National Exams May 2015

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 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.

5. The marks assigned to the subdivisions of each question are shown for information. Each question is worth 20 marks. The total number of marks for the exam is 100

Question 1. Multiple Choice / True and False

1) The study of terrestrial magnetism shows that the current magnetic north is directed to:
   a) geographic north
   b) the geographic south
   c) has no preferred direction

2) A volcanic arc is the result of:
   a) compression of a continental plate beneath an oceanic plate
   b) subduction of an oceanic plate under a continental plate
   c) collision between two lithospheric plates
   d) abduction of an oceanic crust on a continental plate

3) The greatest ocean depths are:
   a) at the mid-ocean ridges
   b) at passive margins
   c) at the hot spots
   d) at subduction zones

4) A normal fault is a fault where:
   a) the roof rises relative to the wall
   b) the roof drops relative to the wall
   c) the roof slides laterally along the wall
   d) none of these answers

5) An anticline has a concavity of:
   a) down
   b) up
   c) sideways
   d) middle

6) An artesian well is a well which:
   a) always conveys without pumping
   b) penetrates an unconfined aquifer
   c) penetrates a confined aquifer
   d) none of these answers

7) Sediment transformation processes in sedimentary rocks are:
   a) very fast
   b) diagenesis
   c) lithification
   d) 2 and 3.

8) During major earthquakes, instantaneous displacements of _____ occur across pre-existing faults.
   a) a few kilometres
   b) a few millimetres
   c) a few metres
   d) a few thousand kilometres

9) Most crustal deformation occurs in active tectonic zones _____.
   a) deep within old plate interiors
   b) at the base of sedimentary basins
   c) in thick piles of unconsolidated sedimentary strata
   d) along plate margins

10) Plutonic rocks are emplaced at depth yet they can be seen at the Earth's surface due mainly to _____.
   a) widespread igneous inversion
   b) erosion of overlying rocks due to uplift
   c) catastrophic violent upheavals that bring them to the surface
   d) continual ongoing intrusion after the magma solidifies

TRUE or FALSE

11) Iceland is located over a hot spot.

12) A sill is an intrusive formation that is parallel to the encasing rock.

13) The Earth's inner core is liquid.

14) The Earth is five hundred million years old.

15) A shield volcano has very steep slopes.

16) A porphyry is a rock which exhibits two significantly different grain sizes.

17) The structure of the Earth was inferred from the study of the propagation of earthquakes' seismic waves.

18) Silicates are, after carbonates, the second most abundant minerals in the crust of the Earth.

19) Quartz is a three dimensional arrangement of silica tetrahedra, while biotite is a chain-like arrangement.

20) Ferromagnesian minerals are darker than non-ferromagnesian minerals.

Question 2. Short (paragraph) Answer

1) Describe the rock cycle, in prose and with a sketch. Remember to define the processes and the resultant materials. (value 10)

2) Draw, label and explain the Bowen's Reaction Series. Ensure to include the continuous and discontinuous components. (value 10)

Question 3. Calculation and Fill in the Blank

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: $v = Q/A=-Ki$; $i = \Delta h/L$; $v_s = v/n$; $h = z + u/\gamma_w$).

Answer the following:

1) 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 10)

2) A standpipe piezometer is installed through the landfill. The water intake is at the bottom of the pipe at an elevation of 205m. If one lowers a pressure gauge to the bottom of the piezometer, what pressure in kPa will it read? (value 4)

3) Fill in the blanks (value 6)

