mineral is a lithified or consolidated aggregate of rocks.
    b. A rock consists of atoms bonded in a regular, geometrically predictable arrangement; a mineral is a consolidated aggregate of different rock particles.
    c. In a mineral the constituent atoms are bonded in a regular, repetitive, internal structure; a rock is a lithified or consolidated aggregate of minerals.
    d. A mineral consists of its constituent atoms arranged in a geometrically repetitive structure; in a rock, the atoms are randomly bonded without any geometric pattern.

18. Minerals consist of an ordered array of atoms or ions that are _____.
    a. all the same size and charge
    b. always packed together in cubes or octahedra
    c. physically attached to each other by shared protons
    d. chemically bonded in a regular crystalline structure

19. Silicate igneous rocks make up the _____.
    a. majority of shallow rocks covering the continents but everything deeper is sedimentary and metamorphic
    b. bulk of the Earth's crust and mantle
    c. densest rocks and are mainly found in the core
    d. bulk of volcanic mountains but not much else on Earth

20. Explosive volcanic eruptions occur _____.
    a. when violently escaping gases evolve suddenly to drop the magma density and propel molten magma from the chamber
    b. in response to deflation of the volcano
    c. when crystallization forces exceed the strength of the volcano
    d. whenever basaltic magma extrudes on the seafloor

Question 2. True and False 10 marks

****NOTE** write your answers in the Exam Booklet (ie not on this page).**

21. Quartz weathers readily to aluminum-rich clay minerals.

22. Feldspars commonly decompose during weathering to clay minerals, silica, and soluble constituents.

23. Ferromagnesian minerals (like olivine and pyroxene) that crystallize at high temperatures in Bowen's reaction series are generally much less susceptible to chemical weathering than quartz.

24. In detail, there is no geologic evidence that mid-ocean ridges spread at uniform rates or even symmetrically.

25. As dense seafloor is subducted, it penetrates the surrounding mantle and ruptures it causing the largest earthquakes.as the mantle fractures.

26. Calcite and halite react with dilute acids to evolve carbon dioxide.

27. Colour is one of the most diagnostic properties of minerals.

28. The Richter earthquake magnitude scale is based on the total amount of energy released by the earthquake, as measured on a seismograph.

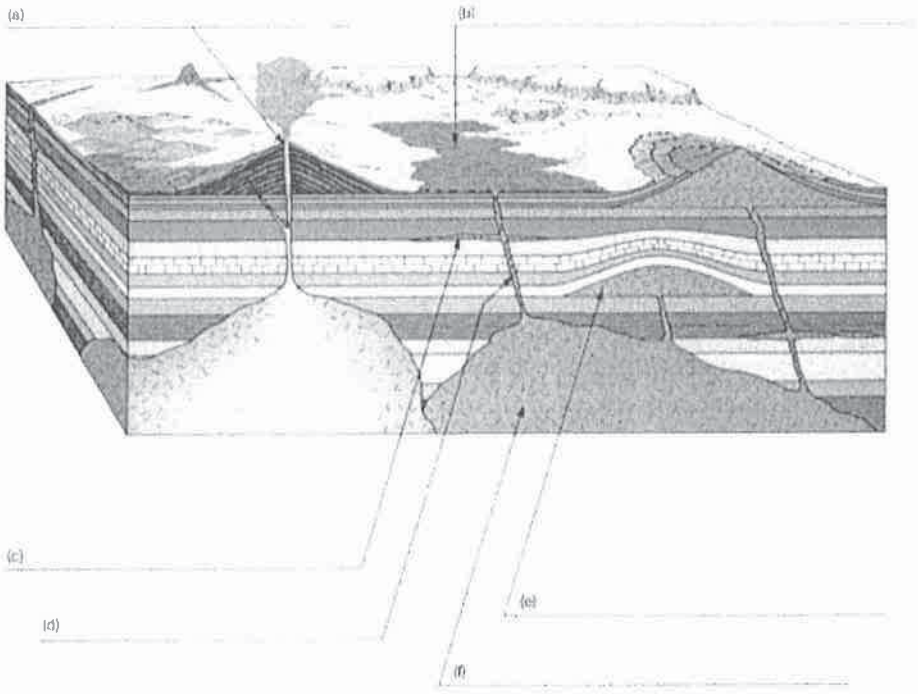
29. In general, rocks of the continental crust are less dense than rocks of the oceanic crust.

