

NATIONAL EXAMINATIONS – December 2007

04-BS-14 Geology

3 hours duration

NOTES:

- A. 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.
- B. This is an CLOSED BOOK EXAM. Candidates may use one of two calculators, the Casio or Sharp approved models.
- C. FIVE (5) questions constitute a complete exam paper. YOU MUST ANSWER QUESTIONS 1 TO 4. Candidates must choose one more question from any of the remaining questions. Where stated in the examination, please hand in any additional pages with your exam booklet.
- D. The first of any of Questions 5 to 7 as it appears in the answer book will be marked, unless the candidate clearly indicates that another question should be substituted for a specified question that was answered previously.
- E. Each question is of equal value. The marks assigned to the subdivisions of each question are shown for information, and are generally of equal value. The total marks for the exam is 100.

***** IMPORTANT: YOU MUST ANSWER QUESTIONS 1, 2, 3, and 4 *****

The structure of the earth, plate tectonics, earthquakes and igneous activity.

1.

- a) In the accompanying map of the Earth (Fig. 1, next page), the continents are shown in white and the oceans are shown in grey. In addition, the boundaries between tectonic plates are shown as solid black lines.

Label the following features listed below directly on the map, using the appropriate letter corresponding to each feature. {5 marks}

[A] Arabian Plate

[B] Mid-Atlantic Ridge

[C] a strike-slip plate boundary

[D] a triple-point junction where 3 subductions zones meet

[E] a mountain belt created by continent-continent collision

- b) Geophysical studies have revealed that the Earth is composed of several distinct layers. Starting from the earth's surface, state each of the major layers and briefly describe its major distinguishing features. {10 marks}
- c) Earthquakes commonly occur every year. Define the following seismological terms. {5 marks}
- (i) focus
 - (ii) epicentre
 - (iii) aftershock
 - (iv) seismic body wave
 - (v) earthquake magnitude

***** IMPORTANT: REMOVE THIS PAGE FROM THE EXAM PAPER!! *****

Clearly PRINT your name on this page and hand it in with your answer booklet.

See Question 1 for instructions.

NAME: _____

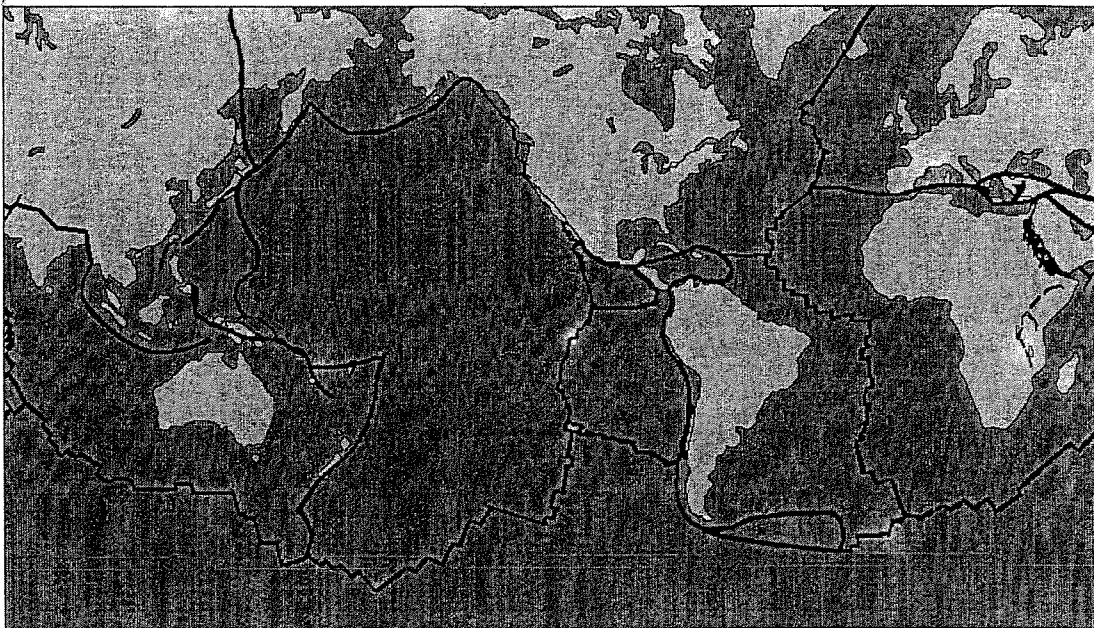


Fig. 1

Minerals and rocks including their formation, identification, basic properties, and classification.

