NATIONAL EXAMINATIONS – May 2012

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 a 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. The total number of 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 (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.

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. *{5 marks}*

(i) Name the 2 tectonic plates on the map which are labelled 2 and 6.
(ii) Name each type of tectonic boundary indicated on the map by the capital letters (C, G, H).

b) Fill in the blanks in the following passage. **Please record your answers in the answer booklet. Do NOT answer on this exam paper.** *{5 marks}*

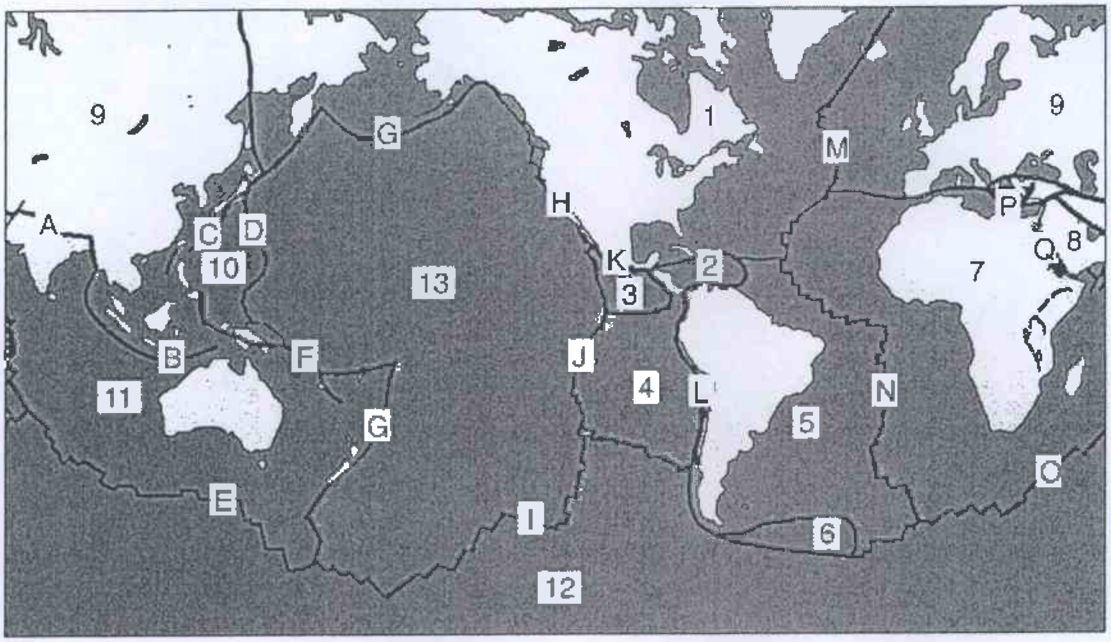
Plate tectonics is one of the most important and fundamental theories in earth science. In considering a cross-section though the earth's crust and mantle, plates are generally defined as rigid slabs of _____(i)_____ which ride on top of a zone of easily deformable material known as the _____(ii)_____ . Earthquakes may occur at a variety of depths depending on the nature of the plate boundary. Shallow earthquakes generally occur at _____(iii)_____ plate boundaries whereas deep earthquakes are characteristic of _____(iv)_____ plate boundaries. One scale which attempts to measure earthquake intensity based on the amount of damage is called the _____(v)_____ scale.

c) Briefly define the following geologic terms. *{5 marks}*

(i) elastic rebound
(ii) foreshock
(iii) circum-Pacific belt
(iv) moment magnitude
(v) seismic gap

d) Indicate in your examination booklet whether each statement below is either true (T) or false (F): *{5 marks}*

(i) Andesite is an intrusive rock.
(ii) Fine-grained igneous rocks often can be described as having an aphanitic texture.
(iii) The process of developing more that one rock type from a common magma is known as magmatic assimilation.
(iv) Ultramafic rocks are thought to be the most common component of the earth's mantle.
(v) Stocks are large intrusive igneous bodies which form only when magma intrudes between sedimentary layers in a near-surface environment.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2.

a) For each mineral listed below, state the best descriptor of the requested physical property. *{5 marks}*

(i) fluorite - hardness
(ii) garnet - lustre
(iii) hematite – streak
(iv) muscovite - cleavage
(v) calcite - optical property

b) For each mineral listed below, state to which mineral group it belongs (i.e. silicate, sulfate, sulfide, oxide, carbonate, halide, hydroxide, phosphate, or a native element). *{5 marks}*