30. Evidence for the supercontinent Pangaea includes fit of continents, matching fossils and mountain chains separated by ocean basins, and ancient glaciated rocks in the southern hemisphere.

Question 3. Short Answer 30 marks

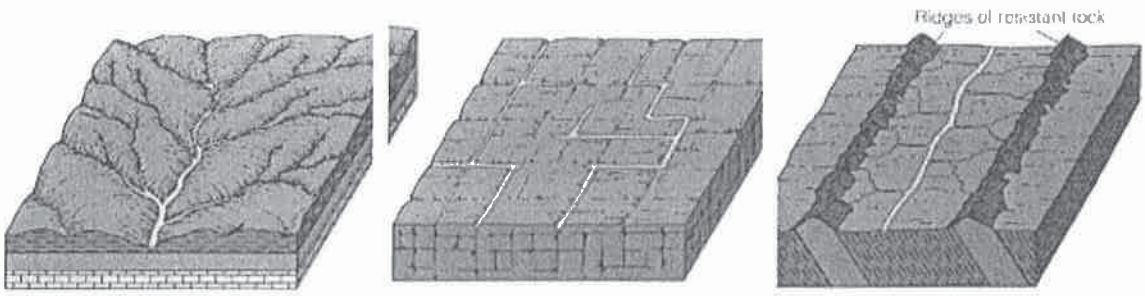
31. Within the blanks provided, write the name of the feature that is denoted with arrows.

6 marks

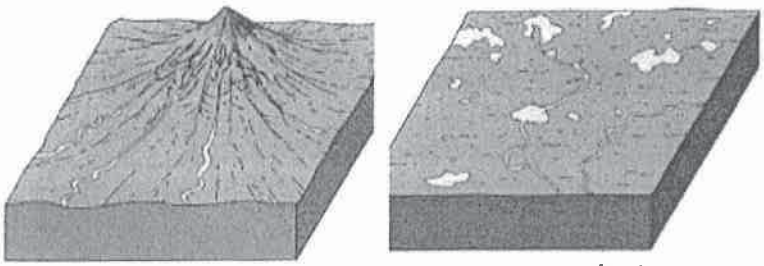


32. Label the drainage pattern:

5 marks



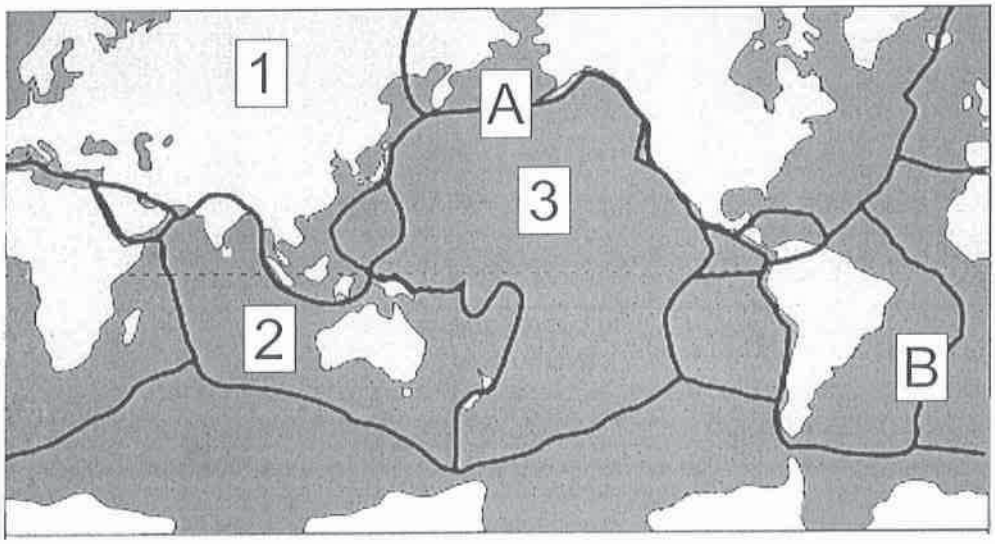
a. _____ drainage b. _____ drainage c. _____ drainage