2.

- a) For each mineral listed below, state the requested physical property. {5 marks}
- (i) potassium feldspar - lustre
 - (ii) pyrite - streak
 - (iii) quartz - hardness
 - (iv) actinolite - most common crystal habit
 - (v) biotite - type of cleavage
- b) Name one specific mineral that belongs to each of the following mineral groups. {5 marks}
- (i) amphiboles
 - (ii) feldspars
 - (iii) pyroxenes
 - (iv) micas
 - (v) feldspathoids
- c) State what kind of rock is best described by the following: {5 marks}
- (i) Intrusive igneous rock. Intermediate color; coarse grain. Slow-cooled mineral equivalent of andesite
 - (ii) Non-foliated very-fine-grain metamorphic rock; usually produced by high-temperature contact metamorphism around intrusive bodies
 - (iii) Clastic sedimentary rock composed of very fine (clay-size) sediment particles
 - (iv) Foliated fine-grain metamorphic rock containing microscopic mica particles in parallel alignment. Silky texture; often wavy cleavage
 - (v) Extrusive igneous rock; light color; fine grain. Rapid-cooled mineral equivalent of granite
- d) Define the following: {5 marks}
- (i) plutonic rock
 - (ii) clastic sedimentary rock
 - (iii) diagenesis
 - (iv) metamorphic facies
 - (v) conglomerate

Occurrence, flow, and quality of groundwater.**3.**

- a) Define the following terms: {10 marks}
- (i) aquifer
 - (ii) porosity
 - (iii) permeability
 - (iv) consolidated porous media
 - (v) confined aquifer
- b) What is the velocity of groundwater flow in an aquifer with a hydraulic conductivity of 25 cm/s which has a discharge point at an elevation of 248 metres above sea level and recharge point at an elevation of 273 metres above sea level over a horizontal distance of 75 metres? {5 marks}
- c) What is meant by groundwater quality? Give an example of two physical quantities measured by scientists and engineers which are considered to be important indicators of groundwater quality. {5 marks}

Introductory aspects of structural geology including faulting, folding, and the overall formation of discontinuities and their effect on the engineering properties of rock masses. Aerial photography and geological maps.

***** IMPORTANT: REMOVE THIS PAGE FROM THE EXAM PAPER!! *****

Clearly PRINT your name on this page and hand it in with your answer booklet.

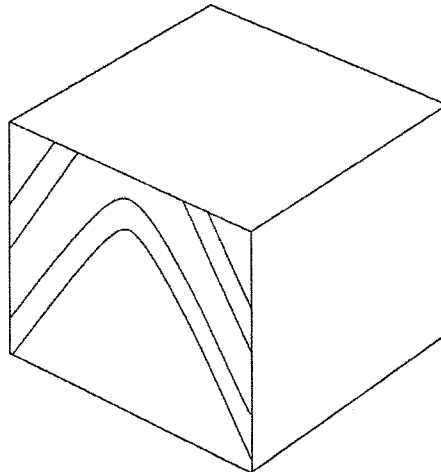
See Question 4 for instructions.

NAME: _____

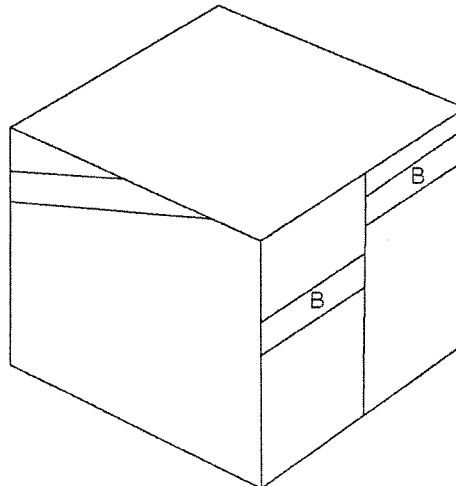
4.

- a) The following block diagrams show several rock layers which have been deformed in some way. Assuming a rock layer always retains the same true thickness, complete all visible sides of the diagram by labelling all rock layers (e.g. A, B, C, D, etc.) on each side and adding all contacts, strikes, dip directions, associated fold hinges with symbols, and arrows showing the relative direction of fault movement (if present). Also name, as precisely as possible, all geologic structures or features in the diagram. {10 marks}

(i)



(ii)



- b) Define, with the aid of diagrams, the various kinds of unconformities. {6 marks}
- c) Briefly explain how geologic structures can have an impact on the design and construction of engineering structures such as buildings or dams. {4 marks}

***** IMPORTANT: COMPLETE ONLY ONE MORE QUESTION ***
FROM QUESTIONS 5, 6, OR 7**

Processes of weathering, erosion, transport, and deposition of geological materials and their results of significance to engineering. [glaciation, permafrost]

5.

- a) Briefly define the following terms. {10 marks}
- (i) col
 - (ii) recessional moraine
 - (iii) drumlin
 - (iv) kettle lake
 - (v) kame
- b) Glaciation affected a large part of Canada and is responsible for many surficial features that are the basis of man geological-engineering investigations. Answer TRUE or FALSE to the following statements. **Please record your answers in the answer booklet. Do NOT answer on this exam paper.** {3 marks}
- (i) Erosion by glaciers takes place mainly by abrasion and quarrying.
 - (ii) Glacial till is an important industrial resource in Canada.
 - (iii) The most recent ice age occurred during the early Tertiary period.
- c) It is often important for engineers to understand the nature of permafrost. Answer TRUE or FALSE to the following statements. **Please record your answers in the answer booklet. Do NOT answer on this exam paper.** {4 marks}
- (i) The seasonal development of a thawed "active layer" makes it impermeable to the subsurface movement of water contaminants.
 - (ii) Permafrost thawing could potentially contribute to global warming.
 - (iii) Permafrost is soil or rock that remains below 5°C throughout the year.
 - (iv) Permafrost underlies more than 50% of the ground surface of Canada.
- d) List 3 common engineering solutions used when building structures in permafrost areas. {3 marks}

Processes of weathering, erosion, transport, and deposition of geological materials and their results of significance to engineering. [running water]

6.

- a) List the various ways in which a stream can transport sediment. {3 marks}
- b) Briefly define the following terms: {6 marks}
 - (i) saltation
 - (ii) stream competence
 - (iii) stream piracy
- c) Briefly describe the formation of a natural levee and how it relates to a back swamp and yazoo stream. {6 marks}
- d) Explain what the following statement means and why it is true: "When an area changes from rural to urban, the lag time of stream discharge is shorter and the flood peak is higher." {5 marks}

Processes of weathering, erosion, transport, and deposition of geological materials and their results of significance to engineering. [wind and wave processes, mass wasting]

7.

a) Select the best answer for each of the following multiple-choice questions. **Please record your answers in the answer booklet. Do NOT answer on this exam paper. {6 marks}**

- i) What is the angle of repose?
- [A] a flat slope
 - [B] overhanging cliffs
 - [C] the slope at which mudflows begin to occur
 - [D] the slope of high mountain rivers
 - [E] the shallowest slope that loose particles can maintain
 - [F] none of the above
- ii) What type of mass wasting is channelized like a river?
- [A] creep
 - [B] earthflow
 - [C] lahar
 - [D] mudflow
 - [E] rockslide
 - [F] slump
 - [G] solifluction
 - [H] none of the above
- iii) Which type of mass wasting is associated with permafrost?
- [A] creep
 - [B] earthflow
 - [C] lahar
 - [D] mudflow
 - [E] rockslide
 - [F] slump
 - [G] solifluction
 - [H] none of the above
- iv) What is the most common type of mass wasting on active volcanoes?
- [A] creep
 - [B] earthflow
 - [C] lahar
 - [D] mudflow
 - [E] rockslide
 - [F] slump
 - [G] solifluction

- [H] none of the above
- v) What is a rock avalanche?
- [A] a glacial moraine
 - [B] a snow avalanche with an abundance of rock in it
 - [C] another term for rockslide
 - [D] the fastest type of mass wasting
 - [E] the slowest type of mass wasting
 - [F] none of the above
- vi) What is the ultimate force that causes mass wasting?
- [A] electricity
 - [B] gravity
 - [C] tides
 - [D] water
 - [E] wind
 - [F] all of the above
 - [G] none of the above
- b) List and briefly describe three mechanisms by which particles can be transported by wind. {6 marks}
- c) Define the following, and describe three landforms associated with each. {8 marks}
- (i) an emergent coast
 - (ii) a submergent coast