

**NATIONAL EXAMINATIONS – December 2018****09-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 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 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  |                 |

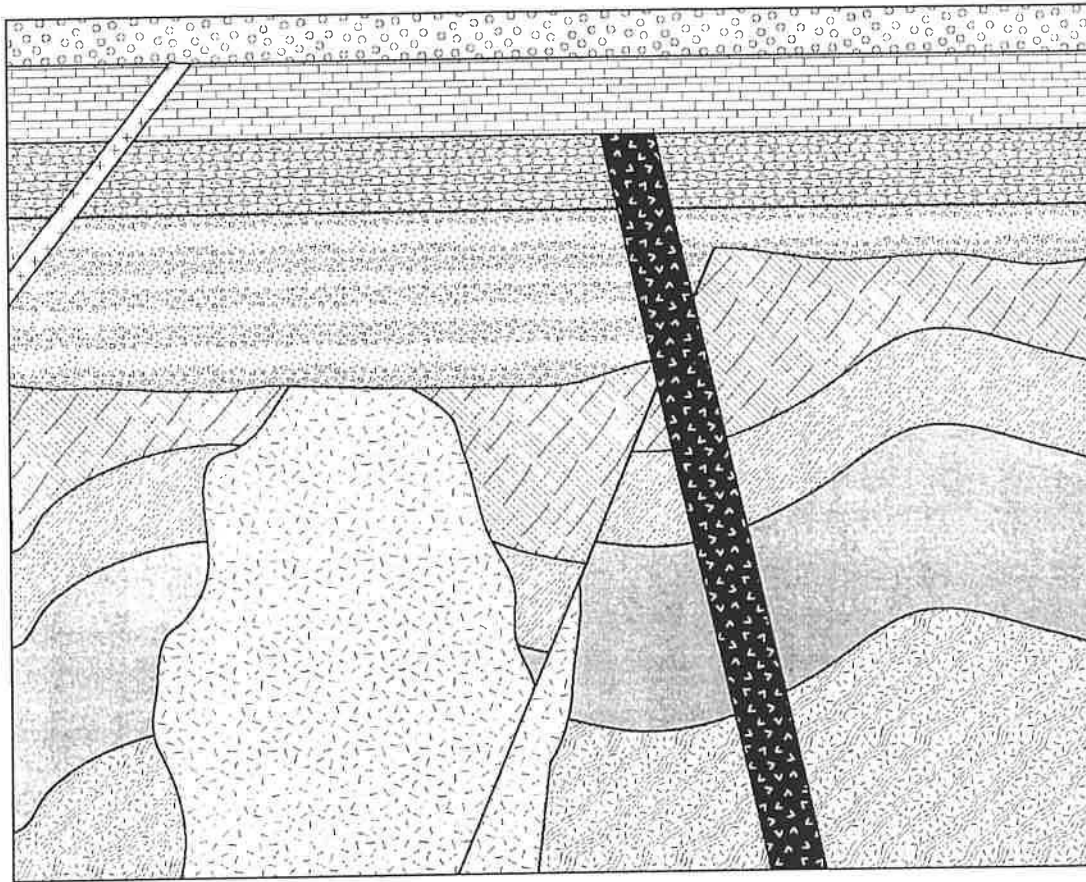
- a) For each ore mineral listed above, state the colour of its streak, as would be seen from a hand specimen. {5 marks}
- b) For each ore mineral listed above, state the element of the Periodic Table for which it is a major ore mineral. {5 marks}
- c) For each ore mineral listed above, state one diagnostic 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)  |                     |





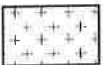







2. Ores can be classified into a variety of deposit types on the basis of ore genesis. For each genetic category below, briefly describe how such deposits form and list a deposit type that is characteristic of that category. {20 marks}

- (i) magmatic deposits
- (ii) pegmatitic deposits
- (iii) magmatic-hydrothermal deposits
- (iv) supergene deposits
- (v) allochthonous sedimentary deposits
- (vi) autochthonous sedimentary deposits
- (vii) diagenetic-hydrothermal deposits
- (viii) metamorphosed deposits

3.  
a) Consider the geological cross-section below.



