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

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)
(ii) mercury (Hg)
(iii) postassium (K)
(iv) titanium (Ti)
(v) copper (Cu)

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

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

(i) syngenetic
(ii) epigenetic
(iii) concordant
(iv) discordant
(i & ii) syngenetic & epigenetic
(i & iii) syngenetic & concordant
(i & iv) syngenetic & discordant
(ii & iii) epigenetic & concordant
(ii & iv) epigenetic & discordant
(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
(ii) black-sand placer deposit
(iii) laterite
(iv) skarns
(v) gemstones in pegmatites

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 fluoresence
(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
(ii) float mapping
(iii) trenching
(iv) stream sediment sampling
(v) drilling

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*}