(i) olivine
(ii) dolomite
(iii) magnetite
(iv) apatite
(v) galena

c) State the most appropriate rock name for the following: *{5 marks}*

(i) a volcanic igneous rock that exhibits a vesicular texture
(ii) a sedimentary rock consisting of sand particles that are predominantly feldspar
(iii) a sedimentary rock that consists of cemented gravels and rounded pebbles
(iv) a strongly foliated rock consisting mainly of intermediate-sized mica flakes giving the rock a scaly appearance
(v) a hard, non-foliated metamorphic rock commonly found in contact aureoles

d) State a typical rock type that would have been the original source rock for the following metamorphic rocks. *{5 marks}*

(i) phyllite
(ii) gneiss
(iii) marble
(iv) quartzite
(v) amphibolite

3.

a) Briefly define the geologic terms. *{10 marks}*

(i) capillary fringe
(ii) zone of saturation
(iii) permeability
(iv) cone of depression
(v) karst landscape

b) Calculate the following: *{6 marks}*

(i) In a particular coastal area, the water table is 4 metres above sea level. Approximately how far below sea level does the fresh water reach?

(ii) If Point A is at an elevation of 6 m above sea level and Point B is at an elevation of 47 m above sea level, what is the hydraulic gradient between A and B if both points are on the water table and are separated by a horizontal distance of 30 m?

(iii) The estimated groundwater velocity of an aquifer from Point X to Y is about 3.0×10^{-6} m/s. If the distance between X and Y is 26 m, the hydraulic conductivity K is 0.8×10^{-5} cm/s, and the elevation of Point Y is 94 m above sea level, what is the elevation of Point X?

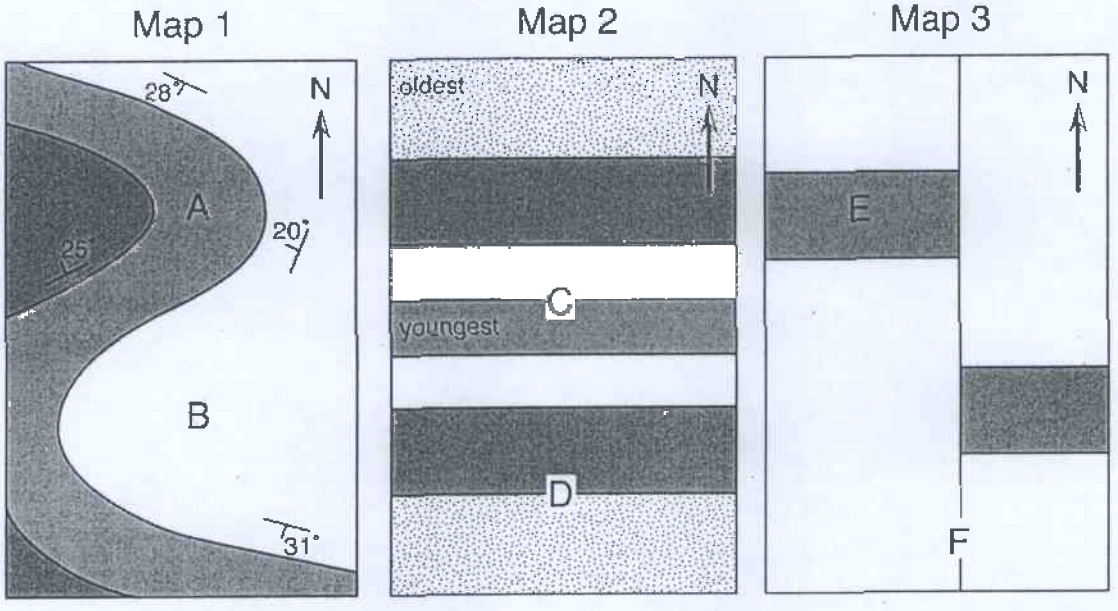
c) Briefly describe two general engineering problems that may result from the excessive pumping of groundwater. *{4 marks}*

4.

a) Briefly define, with the aid of sketches (if desired), the following geologic terms. *{8 marks}*

(i) strike
(ii) hanging wall
(iii) graben
(iv) joint

b) The following questions refer to the geological maps below. Select the best answer for each of the following multiple-choice questions. **Please record your answers in the answer booklet. Do NOT circle your answers on this exam paper.** *{8 marks}*



(i) Map 1 shows some geologic structures labelled A and B. Which statement below is the most correct?

[A] A is an anticline, B is a basin
[B] A is a basin, B is an anticline
[C] A is a syncline, B is a basin
[D] A is a basin, B is a syncline
[E] A is an anticline, B is a syncline
[F] A is a syncline, B is an anticline
[G] A and B are anticlines
[H] A and B are synclines

(ii) In Map 1, if both structures (A and B) are plunging folds, the plunge direction(s) of both folds would be:

[A] north
[B] south
[C] east
[D] west
[E] north and south
[F] east and west
[G] all of the above
[H] none of the above

(iii) In Map 1, the oldest rocks are found:

[A] to the north and east
[B] to the north and west
[C] to the south and east
[D] to the south and west
[E] to the north and south
[F] to the east and west
[G] all of the above
[H] none of the above

(iv) Map 2 shows four rock units whose relative ages are indicated. Several rock units are seen to repeat across the map. This map shows which geologic structure?

