

## **NATIONAL EXAMINATIONS – May 2010**

### **98-Mmp-A1 General Geology and Exploration**

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. 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 marks for the exam is 100.

**\*\*\* IMPORTANT: YOU MUST ANSWER QUESTIONS 1, 2, 3, and 4 \*\*\***

1. Consider the following 5 ore minerals:

- |                  |                 |
|------------------|-----------------|
| (i) galena       | (iv) sphalerite |
| (ii) cassiterite | (v) ilmenite    |
| (iii) scheelite  |                 |

- a) For each ore mineral listed above, state the colour of its streak, as would be seen from a hand specimen. {5 marks}
- b) For each ore mineral listed above, state the element of the Periodic Table for which it is a major ore mineral. {5 marks}
- c) For each ore mineral listed above, state one diagnostic physical property which may be unambiguously used to identify the mineral in a hand specimen. {5 marks}
- d) Excluding any of the ore minerals listed above, state an ore mineral for each of the following elements: {5 marks}
- |                  |                     |
|------------------|---------------------|
| (i) mercury (Hg) | (iv) manganese (Mn) |
| (ii) cobalt (Co) | (v) aluminum (Al)   |
| (iii) iron (Fe)  |                     |

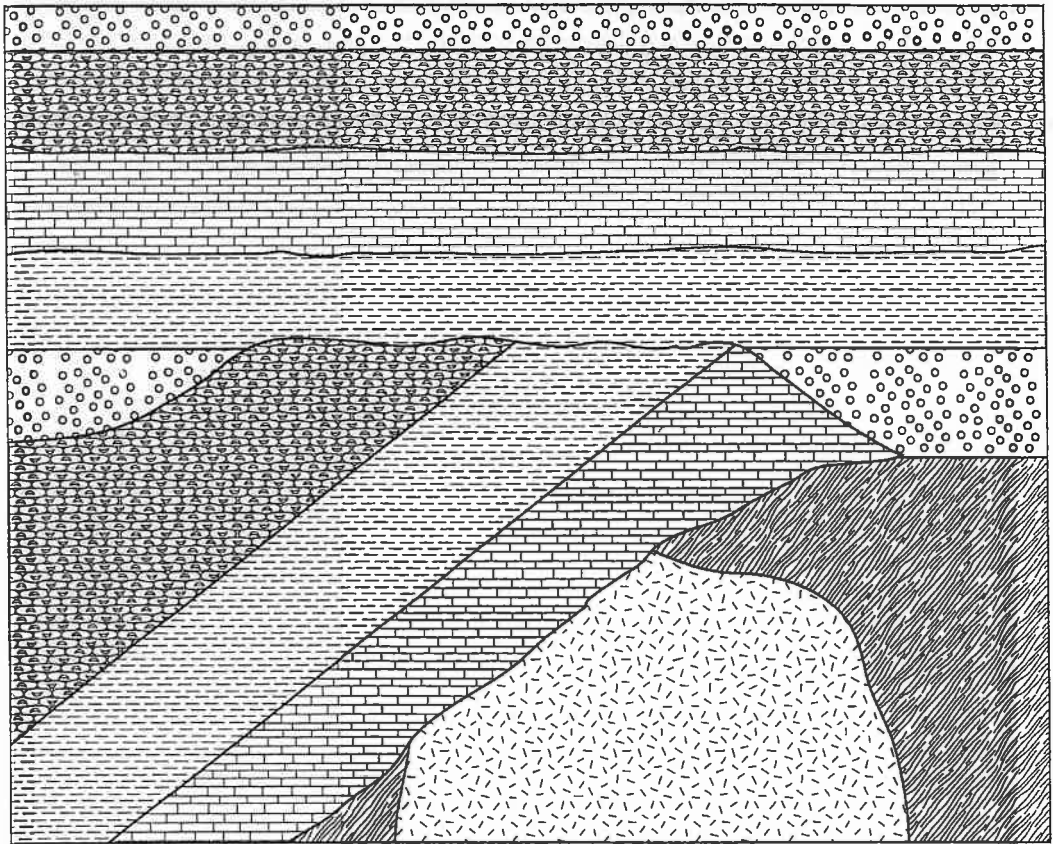
2.

- a) Many types of ore deposits are hosted in intrusive igneous rocks. Diagrammatically sketch the International Union of Geological Sciences (IUGS) classification of plutonic igneous rocks, also known as the Streckeisen classification scheme, and explain how the classification works. Do not include the classification scheme for feldspathoid-bearing rocks. {15 marks}
- b) Name the most common or typical ore resources which are mined from the following host rocks: {5 marks}
- (i) komatiites
  - (ii) skarns
  - (iii) serpentinites
  - (iv) alluvial deposits
  - (v) laterites













**\*\*\* 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 3 for instructions.

NAME: \_\_\_\_\_

3. Consider the geological cross-section shown below.



LEGEND (in alphabetical order)

	Basalt		Limestone		Schist
	Fossiliferous Chert		Pegmatite		Shale
	Gneiss		Quartzite		Slate
	Granite		Sandstone		Volcanic Breccia and Tuff

