National Exams May 2014

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. FIVE (5) questions constitute a complete exam paper. YOU MUST ANSWER QUESTIONS 1 TO 4. Candidates must choose one more question from the remaining questions. Where stated in the examination, please hand in any additional pages with your exam booklet.

4. The marks assigned to the subdivisions of each question are shown for information. The total number of marks for the exam is 80.

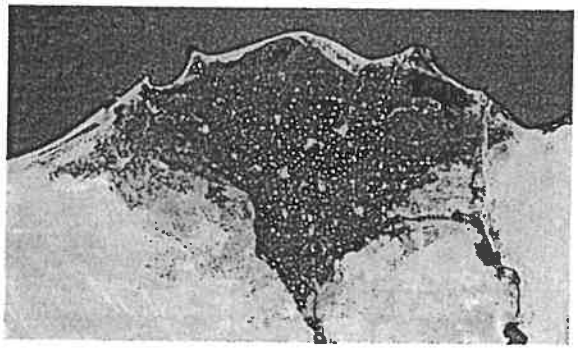
Question 1: Multiple choice questions; answer all questions. (5 points)

1. Which of the following is a mafic rock?
   a. Granite
   b. Rhyolite
   c. Basalt
   d. Andesite

2. 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

3. 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

4. The following is an example of a _____ dominated delta.
   a. Tide
   b. Stream
   c. 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

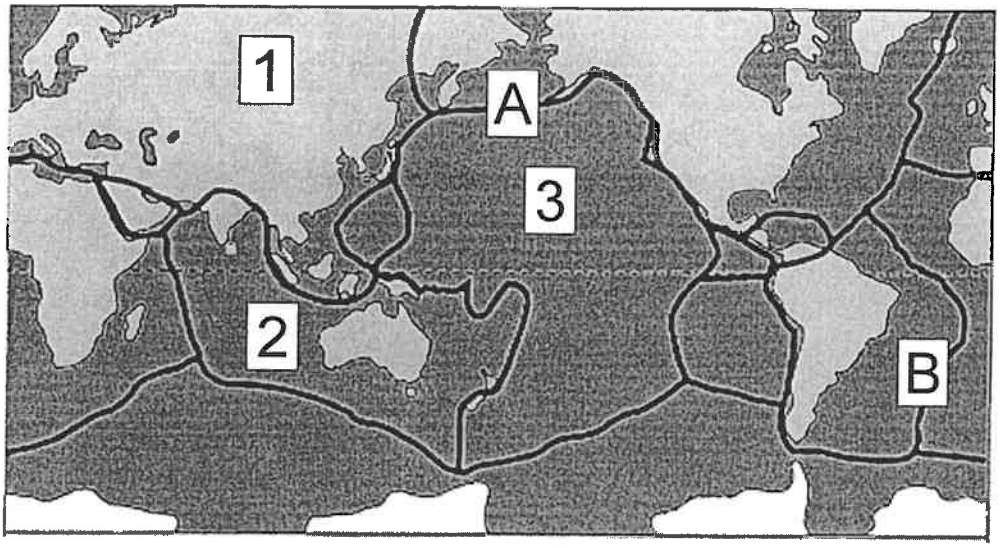
Question 2: TRUE/FALSE; answer all questions in your exam booklet (10 points)

1. Engineering solutions for problems with permafrost include thermosyphons and insulation to aid in melting of permafrost.
2. An aquifer is an impermeable layer which serves as a confining layer above an aquiclude which has the capacity for transmitting groundwater.
3. A spring is a place where the groundwater flows into the ground.
4. Oxbow lakes form when a mature meandering stream cuts off a meander.
5. Drumlins and roche moutonnees have the same overall shape however drumlins are composed of till and roche moutonnees are composed of rock.
6. Normal faults are caused by extensional tectonic forces and reverse faults are caused by compressional tectonic forces.
7. The water velocity required to mobilize a grain of silt is greater than that which will mobilize a grain of sand.
8. Aa flows are generally thinner, faster moving, and have smoother surfaces than pahoehoe flows.
9. Dry granite melts at a higher temperature than dry basalt.
10. Like most other liquids, water decreases in volume when it freezes.

Question 3: Short answer questions; answer all questions. (15 points)

1. In the following map of the Earth the continents and oceans are shown. The tectonic plates and boundaries are also indicated with the thick 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
   a. Name the 3 tectonic plates (1, 2 and 3)
   b. Name each type of tectonic boundary indicated in capital letters (A, B)

   (5 points)

