

National Exams December 2016

**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 4.
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. The total number of marks for the exam is 100

**Question 1. Multiple Choice / True and False 20 Marks**

1. The best way to determine the age a pre-Cambrian rock is:
  - a. Tree rings
  - b. Radioactive dating
  - c. Carbon14 dating
  - d. Asking the rock
  
2. Which of the following is mafic?
  - a. Granite
  - b. Rhyolite
  - c. Basalt
  - d. Andesite
  
3. 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
  
4. 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
  
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. When does permanent rock deformation occur?
  - a. once its elastic limit is surpassed
  - b. when it goes on a real bender
  - c. once it is completely lithified and becomes inflexible
  - d. only after it comes to be located on a plate margin

7. When do rocks succumb to ductile deformation?
- at great depth under active mountain belts with high confining pressure and low strain rates or prolonged strain
  - in fault zones with intermittent high strain rates
  - at shallow depth, at low confining pressure, and low temperature
  - on the rims of meteorite impact craters
8. Which of the following best defines a mineral and a rock?
- A rock has an orderly, repetitive, geometric, internal arrangement of minerals; a mineral is a lithified or consolidated aggregate of rocks.
  - A rock consists of atoms bonded in a regular, geometrically predictable arrangement; a mineral is a consolidated aggregate of different rock particles.
  - In a mineral the constituent atoms are bonded in a regular, repetitive, internal structure; a rock is a lithified or consolidated aggregate of minerals.
  - 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.
9. The physical removal of dissolved or disaggregated rock from the site of weathering by wind, water, or ice is termed \_\_\_\_\_.
- ablation
  - recidivism
  - solifluction
  - erosion
10. \_\_\_\_\_ is one of the three ways a glacier can move over its bed.
- Frost heaving
  - Basal slip
  - Morainal sliding
  - Crevassal slip

TRUE or FALSE

11. In locations with continuous permafrost the active layer never melts.
12. Engineering solutions for problems with permafrost include thermosyphons and insulation to aid in melting of permafrost.
13. An aquifer is an impermeable layer which serves as a confining layer above an aquiclude which has the capacity for transmitting groundwater.
14. A spring is a place where the groundwater flows into the ground.
15. Oxbow lakes form when a mature meandering stream cuts off a meander.
16. Drumlins and roche moutonnees have the same overall shape however drumlins are composed of till with and roche moutonnees are composed of rock.
17. Normal faults are caused by extensional tectonic forces and reverse faults are caused by compressional tectonic forces.
18. The water velocity required to mobilize a grain of silt is greater than that which will mobilize a grain of sand.
19. Quartz is a three dimensional arrangement of silica tetrahedra, while biotite is a chain-like arrangement.
20. A mineral's color and streak are always a consistent and reliable property for identification.

## Question 2. Relative time

20 marks

Note: there are two parts to this Question

### PART A

21. For the cross-section shown below in Figure Q21, list the geologic events that caused the current configuration in chronological time. Be sure to identify rock units, identify, list and **explain** in sequence ALL the events that lead to the present situation. If you cannot determine which of two or more rocks/events is the older, explain why not.