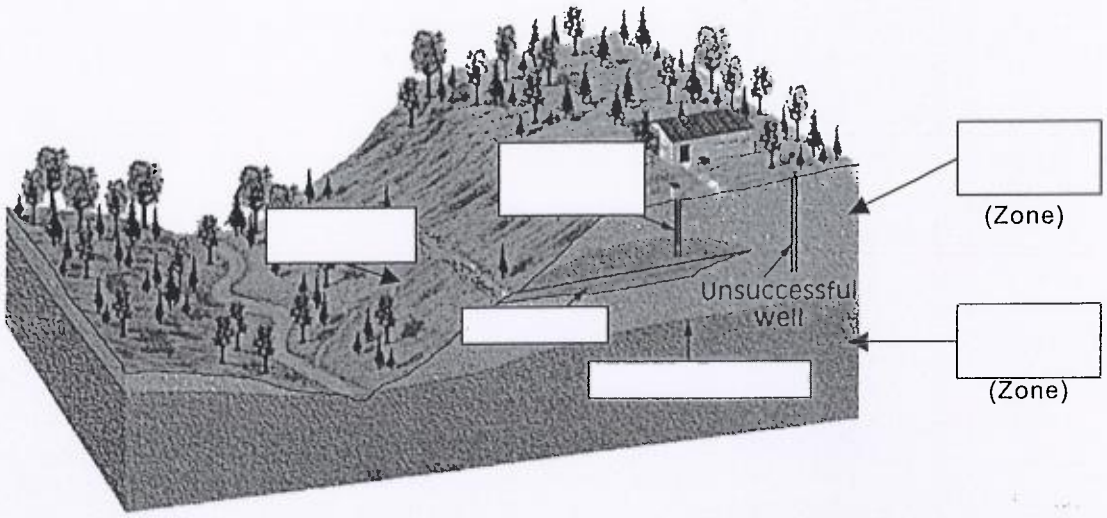
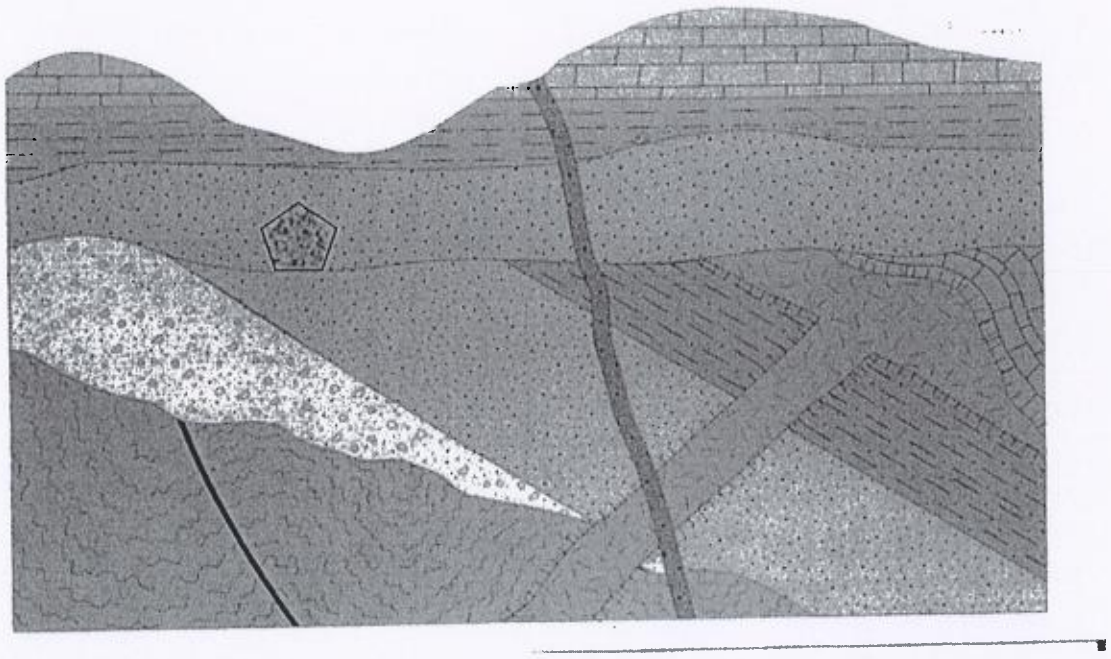


Figure Q3-1 – Water Related Features

Question 4. Relative Dating and Map

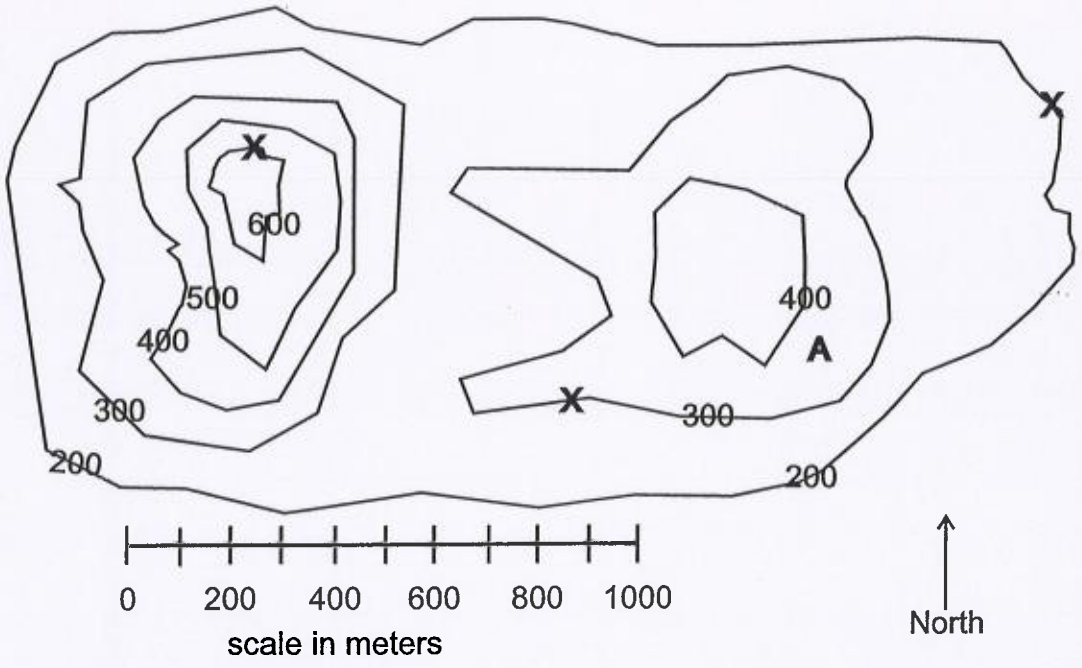
1) Using the figure below, identify rock units, identify, list and **explain** in sequence ALL the events that lead to the present situation. On the cross-section, start with the number 1 for the oldest rock or event, and number the subsequent events/rocks in chronological order to the present formation. If you cannot determine which of two or more rocks/events is the older, explain why not.
(value 10)