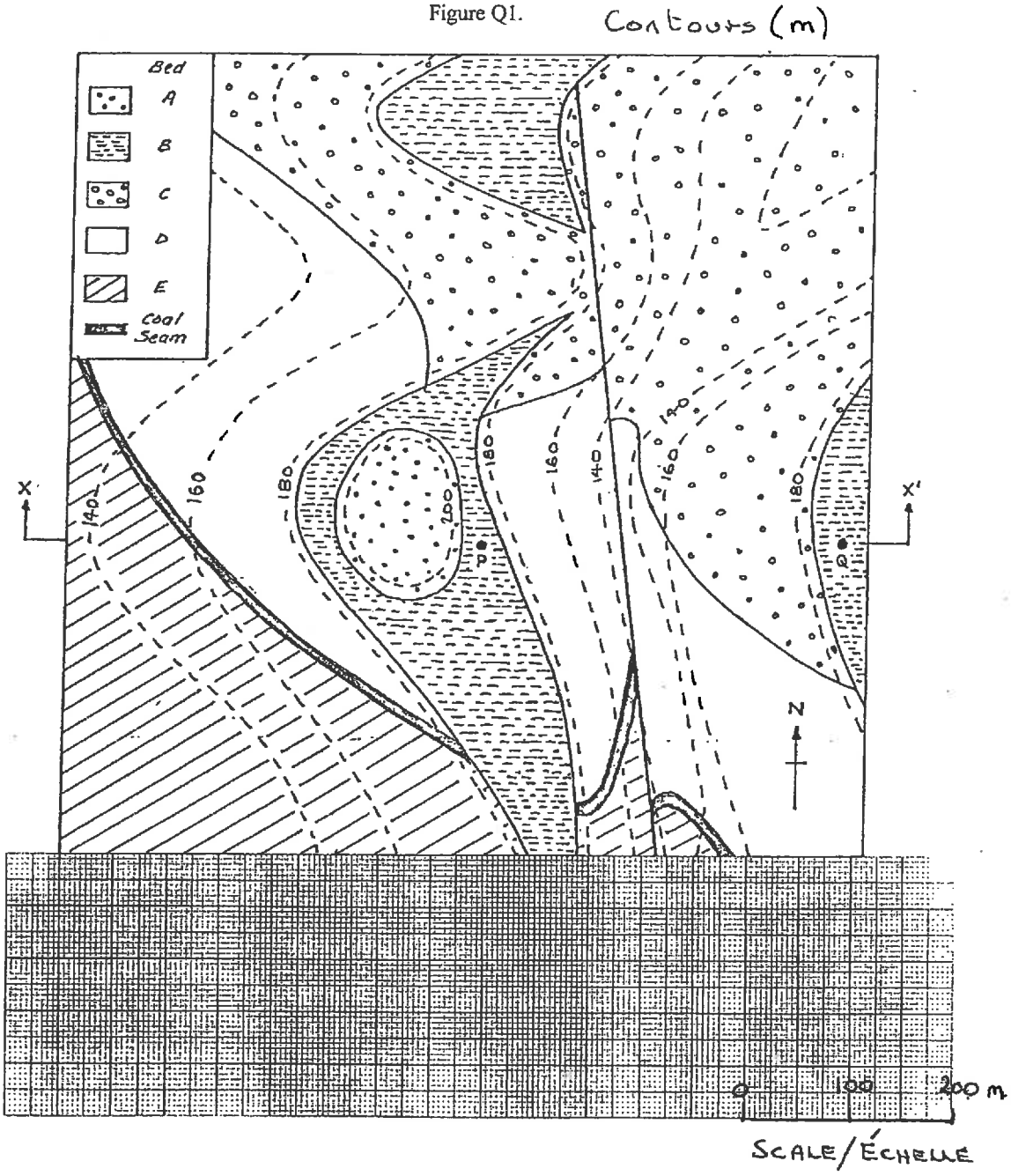


2. Draw a cross-section of the earth, label each section and distinguish between them in terms of their diameter (thickness), density and composition. (10 points)

Question 4: Calculation questions; answer all questions. (40 points)

1. Carefully examine the geological map in Figure Q.1. Beds C, D and E are parallel to the coal seam.
   a. Determine the strike and dip of the coal seam and all the beds shown on the map.
      (value 6)
   b. Draw the cross-section X-X' on the graph paper below the map.
      DETACH THE CROSS-SECTION AND HAND IN WITH YOUR EXAM.
      (value 10)
   c. Determine the thickness of as many layers as you can.
      (value 4)

Figure Q1.


Contours (m)
Bed
A
B
C
D
E
Coal Seam
X
X'
140
160
180
200
P
Q
N
0
100
200 m
SCALE/ÉCHELLE

2. Two major joint sets have been identified in a rock mass in which a rock cut is planned. We are concerned about the creation of unstable rock wedges. Orientations are as follows:

	Strike	Dip
Joint set #1	N 25° E	60° SE
Joint set #2	N 70° W	50° NE
Rock cut face	N	????° E

   a. What is the maximum dip for the Rock Cut Face to avoid daylighting? (value 7)

   b. What are the apparent dips of both joint sets in the direction N90° E? (value 3)

3. A landfill is located 1 km away from a stream. The free surface of the water table below the landfill is at an elevation of 210 m (above mean sea level). The groundwater flow is perpendicular to the stream. The free surface where it enters the stream is at an elevation of 203m. The soil in which the groundwater flows has a hydraulic conductivity of 3×10^{-5} m/s and a porosity of 27%. (Useful equations: $v = Q/A = -Ki$; $i = \Delta h/L$; $v_s = v/n$; $h = z + u/\gamma_w$)

   a. Assuming that only advection controls the solute transport, how long will it take for a solute entering the groundwater under the landfill, to reach the stream?
   (value 7)

   b. A standpipe piezometer is installed through the landfill. The water intake is at the bottom of the pipe at an elevation of 205m. If we lower a pressure gauge to the bottom of the piezometer, what pressure in kPa will we read?
   (value 3)

Question 5: Short answer questions; <u>answer 1 of 3 questions</u>. (10 points)

1. List and describe the factors that influence mass wasting
   (10 points)

2. Elaborate on the glacial processes that are responsible for the creation of:
   a. Erosional Landforms (name and describe at least 3)
      (5 points)
   b. Till Landforms (name and describe at least 3)
      (5 points)

3. Distinguish between the following. When appropriate, use diagrams and examples to clarify your explanations.
   (2 points each)
   a. Joints and faults
   b. Unconformity and non-conformity.
   c. Polymorphic and isomorphic.
   d. Elastic and plastic strain
   e. Dyke and sill.