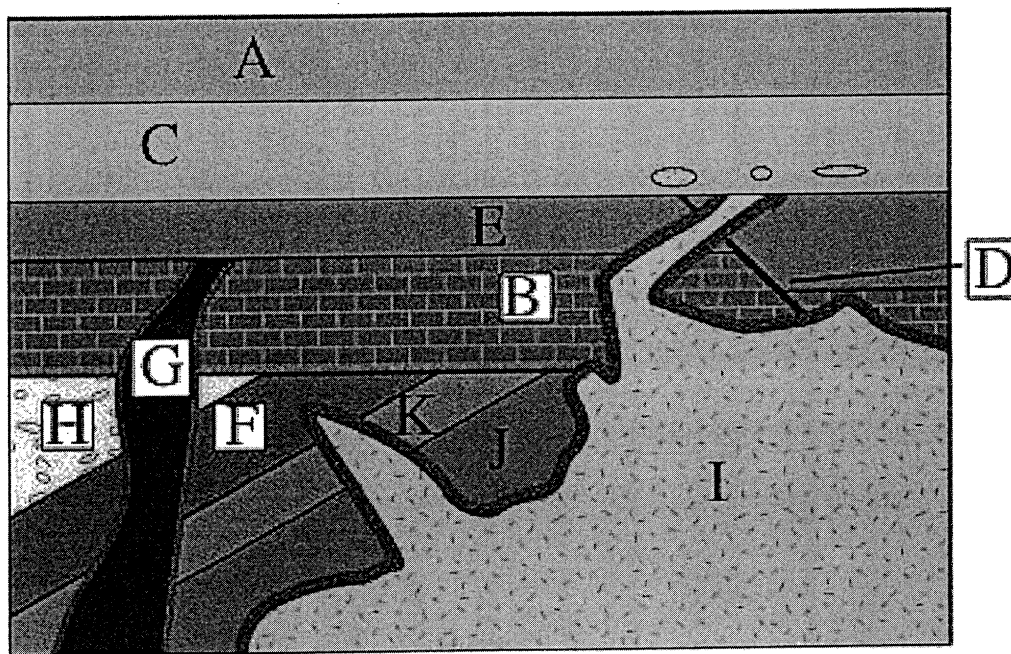


Figure Q21. Geological Cross-section

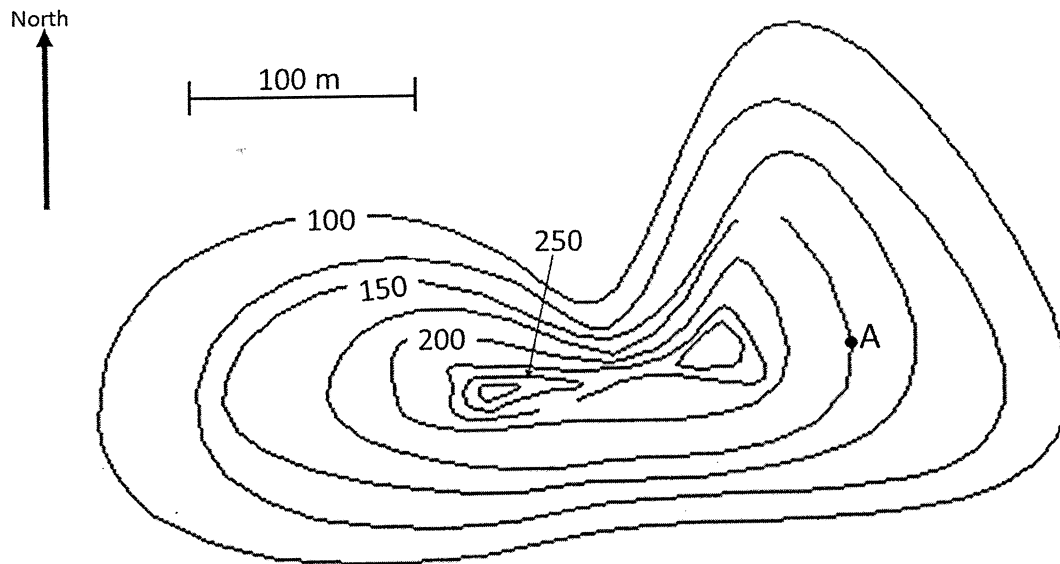
### PART B

22. List, describe and sketch 3 types of unconformities.

### Question 3. 3-Point Problem and Tectonic Plates 20 marks

23. On the contour map below (Figure Q23) a coal seam was discovered at point A. The seam appears to dip to the West at 14 degrees, however, the geologist is not sure. Assuming the geologist found the true dip:

- Name the strike and dip of the coal layer.
- Trace the outcrop pattern on the surface contours.
- What is the apparent dip in the direction S60°W.



Note: contours are in meters

Figure Q23. Contour Map of Coal Seam

Useful equations:  $\alpha' = \arctan(\cos\theta \times \tan \alpha)$ ;  
Where,  $\alpha$  = actual dip

24. In the following map (Figure Q24) of the Earth the continents and oceans are shown. The tectonic plates and boundaries are also indicated with the thick black lines. Answer this question completely within the answer booklet. i.e. **DO NOT** mark anything on the map and submit with your answer. 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)

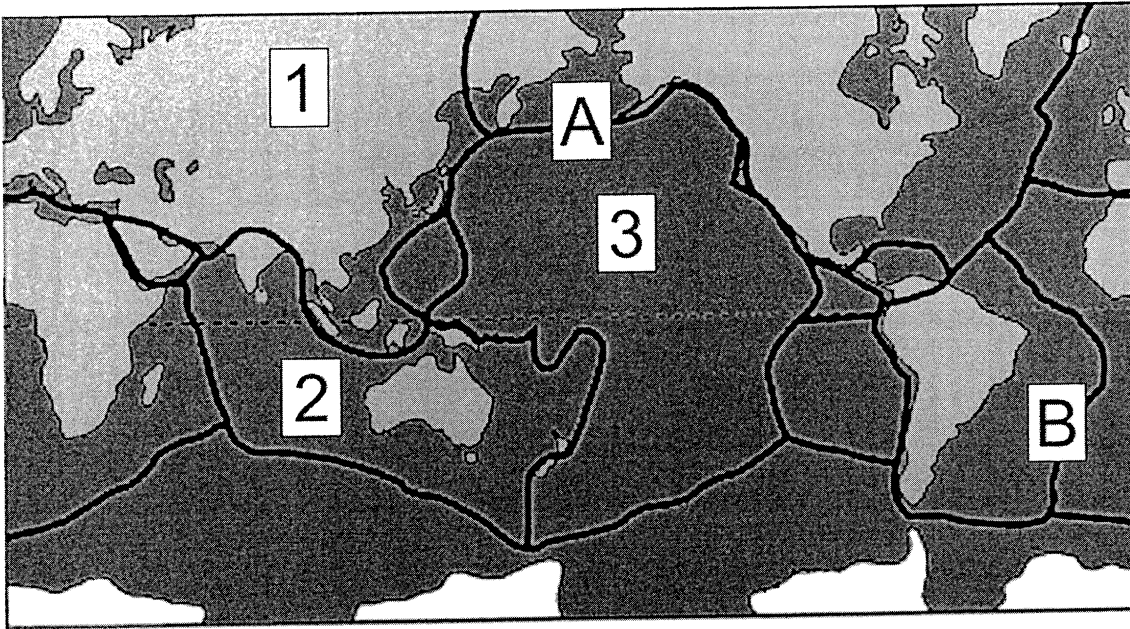


Figure Q24. Tectonic Map of the Earth

**Question 4. Write the answer to four (4) of the following questions: 40 points**

25. 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.
26. Name and draw four (4) drainage patterns. For each pattern, provide a reasonable explanation of the type of geology that may exist below the surface that has directly influenced these drainage patterns.
27. Describe four (4) factors that affect mass wasting.
28. Sketch and describe the hydrologic cycle.
29. Name three (3) types of glaciers and give key characteristics of each.
30. Sketch a stress-strain graph, label the axes and draw 2 characteristic behaviour curves: One for a brittle sample and a second for ductile sample.
31. List and describe two (2) erosional features and two (2) depositional features associated with glaciers.