

National Exams May 2010

98-MMP-A6, Environmental Protection

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.

- /2 each
10 marks
total
- a) Subaqueous tailings disposal (to fresh water lakes or sea/ocean waters) is legal in Canada.
 - b) Fisheries are regulated by the provinces.
 - c) Mineral and mining rights fall under federal jurisdiction.
 - d) Federal environmental approval is required for most mining projects in Canada.
 - e) Tailings disposal to rivers is legal in Canada.

Define ONLY FIVE of the following terms. One to two sentences should be sufficient for each term. You may define any five terms, but only the first five definitions provided in the answer booklet will be marked.

Define FIVE of:

- /2 each
10 marks
total
- Tailings
 - Valley-fill
 - Raised embankment
 - Phreatic surface
 - Plasticity index
 - Atterberg limits
 - Standard Proctor Compaction Test
 - Darcy’s Law
 - Liquid Limit

2. Regulatory issues and management best practices

20 marks
total

Discuss the role of FIVE of the following laws/regulations or industry associations 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, including engineering staff, and the powers held by the government, where applicable.

Discussion of each item should take five to ten sentences.

Select FIVE of:

Federal Legislation and Regulations

- Canadian Environmental Assessment Act
- Metal Mining Effluent Regulations (MMER)

Provincial Legislation, Regulations and Referenced Codes

- Mining Act Part VII / Mine Development and Closure Ontario Regulation 240/00
- Lakes and Rivers Improvement Act (LRIA)
- Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia / Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia

Industry Associations

- 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

3. Acid rock drainage

- 5 marks a) List the five main factors or conditions necessary for acid rock drainage.
- 15 marks b) Describe THREE methods for the prevention or treatment of acid rock drainage. Your description should include an overview of how the method is applied, the chemical reactions involved, a discussion of the benefits and disadvantages, and an indication of the relative cost and effectiveness of the method.

You are encouraged to include sketches or diagrams as appropriate.

Discussion in part (b) should take ten to fifteen sentences for each method, with length reductions for diagrams as appropriate.

4. Failure modes and prevention

Tailings dam failures can have catastrophic results on the environment, communities, corporate finances and social perceptions of mining. Describe FOUR of the following failure modes. Include a description of typical causes and the physical failure process for each.

Four to six sentences should be sufficient for each mode and the use of diagrams is encouraged in describing the physical failure process.

Select FOUR of:

- 10 marks
- Erosion
 - Foundation Failure
 - Liquefaction
 - Overtopping
 - Piping
 - Rotational Sliding

Performance monitoring and maintenance activities are critical to ensure safe impoundment performance. Discuss the role of EACH of the following in a tailings dam management program including the equipment or methods involved in each activity and how the data are analysed and used.

Discussion should take four to six sentences for each monitoring activity/method.

- 10 marks
- a) Visual Observation
 - b) Piezometers
 - c) Embankment movement

5. Disposal options

15 marks a) There are three common methods of raised embankment design and construction: downstream; upstream; and, centerline. Identify the benefits and issues associated with each of the three methods. Your discussion should include appropriate applications. A table and/or diagrams may be used to simplify the discussion.

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. Dust and water issues

Dust

5 marks a) What are the primary health and environmental concerns associated with dust from waste dumps and tailings impoundments? Include both metal and non-metal mining issues. Discussion should take five to ten sentences.

5 marks b) Discuss two methods of dust control or dust suppression that can be used on waste dumps and tailings impoundments. For each method discuss the advantages or benefits of the method as well as any drawbacks. Four to six sentences should be sufficient for each method.

Water Issues

10 marks Sketch a basic water balance diagram for a surface impoundment tailings system showing the primary inflow and outflow sources. Identify how input and output water volumes could be measured or estimated.