

National Exams December 2013

09-MMP-A6, Mining and the Environment

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 an OPEN BOOK EXAM.  
Any non-communicating calculator is permitted.
3. FIVE (5) questions constitute a complete exam paper.  
The candidate may answer any five of the six questions posed.  
Only the first five questions as they appear in the answer book will be marked.
4. Each question is of equal value (20 marks). Marks are allocated as indicated.
5. Most questions require an answer in essay format. Clarity and organization of the answer are important.

**1. Basic terms and knowledge**

True/False. Answer each of the five questions below with a “true” or “false” in your answer booklet and provide a one to two sentence explanation of your answer. You must provide an explanation to receive marks.

- /2 each  
10 marks  
total
- a) Subaqueous tailings disposal (to fresh water lakes or sea/ocean waters) is legal in Canada.
  - b) Mineral and mining rights fall under the jurisdiction of the Federal Government.
  - c) Tailings disposal to rivers is legal in Canada.
  - d) Mine sites in Canada are not allowed to discharge effluent to the environment.
  - e) Progressive reclamation is a requirement under the Mining Act (or similar) in the jurisdiction (Province) in which you are writing this exam.

Define ANY FIVE of the following terms. One to two sentences should be sufficient for each term. Only the first five definitions provided in the answer booklet will be marked.

Define FIVE of:

- /2 each  
10 marks  
total
- Tailings
  - Phreatic surface
  - Plasticity index
  - Liquid limit
  - Creep
  - Subsidence
  - Financial surety for reclamation

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**2. Regulatory issues, sustainability and management best practices**

20 marks  
total

Discuss the role of any FIVE of the following laws/regulations or industry associations or guidelines in the regulation or management mine wastes and mine closure.

Your discussion should include the activities governed by the legislation or addressed by the industry guidelines, the responsibilities assigned to the mine operator, and the powers held by the government, where applicable.

Discussion of each item should take four to eight sentences.

Select FIVE of:

**Federal Legislation and Regulations**

- Canadian Environmental Assessment Act
- Metal Mining Effluent Regulations (MMER)
- National Pollutant Release Inventory (under the *Canadian Environmental Protection Act, 1999*)

**Industry Associations and Voluntary Guidelines**

- Canadian Dam Association – Dam Safety Guidelines
- Mining Association of Canada – Towards Sustainable Mining Tailings Working Group
- International Cyanide Management Code for the Gold Mining Industry
- International Council on Mining and Metals
- International Network for Acid Prevention-Global Acid Rock Drainage Guide

### **3. Acid rock drainage**

- 5 marks a) Briefly describe the acid-base accounting method for assessing the acid generating potential of an ore body.

Your description should take approximately five sentences.

- b) Provide a brief description of the conventional active treatment method for acid rock drainage impacted mine water (i.e., a water treatment plant).

10 marks

Your description should include an overview of the steps involved in treatment, including relevant chemical reactions, a discussion of the benefits and disadvantages of the method, and an indication of the relative cost and effectiveness of the method.

Your discussion should take approximately ten sentences.

- 5 marks c) List five active or passive methods used in the **prevention** of acid rock drainage.

### **4. Reclamation and mine closure**

- 5 marks a) Reclamation of tailings dams may present special challenges due to difficulties in establishing load-bearing ground conditions for earth moving equipment. LIST three methods of limiting pond water collection and reducing pore water pressures in tailings impoundments.

- 15 marks b) Mine closure planning is required to obtain and maintain a mining license in most provinces. Identify what hazards need to be addressed at mine closure for an open pit mine. Discuss the engineering investigations that need to be considered in a closure plan for an open pit mine in order to deal with hazards associated with the mine complex.

Point form or a table may be used for this question.

**5. Tailings disposal options**

- 15 marks
- a) The upstream method of raised embankment design and construction is the most commonly used method of tailings dam construction in Canada. Provide a detailed description of the upstream method, including the benefits and limitations of the method and an indication of the relative costs and material demands when compared to centerline and downstream designs. Your answer should indicate situations where this construction approach is not appropriate. A table and/or diagrams may be used to simplify the discussion.

Discussion should take 10-15 sentences.

- 5 marks
- b) Briefly discuss the benefits and issues associated with subaqueous tailings disposal in natural water bodies (lakes or oceans). Your discussion should include both technical and social issues and/or benefits.

Discussion should take five to ten sentences.

**6. Effluents and emissions**

- 12 marks
- a) What are the primary environmental and human health concerns associated with the following substances:
- Arsenic
  - Mercury
  - Lead
  - Silica

Discussion should take four to six sentences for each substance and include typical air and waterborne transmission mechanisms, human health effects, environmental impacts and identification of the minerals most commonly associated with the metal.

- 8 marks
- b) Discuss three methods of dust control used for open pit haul roads and/or waste dumps and/or tailings impoundments. For each method discuss the benefits as well as any drawbacks. Four to six sentences should be sufficient for each method.

## Marking Scheme

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All questions carry equal marks of 20 points. Five answers constitute a complete exam paper.

1. 20 marks total (10 items times 2 marks each)
2. 20 marks total (5 items times 4 marks each)
3. (a) 5 marks  
(b) 10 marks (4 marks for steps; 2 marks for chemistry and 4 marks for discussion)  
(c) 5 marks (1 mark for each)
4. (a) 5 marks (1.5 marks for each plus 0.5 marks for listing unrelated methods)  
(b) 15 marks (5 marks for hazard identification and 10 marks for study identification)
5. (a) 15 marks  
(b) 5 marks
6. (a) 12 marks (3 marks each)  
  
(b) 8 marks (2 marks per method, plus up to 2 marks for identification of best in class methods)