2) On the contour map below three (3) X's mark an outcrop of a coal layer (value 10)

a) Determine the strike and dip of the coal layer.
b) Trace the outcrop pattern.
c) What is the depth of the coal layer at point A?
d) What is the apparent dip in the direction N90°E?

α' = arctan ($\cos\theta$ x tan α)
α = actual dip
α' = apparent dip in a direction other than the direction of dip
θ = angle in the horizontal plane, between the desired direction and the direction of dip



Question 5. Short Answer (paragraph) and Fill in the Blank

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

(value 14)

2) Fill in the blanks on the schematic: (value 6)

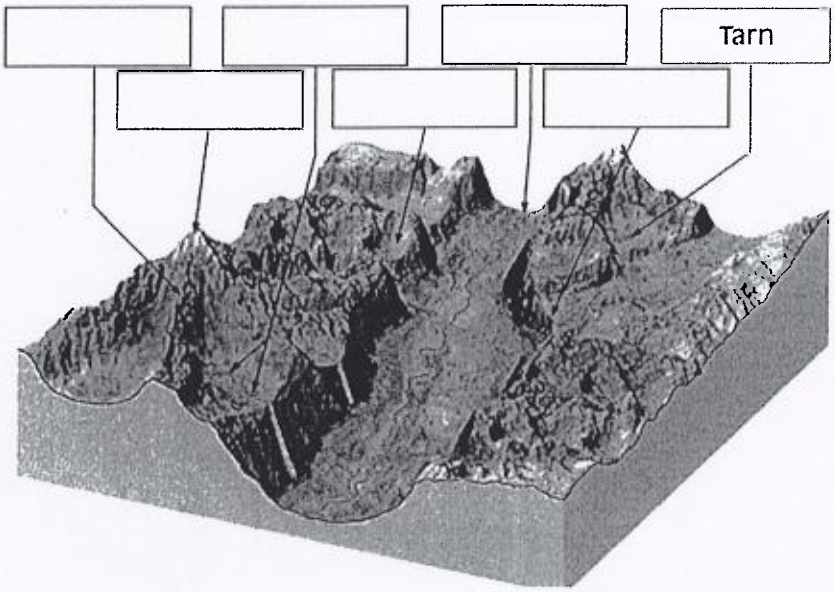


Figure Q5-1 – Features from a Major Weathering Process

Question 6. Multiple Choice and Short (paragraph) Answer

1) The physical removal of dissolved or disaggregated rock from the site of weathering by wind, water, or ice is termed _____.
   a) ablation
   b) recidivism
   c) solifluction
   d) erosion

2) _____ is the dissolution or decomposition of minerals and rocks.
   a) Mechanical weathering
   b) Chemical weathering
   c) Hydrolysis
   d) Rendering

3) In nature, where does the acidity come from to speed up chemical weathering?
   a) plutonism
   b) nuee ardentes from explosive volcanic eruptions
   c) Bowen's reaction series
   d) organic acids from decayed plants, acid rain, and sulphuric acid from oxidation of pyrite

4) The principal causes of mechanical fragmentation of rocks *in place* are _____.
   a) erosion and transport by moving wind, water, or ice
   b) the relentless actions of Sisyphus
   c) always inscrutable because they happened at some time in the past
   d) biologic activity, expansion from unloading, frost wedging

5) The three major processes involved in chemical weathering are _____.
   a) dissolution, hydrolysis, and oxidation
   b) precipitation, ion exchange reactions, and degasification
   c) carbonation, dissimulation, and salinization
   d) recrystallization, pitting, and rinsing

6) Briefly define the following terms (8 marks)
   a) Oxbow lake
   b) Meander
   c) Levee
   d) Tide dominated delta

7) Describe and sketch three types of drainage basins (7 marks)

Question 7. Short answer and Fill in the Blank

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

2) Label the drainage pattern: