

## NATIONAL EXAMINATIONS – May 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.
- 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**

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] African Plate
- [B] a plate entirely bounded by subduction zones
- [C] a divergent plate boundary
- [D] a mountain range associated with plate subduction
- [E] the plate with the oldest oceanic crust

- b) Sketch a cross-section of a divergent plate margin through the top 100 km of the Earth as it would appear in within continental crust. Label all important features and name one locality on the Earth where this can be found. {5 marks}

- c) Earthquakes commonly occur every year. {5 marks}

- (i) Explain the difference between a P-wave and and S-wave.
- (ii) Name two kinds of surface waves.
- (iii) In terms of plate-tectonic theory, where do the vast majority of earthquakes originate?

- d) Define the following terms. {5 marks}

- [A] diapir
- [B] plateau or flood basalt
- [C] geothermal gradient
- [D] porphyry
- [E] magmatic arc

**\*\*\* 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: \_\_\_\_\_

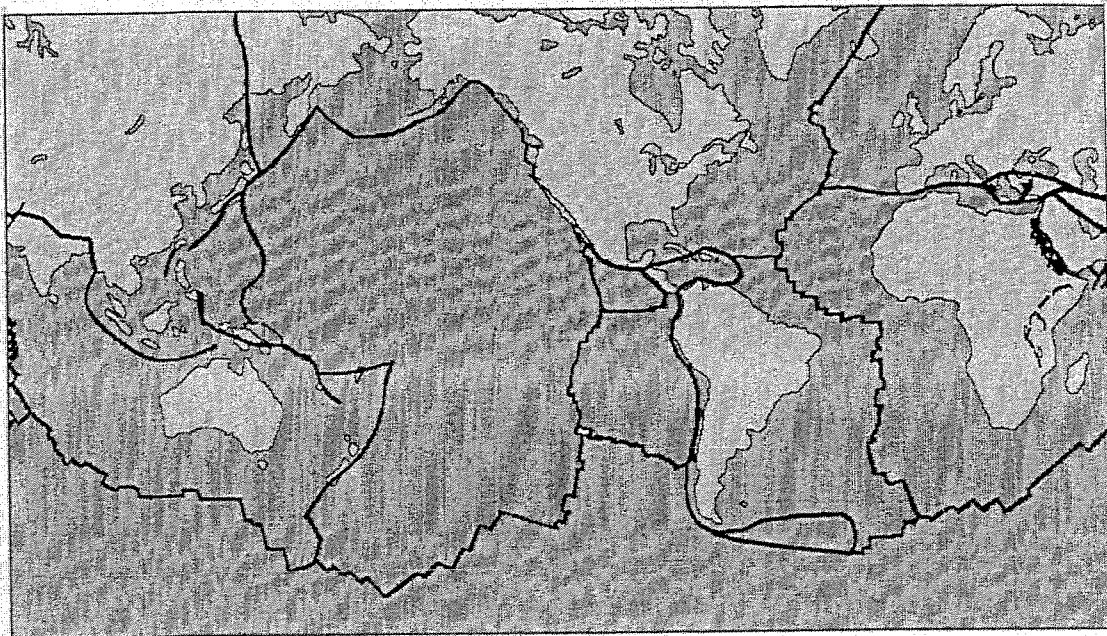


Fig. 1

2.

- a) For each mineral listed below, describe or state the requested physical property. {5 marks}
- (i) chalcopyrite - lustre
  - (ii) hematite - streak
  - (iii) apatite - hardness
  - (iv) calcite - crystal form
  - (v) amphibole - cleavage
- b) Name one mineral that belongs to the following group: {5 marks}
- (i) framework silicate
  - (ii) double-chain silicate
  - (iii) single-chain silicate
  - (iv) sheet silicate
  - (v) chloride
- c) State what kind of rock you would expect to form in each of the following natural environments: {5 marks}
- (i) bed of a fast-running stream
  - (ii) sandy beach
  - (iii) deep ocean floor
  - (iv) warm, shallow sea
  - (v) saline lake in a hot, arid desert
- d) State a metamorphic rock that could be created if the following rocks were metamorphosed. {5 marks}
- (i) limestone
  - (ii) quartz sandstone
  - (iii) shale
  - (iv) granite
  - (v) basalt

3.

- a) Rearrange the following list of geologic materials in terms of increasing porosity {2.5 marks}

clay, glacial till, gravel, sand, granite

- b) For each geologic material in (a), comment on its permeability (poor, moderate, good, or excellent) {2.5 marks}

- c) An understanding of groundwater flow is important in many geological-engineering and civil-engineering applications.

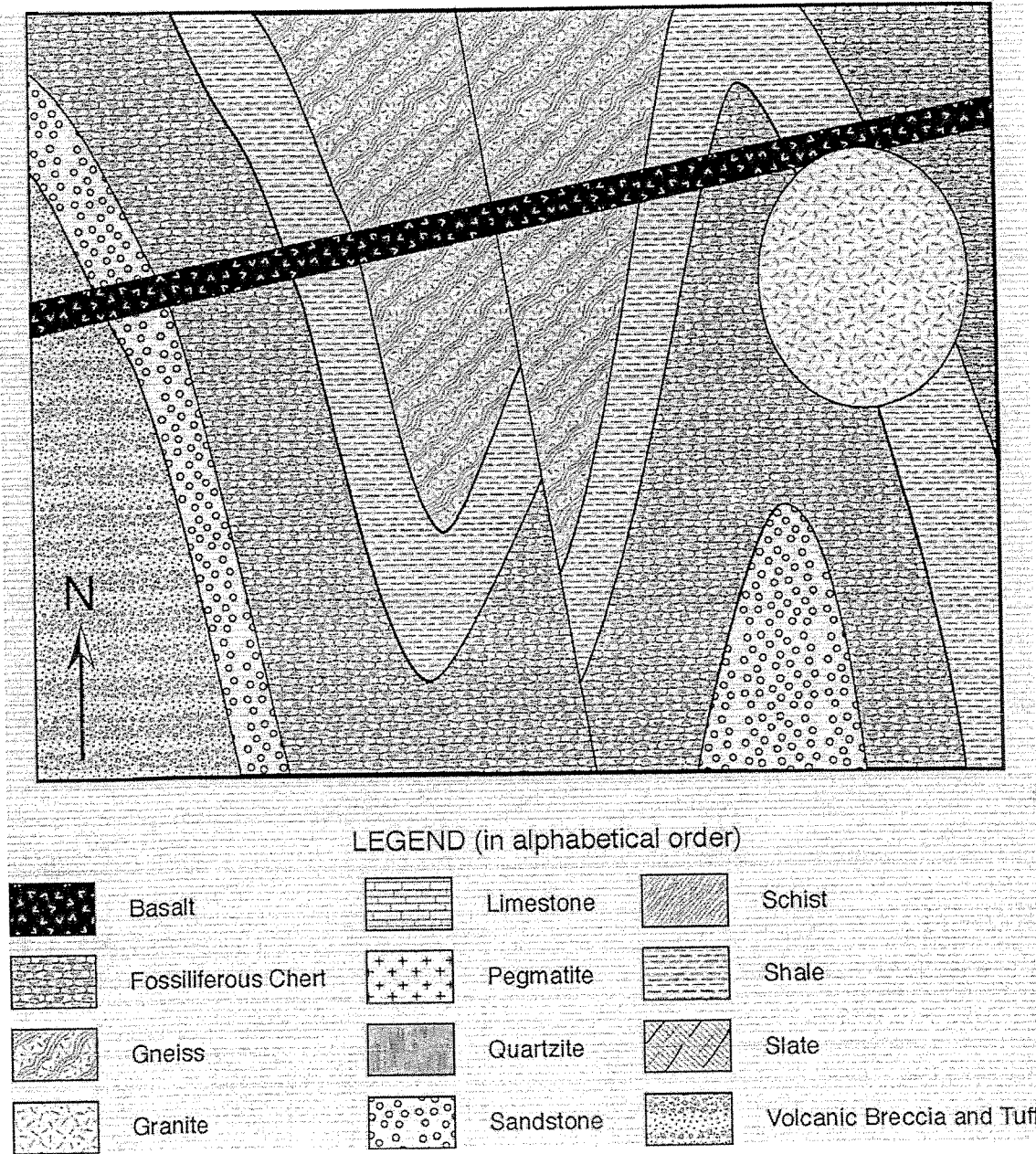
- (i) Consider two points A and B which lie on the water table. If Point A is at an elevation of 130 m above sea level, Point B is at an elevation of 100 m above sea level, and they are separated by a horizontal distance of 40 m, calculate the hydraulic gradient between the two points. {2 marks}

- (ii) Write the general equation describing the velocity of groundwater flow and state what all of the terms are. {5 marks}

- d) Define the following terms: {8 marks}

- (i) saturated zone
- (ii) perched water table
- (iii) unconfined aquifer
- (iv) sinkhole

4. Consider the geological map of a flat, horizontal terrain shown below.



- a) Using the information in the map, outline in point form the geologic history of the region. {12 marks}
- b) Describe as much geological information as you can about the fault. {3 marks}
- c) What two kinds of geologic folds are shown in the map? {2 marks}
- d) Briefly explain how faults can be (i) a help and (ii) a hazard to society. {3 marks}

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

5.

- a) Briefly define the following terms. {10 marks}
- (i) valley glacier
  - (ii) equilibrium line or snow line
  - (iii) cirque
  - (iv) medial moraine
  - (v) fjord
- b) Briefly describe 3 possible causes of glacial ages. {6 marks}
- 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) Permafrost is as solid as concrete.
  - (ii) A saturated zone above the permafrost layer can be easily distinguished from the permafrost in the winter.
  - (iii) Permafrost occurs at depths ranging from a few millimetres to a few centimetres beneath the surface.
  - (iv) Solifluction is a hazard that is associated with permafrost.

6.

- a) In the geological context, briefly define the following terms: {6 marks}
- (i) stream channel
  - (ii) drainage basin
  - (iii) divide
- b) List and briefly describe four (4) different drainage patterns and give an example of the kind of geologic terrain in which each may be found. {8 marks}
- c) Streams can wreak havoc on cities due to flooding. With this in mind, answer the following questions. {8 marks}
- (i) Briefly explain how urbanization can contribute to flooding.
  - (ii) Name two geologic materials that usually comprise flood deposits.
  - (iii) List four flood-control structures used to mitigate the effect of floods.

7.

- a) In the geological context, briefly describe the difference between a flow, a slide, and a fall. *{6 marks}*
- b) Mass movements of soil can be a hazard to society. List and briefly describe three preventative measures which can be implemented to mitigate the effects of mass wasting of soils. *{6 marks}*
- c) List and briefly describe two factors which could lead to desertification and give an example of a locality due to each. *{4 marks}*
- d) Fill in the blanks. **Please record your answers in the answer booklet. Do NOT answer on this exam paper.** *{4 marks}*
- (i) A \_\_\_\_\_ is a horizontal bench of rock formed beneath the surf zone as a coast retreats by wave erosion.
- (ii) An \_\_\_\_\_ is a drowned river mouth.
- (iii) A ridge of sediment that cuts a bay off from the ocean is known as a \_\_\_\_\_.
- (iv) \_\_\_\_\_ is the movement of sediment parallel to the shoreline.