[A] strike-slip fault
[B] dip-slip fault
[C] anticline
[D] syncline
[E] dome
[F] basin
[G] all of the above
[H] none of the above

(v) In Map 2, what is the dip direction of the rocks at Location C?

[A] north
[B] northeast
[C] southeast
[D] south
[E] southwest
[F] west
[G] northwest
[H] none of the above

(vi) In Map 2, what is the dip direction of the rocks at Location D?

[A] north
[B] northeast
[C] southeast
[D] south
[E] southwest
[F] west
[G] northwest
[H] none of the above

(vii) Map 3 shows a vertical dike E offset by a fault F. What type of displacement could produce this map pattern?

[A] dip-slip
[B] strike-slip
[C] oblique-slip
[D] dip-slip and strike-slip
[E] dip-slip and oblique-slip
[F] strike-slip and oblique-slip
[G] all of the above
[H] none of the above

(viii) Map 3 shows the following kind of fault:

[A] normal
[B] reverse
[C] thrust
[D] left-lateral
[E] right-lateral
[F] strike-slip and oblique-slip
[G] all of the above
[H] none of the above

c) With respect to Map 2 in part b), sketch a geologic cross-section from the northern boundary of the map to the southern boundary, labelling the various rock units as they would occur underground. *{2 marks}*

d) Briefly explain how geological faults and folds may be beneficial to society. *{2 marks}*

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

5.

a) Indicate whether the following features are characteristic of alpine or continental glaciation and then briefly define each. *{10 marks}*

(i) truncated spur
(ii) esker
(iii) fiord
(iv) kettle
(v) roche moutonée

b) Fill in the blanks in the following passage. **Please record your answers in the answer booklet. Do NOT answer on this exam paper.** *{6 marks}*

Ice flows in complex ways. One method, called _____(i)_____ , results when the thickness of the ice is so great, the pressure allows the ice to flow. Another mechanism, called _____(ii)_____ , occurs when the entire ice mass slides along the ground. Glaciers move at varying speeds, but can move at rates of up to several _____(iii)_____ per day. The glacial budget refers to the balance between the accumulation of snow at the upper end of a glacier and loss at the lower end. The region of a glacier where more snow and ice is lost than is gained is known as the zone of _____(iv)_____ which, by definition, is always below the _____(v)_____ . One way in which glaciers can erode bedrock is by loosening and lifting blocks of rock and incorporating them into the ice mass in a process known as _____(vi)_____.

c) Permafrost affects a large part of Canada and also poses some engineering challenges. Explain. *{4 marks}*

6.

a) Streams can transport sediments in three ways. Briefly explain what each of these are. *{6 marks}*

b) Briefly define the following terms. *{8 marks}*

(i) yazoo
(ii) alluvial fan
(iii) distributary
(iv) stream piracy

c) Fill in the blanks in the following passage. **Please record your answers in the answer booklet. Do NOT answer on this exam paper.** *{6 marks}*

Runoff initially flows across the ground in broad, thin sheets in a process known as _____(i)_____ flow. Water within a stream may flow in one of two ways: _____(ii)_____ flow or _____(iii)_____ flow. The _____(iv)_____ of a stream is the amount of water flowing past a certain point in a given unit of time. One of the most important factors controlling the stream velocity is the _____(v)_____ of the stream channel. Fast-moving streams can cause particles to abrade rounded depressions in the stream bed which are known as _____(vi)_____ .

7.

a) Briefly define the following terms. {*8 marks*}

(i) loess
(ii) baymouth bar
(iii) groin
(iv) wave-cut platform

b) Fill in the blanks in the following passage. **Please record your answers in the answer booklet. Do NOT answer on this exam paper.** {*6 marks*}

Three general processes characterize mass wasting: ____(i)____ occur commonly on slopes that are so steep, the loose material cannot remain on the surface; ____(ii)____ occur when the material remains fairly coherent and moves along a well-defined surface; and ____(iii)____ occur when material moves downslope as a viscous fluid. A ____(iv)____ refers to a mass of rock sliding along a curved surface. Lahars are a particular type of ____(v)____ which are common on the slopes of volcanoes. The most common form of mass wasting in regions of permafrost is called ____(vi)____ .

c) Desertification is a serious societal issue in some parts of the world. Define "desertification", list a region of the world where it is a problem, and explain how it is related to the impact of humans. {*6 marks*}