d. _____ drainage e. _____ drainage

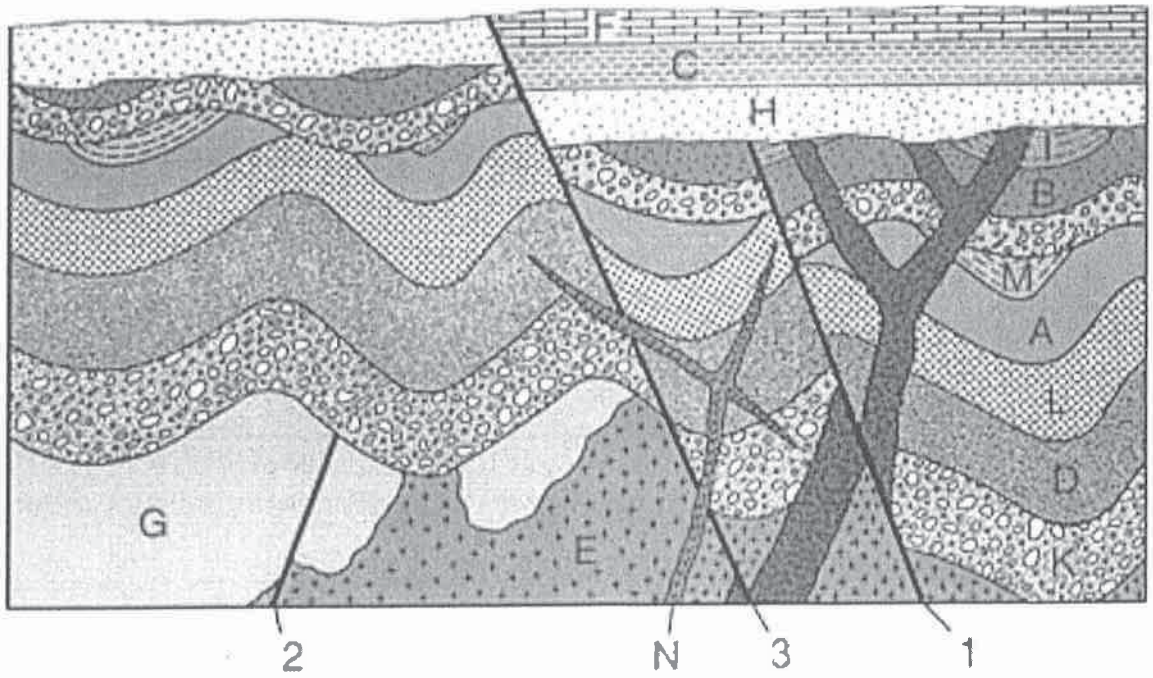
33. In the following map of the Earth the continents and oceans are shown. The tectonic plates and boundaries are also indicated with the thick black lines. Do Not Mark Anything on the map and do not hand it in with your exam booklet. Clearly write the answers in your exam booklet
    a. Name the 3 tectonic plates (1, 2 and 3)
    b. Name each type of tectonic boundary indicated in capital letters (A, B)

6 marks



34. For the cross-section shown below, list the geologic events that caused the current configuration in chronological time.

13 marks



Question 4. Answer four (4) of the following questions: 40 marks

35. List and describe five (5) factors that influence mass wasting.

36. Sketch and describe the hydrologic cycle.

37. Name three (3) types of glaciers and give key characteristics of each.

38. List and describe three (3) erosional features and three (3) depositional features associated with glaciers.

39. Describe Bowen's Reaction Series.

40. List and describe four (4) types of volcanoes.

41. Draw a typical permafrost profile, label, and describe the layers. Beside the profile (i.e. correlating it to depth), sketch a graph of temperature versus depth for summer and winter.

42. Distinguish between the following. When appropriate, use diagrams and examples to clarify your explanations. **2 marks each**
    a. Joints and faults
    b. Unconformity and non-conformity.
    c. Polymorphic and isomorphic.
    d. Elastic and plastic strain
    e. Dyke and sill.

43. A landfill is located 1.5 km away from a stream. The free surface of the water table below the landfill is at an elevation of 210 m (above mean sea level). The groundwater flow is perpendicular to the stream. The free surface where it enters the stream is at an elevation of 203m. The soil in which the groundwater flows has a hydraulic conductivity of $K=5\times10^{-4}$ m/s and a porosity of n=30%.
    (Useful equations: $v=-Ki$; $i = \Delta h/L$; $v_s = v/n$; $h = z + u/\gamma_w$)
    a. Assuming that only advection controls the solute transport, how long will it take for a solute entering the groundwater under the landfill, to reach the stream? **7 marks**
    b. A standpipe piezometer is installed through the landfill. The water intake is at the bottom of the pipe at an elevation of 205m. If we lower a pressure gauge to the bottom of the piezometer, what pressure in kPa will we read? **3 marks**