- a) For the given cross-section, select the best answer. **Please record your answers in the answer booklet. Do NOT circle your answers on this exam paper. {10 marks}**
- (i) A list of rocks, In order of youngest to oldest, would be:  
[A] chert, limestone, sandstone  
[B] limestone, schist, granite  
[C] limestone, granite, slate  
[D] sandstone, chert, limestone  
[E] none of the above
- (ii) A list of geologic events, In order of oldest to youngest, would be:  
[A] metamorphism, tilting of sediments, igneous intrusion  
[B] deposition of sediments, tilting of sediments, metamorphism  
[C] deposition of sediments, igneous intrusion, metamorphism  
[D] tilting of sediments, erosion, igneous intrusion  
[E] none of the above
- (iii) A list of geologic events, In order of oldest to youngest, would be:  
[A] igneous intrusion, erosion, faulting  
[B] metamorphism, igneous intrusion, erosion  
[C] erosion, deposition of sediments, igneous intrusion  
[D] tilting of sediments, deposition of sediments, erosion  
[E] none of the above
- (iv) A list of geologic environments in which these rocks would have formed, in order of earliest to latest, are:  
[A] warm and shallow sea, surface exposure, deep ocean  
[B] sandy beach, warm and shallow sea, burial in the mid-crust  
[C] deep ocean, warm and shallow sea, burial in the mid-crust  
[D] burial in the mantle, surface exposure, sandy beach  
[E] none of the above
- (v) There has been:  
[A] magmatic differentiation  
[B] erosion of sediments prior to igneous injection  
[C] deformation without metamorphism  
[D] faulting after sedimentary deposition  
[E] none of the above

**\*\*\* IMPORTANT: REMOVE THIS PAGE FROM THE EXAM PAPER!! \*\*\***

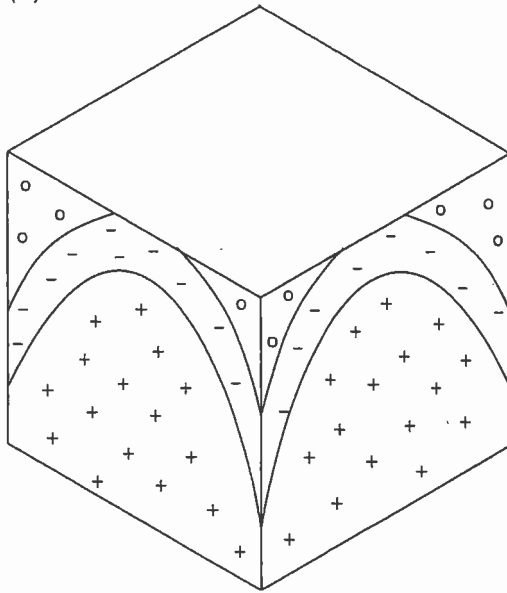
Clearly PRINT your name on this page and hand it in with your answer booklet.

NAME: \_\_\_\_\_

- b) Consider the three-dimensional block diagrams below. For each diagram, (i) complete the missing geological information from any faces to clearly demonstrate all the geologic features in 3 dimensions, (ii) on each face label the oldest rocks with an "O" and the youngest rocks with a "Y", and (iii) name the geological structure (e.g. type of fold/fault, if present). {10 marks}

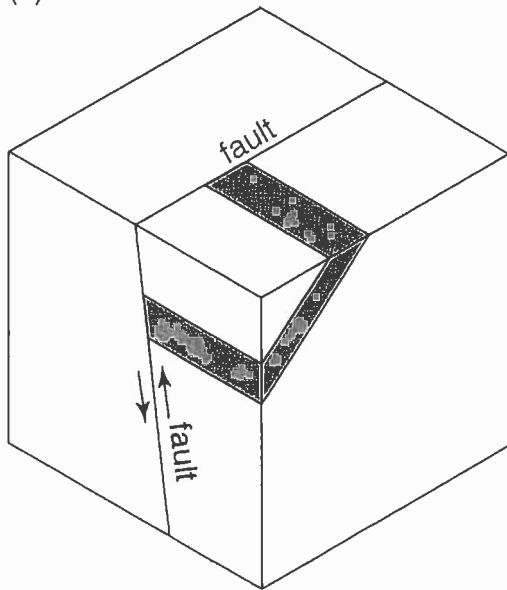
(1)

Name of Geologic Structure:



(2)

Name of Geologic Structure:



4. Ores can form in a variety of geological environments resulting from a variety of processes. Define each of the processes below, and state the most likely kind of genetic ore deposit to be formed. {20 marks}

- (i) fractional crystallization
- (ii) liquid immiscibility
- (iii) hydrothermal fluid circulation
- (iv) sedimentary deposition
- (v) weathering

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

5. Many different geophysical techniques can be used to find and delineate ore bodies. Consider the following different kinds of electrical methods:
- |                              |                                |
|------------------------------|--------------------------------|
| (i) magnetotelluric (MT)     | (iv) induced polarization (IP) |
| (ii) electromagnetic (EM)    | (v) self-potential (SP)        |
| (iii) electrical resistivity |                                |
- a) Explain the fundamental physical principles by which electrical methods are designed to operate. *{3 marks}*
- b) Based on the fundamental nature of a particular electrical method, there are two general categories by which each method can be classified. Explain what those categories are and state in which category each of the above electrical methods [(i) to (v)] can be placed. *{7 marks}*
- c) For each of the electrical methods listed above, briefly describe the fundamental principles by which it works *{10 marks}*



6.

- a) The design of an effective geochemical survey in the surficial environment depends on a good understanding of certain natural factors. State what these natural factors are and explain why they are relevant. {7 marks}
  
- b) Outline and describe the appropriate sequence of steps one should take in conducting a geochemical survey for a placer gold deposit in a river. {13 marks}

7.

- a) Rotary-percussion drilling is a commonly used sampling method. Briefly describe the method, the conditions under which it is most effectively used, as well as its advantages and disadvantages. {10 marks}
  
- b) "The optimum drilling methodology for a deposit may change throughout the life of a project". True or False? Explain. {10 marks}