

NATIONAL EXAMINATIONS - May, 2005

| 98-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 the assumptions made.
2. Candidates may use one of two calculators, the Casino or Sharp approved models. This is a Closed Book examination.
3. Five questions constitute a complete paper. Only the first five questions as they appear 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.
4. All questions are of equal value. The marks assigned to the subdivisions of each question are essentially of equal value.

1. A. (i) Name the first three layers of rock that occur beneath the ocean floor in order of increasing depth. What physical property changes going to the third layer from the second?  
  
(ii) One type of boundary between the earth's moving plates is called a transform boundary. Name the other two types.  
  
(iii) Sketch cross sections of one of the two types of boundaries you named above, labelling all the rock units involved.  
  
(iv) Explain the following terms: Mohorovicic discontinuity. Benioff zone.  
  
(v) What is the dominant material likely to be present in: (a) The mantle? (b) The core?
  - B. (i) Describe so as to differentiate between:
    - (a) Granite and rhyolite.
    - (b) Phaneritic and aphanitic.
    - (c) Pumice and obsidian.
    - (d) Laccolith and batholith.
    - (e) Shield volcano and stratovolcano (or composite cone).  
(ii) Reproduce Bowen's Reaction Series.
2. A. Name a mineral whose internal crystal structure is based on:
    - (i) A single silicon-oxygen tetrahedron.
    - (ii) A single chain of silicon-oxygen tetrahedra.
    - (iii) A sheet or layer of silicon-oxygen tetrahedra.
    - (iv) A three-dimensional network of silicon-oxygen tetrahedra.
  - B. Name and give the chemical formula of a mineral that is a common ore of:
    - (i) Lead. (ii) Zinc. (iii) Copper. (iv) Iron.
  - C. Name a rock that forms as a result of:
    - (i) Evaporation.
    - (ii) Chemical precipitation.
    - (iii) The cementation of shell fragments.
    - (iv) The cementation of angular rock fragments.
  - D. What rock would probably form as a result of:
    - (i) Contact (or thermal) metamorphism of shale?
    - (ii) The low grade regional metamorphism of shale?
    - (iii) The moderate grade regional metamorphism of limestone?
    - (iv) Metamorphism of a shale so intense that some melting occurred?

- E. In which rock would you expect to find a high concentration of the mineral:  
(i) Calcite? (ii) Kaolinite? (iii) Mica? (iv) Olivine?
3. A. Give the exact name of a glacial landform that:  
(i) is deposited by a river flowing under a glacier.  
(ii) is deposited by ice at the edge of an alpine glacier.  
(iii) is smoothed into a teardrop-shaped mass of till by a flowing glacier.  
(iv) is composed of thin layers, two of which are deposited annually.  
(v) forms a ridge along an ice front some distance back from the glacier's farthest advance.  
(vi) develops after a block of ice stranded beyond the ice front finally melts.  
(vii) consists of boulders, cemented together by ice, creeping down a valley.
- B. In a sentence or two, explain how the following landforms are created.  
(i) Col. (ii) Arete. (iii) Tarn. (iv) Kame. (v) Fiord. (vi) Valley train. (vii) Kame terrace.
- C. Explain briefly how and why continental glaciation affected the levels of the land, the sea, and lakes in interior drainage basins.
4. A. What drainage pattern would most probably develop:  
(i) On a strongly jointed granite upland?  
(ii) On an active volcano?  
(iii) When the gradient of a stream is very low?  
(iv) When a stream receives an excessive load of sediment from a melting glacier or a high gradient tributary?  
(v) When a large area has a uniform resistance to stream erosion?
- B. How does a rejuvenated stream form? Name and describe two alluvial landforms that indicate rejuvenation has occurred.
- C. Describe all the ways that a stream transports its load. Indicate in what part of the stream each type of load is carried, and why it is carried there.
- D. Name three types of deltas, and explain how they differ. How does their mode of origin differ from the way an alluvial fan forms?
5. A. (i) There are three basic types of deserts. Explain what natural phenomena are responsible for the formation of each type.  
(ii) Explain briefly how the following form.  
(a) Ventifact. (b) Star dune. (c) Bajada.
- B. With the aid of sketches, explain how and why the following form.  
(i) Barrier bar. (ii) Tombolo. (iii) Tidal delta.

- C. (i) What name is given to a mass wasting event where:
- (a) Much of the movement is out of contact with the ground?
  - (b) The failure takes place along a curved plane cutting uniform material?
  - (c) Unconsolidated material initially moves rapidly as a coherent unit downslope?
  - (d) Unconsolidated material moves slowly down a gentle slope in an Arctic area?
- (ii) Discuss, in some detail, factors that contribute to the occurrence of mass wasting.
6. A. Use a fully labelled sketch to help explain why:
- (i) Drawdown occurs.
  - (ii) A spring can appear halfway up a hillside.
- B. Use a labelled diagram to show all the hydrologic zoning that could be present in an area underlain by a low porosity soil.
- C. Explain clearly the difference between:
- (i) Porosity and permeability.
  - (ii) Influent and effluent streams.
- D. Explain briefly why problems occurred due to overpumping wells in areas:
- (i) Like Mexico, the Santa Clara Valley, and the San Joaquin Valley
  - (ii) Like Long Island, Bermuda, Barbados, and Florida.
- E. The volume of water entering a trench can be calculated using the formula  $Q = K h/l A$ , which is based on Darcy's Law.  $Q$  is the volume in cubic metres. What do the  $K$  and  $h/l$  stand for? If the trench is 100 m long, the water is entering through a 1 m thick aquifer between two aquicludes, the value of  $K$  is  $1 \times 10^{-4}$  m/second, and of  $h/l$  is 0.1, how many cubic metres will enter the trench in an hour?
7. A. (i) Describe the three types of waves generated by an earthquake that involve the solid earth (i.e., don't count tsunamis). Explain how two of these waves can help determine the location of an earthquake.
- (ii) (a) Why do earthquakes occur at shallow depths off the east coast of central Japan, but at much greater depths off the west coast?
- (b) Distinguish between the focus of an earthquake and its epicentre.
  - (c) What name is given to the zone where most severe earthquakes occur?
  - (d) How does the Richter scale differ from the Mercalli scale?
  - (e) Why does one type of earthquake wave arrive later than might be anticipated at a seismic station located  $150^\circ$  of arc away from the earthquake's location?
- B. Describe fully the geologic structures illustrated in block diagrams on the following page. All formations are sedimentary rocks, except for the granite, which is marked with x's.

Question 7 B. Structural block diagrams.

