

NATIONAL EXAMINATIONS – December 2015

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) spodumene | (iii) apatite | (v) pitchblende |
| (ii) pyrrhotite | (iv) halite | |

- a) For each ore mineral listed above, state its most common crystal form, as would be seen in 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) lead (Pb) | (iii) potassium (K) | (v) copper (Cu) |
| (ii) mercury (Hg) | (iv) titanium (Ti) | |

2. Ores can be classified into a variety of deposit types on the basis of ore genesis and morphology. Consider the following types of ore deposits:

- | | |
|-----------------|------------------|
| (i) syngenetic | (iii) concordant |
| (ii) epigenetic | (iv) discordant |

(a) Define each of the terms above as it applies to ore deposits. {8 marks}

(b) Consider the following kinds of ore deposits:

- | | |
|----------------------------------|-----------------------------------------|
| 1) Kiruna-type | 7) Mississippi Valley type (MVT) |
| 2) placer | 8) kimberlite |
| 3) iron oxide-copper-gold (IOCG) | 9) banded iron formation |
| 4) pegmatite | 10) skarn |
| 5) porphyry | 11) laterite |
| 6) sedex | 12) volcanogenic massive sulphide (VMS) |

Classify each deposit above as one of the following: {12 marks}

- | | |
|----------------------------------|------------------------------------|
| (i) syngenetic | (i & iii) syngenetic & concordant |
| (ii) epigenetic | (i & iv) syngenetic & discordant |
| (iii) concordant | (ii & iii) epigenetic & concordant |
| (iv) discordant | (ii & iv) epigenetic & discordant |
| (i & ii) syngenetic & epigenetic | (iii & iv) concordant & discordant |

3. Ore bodies can come in a variety of shapes, sizes, and forms. For each kind of deposit characteristic below, describe at least two different kinds of ore deposits which illustrate this feature. {20 marks}

(i) tabular

(ii) tubular

(iii) disseminated

(iv) replacement

(v) residual

4. Ores can form in a variety of geological environments resulting from a variety of processes. Briefly describe the genetic geological processes and environments in which the following types of ore deposits may be formed. {20 marks}
- (i) placer deposits
 - (ii) pegmatite deposits
 - (iii) Mississippi Valley type (MVT) deposits
 - (iv) skarn deposits
 - (v) volcanogenic massive sulphide (VMS) deposits

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

5. Remote-sensing techniques (both geophysical and satellite-based) are now commonly used in mineral exploration programs.
- a) Satellite-based remote-sensing techniques can provide high-resolution imagery of almost all of the Earth's surface.
- (i) Explain the difference between the acquisition of satellite data from passive versus active sensors. {4 marks}
- (ii) What regions of the electromagnetic spectrum are sampled by satellite remote sensors? Explain why certain wavelengths of the spectrum cannot be sampled. {6 marks}
- b) For each of the following ore deposits below, state two geophysical exploration methods which would be the optimum ones to use in order to detect it and explain why. {10 marks}
- | | |
|--------------------------------|-----------------------------|
| (i) Cu porphyry deposit | (iv) skarns |
| (ii) black-sand placer deposit | (v) gemstones in pegmatites |
| (iii) laterite | |

6.

- a) A junior exploration company is about to embark on an exploration program to find a gold deposit in the Canadian Shield. Outline and briefly describe the appropriate steps that should be followed in the design of a successful surficial geochemical survey. *{10 marks}*
- b) Briefly explain how each of the following techniques can be useful in the exploration for ore deposits. *{10 marks}*
- (i) airborne and satellite techniques
 - (ii) fluid inclusions
 - (iii) radioisotopes
 - (iv) X-ray fluorescence
 - (v) lasers

7. Various kinds of sampling methods can be used in mineral exploration.
- a) Briefly describe each of the sampling methods below and why it would be used in an exploration programme. {10 marks}
- | | |
|--------------------|-------------------------------|
| (i) hand sampling | (iv) stream sediment sampling |
| (ii) float mapping | (v) drilling |
| (iii) trenching | |
- b) One of the most difficult decisions during an exploration drilling program is deciding when to stop. Explain 5 reasons why a drilling program should be terminated. {10 marks}