LEGEND (in alphabetical order)

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

For the geological cross-section above, 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.**

{ 10 marks }

- (i) A list of rocks, In order of oldest to youngest, would be  
 [A] quartzite, slate, schist, basalt  
 [B] gneiss, schist, chert, granite  
 [C] granite, basalt, pegmatite, schist  
 [D] schist, limestone, sandstone, pegmatite  
 [E] none of the above
- (ii) A list of geologic events, In order of oldest to youngest, would be  
 [A] deposition of sandstone, metamorphism, igneous intrusion  
 [B] deformation, sedimentary deposition, metamorphism  
 [C] metamorphism, faulting, granitic intrusion  
 [D] metamorphism of limestone, deformation, faulting  
 [E] none of the above
- (iii) A list of geologic events, In order of oldest to youngest, would be  
 [A] faulting, metamorphism, intrusion of pegmatites  
 [B] metamorphism of sediments, dyke intrusion, volcanism  
 [C] granitic intrusion, faulting, erosion  
 [D] metamorphism of limestone, deformation, faulting  
 [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] burial in the lower crust, 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 lower crust  
 [D] surface exposure, burial in lower crust, deep ocean  
 [E] none of the above
- (v) There has been:  
 [A] rotation on the fault plane  
 [B] compaction of sediments prior to dyke injection  
 [C] deformation without metamorphism  
 [D] synchronous intrusion events  
 [E] none of the above
- b) Joints and joint sets are common in many geological terranes. Define these underlined terms and explain why they are extremely relevant to mining engineering. { 10 marks }

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

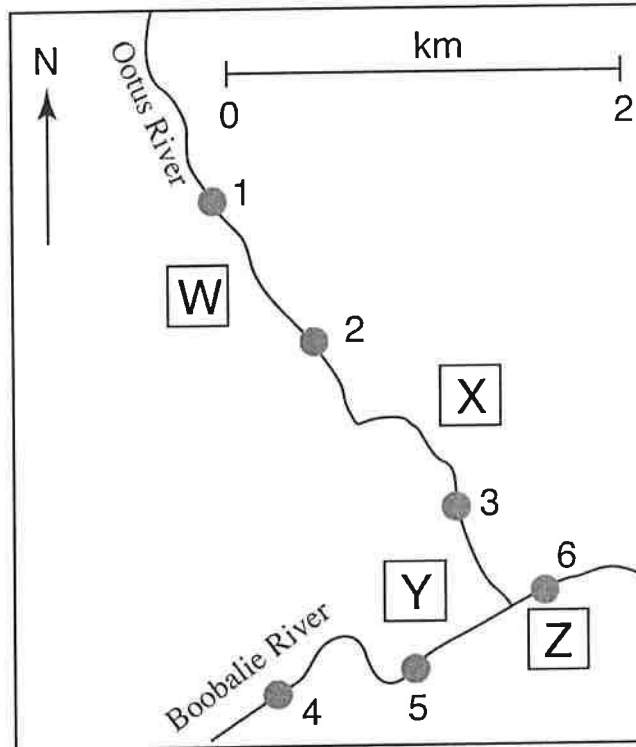
**\*\*\* IMPORTANT: COMPLETE ONLY ONE MORE QUESTION \*\*\*  
FROM QUESTIONS 5, 6, OR 7**

5. Many different geophysical techniques can be used to find and delineate ore bodies. Consider the use of magnetic methods.
- a) List three elements which can acquire a magnetic signature and explain how magnetism occurs in minerals. {5 marks}
  - b) Define magnetic susceptibility and state two properties which determine a rock's magnetic susceptibility. {6 marks}
  - c) Place the following list of minerals in order of lowest to highest magnetic susceptibility: pyrrhotite, pyrite, magnetite, salt {4 marks}
  - d) Explain how exploration surveys can use magnetism to detect some types of ore deposits. Give an example of a rock that would typically produce a magnetic "high" and another rock which would typically produce a magnetic "low". {5 marks}

- 6.
- List three kinds of materials which are typically sampled in a geochemical survey. What is the main purpose of geochemical sampling, and explain how this is achieved in a geochemical survey. {5 marks}
  - Explain what a dispersion halo is and describe the various factors which can control its extent. {7 marks}

- c) Consider the following map, showing two rivers – the Ootus and Boobalie Rivers, and six geochemical sampling stations (grey circles labelled 1 to 6).

The Ootus River flows towards the southeast and the Boobalie River flows towards the northeast.



- If a gold deposit was located at X, indicate for each of the 6 stations whether the gold content of a stream-sediment sample would be zero, low, moderate or high, and briefly give reasons. {6 marks}
- What should the optimum spacing be for a geochemical stream survey? Are the geochemical stations shown on the map at the optimum spacing? {2 marks}



7. Diamond-core drilling is a commonly used sampling method.
- a) Briefly describe the method, the conditions under which it is most effectively used, as well as its advantages and disadvantages. *{8 marks}*
  - b) Briefly outline the various drilling parameters which must be taken into account when designing a drilling program and explain how each may affect the overall project. *{12 marks}*