

National Exams May 2013

09-Mmp-A2, Underground Mining Methods and Design

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. One only reference sheet, 8.5 x 11 inch, hand written both sides is allowed in the exam. This is a closed book exam, therefore only the approved Sharp or Casio type calculators are permitted.
3. Compulsory Question 1 and FOUR (4) other questions constitute a complete exam paper.
Only question 1 and the first four optional questions as they appear in the answer book will be marked. You must select four questions from the "optional" Questions 2 to 7. Be sure you understand that two of Questions 2 to 7 must not be answered.
4. Compulsory Question 1 is worth 40 marks. Each optional question is of equal value (15 marks). Four optional questions plus Question 1 constitute a complete exam paper.
5. Many questions require an answer in essay format. Clarity and organization of the answer are important. Use neat sketches and drawings to illustrate your answers whenever possible.

Question 1 (40 marks) You must answer all of this question, parts 1.1 to 1.7 inclusive

Question 1.1 (total 5 marks)

You are conducting a feasibility study to develop an underground mine.

How would you go about estimating capital and operating costs given the deposit type/geometry and rock conditions, and the cost of mining.

Question 1.2 (total 6 marks)

Explain the basic law of mine ventilation relating Head (Pa or ins H₂O) to flow Quantity (m³/sec or cfm)

(2 marks)

In the context of mine ventilation systems utilizing a large single fan, what do you understand by the terms;

“static head of a system”. (1 mark)

“measured system head for an actual airflow”. (1 mark)

“mine characteristic curve”. (2 marks)

Question 1.3 (total 6 marks)

A dual skip hoisting system is based on the following;

- | | |
|--|----------------------|
| • Fixed time for load,dump and creep | 1 minute |
| • Acceleration and deceleration rate | 1 m/sec ² |
| • Hoisting and return rate, assume instantaneous | 400 m/min |
| • Hoisting distance | 500 m |

What is the cycle time required (seconds) to load, hoist and dump ?

Question 1.4 (6 marks)

Draw a neat sketch and briefly explain the features of the following mining methods;

- Cut and fill (3 marks)
- Longhole (3 marks)

Question 1.5 (6 marks)

Draw a neat sketch and briefly explain the features of the following mining methods;

- Shrinkage (3 marks)
- Sub-level caving (3 marks)

Question 1.6 (5 marks)

A mine pumping application for clear water is required to move 12.6 L/sec (200 USgpm) at a dynamic head of 183m (600 ft). The motor and pump efficiencies are 85% and 70% respectively.

What is the power requirement delivered to the motor in kW (horsepower).

Question 1.7 (6 marks)

Explain the uses and differentiate between the following types of backfilling materials;

- Hydraulic fill
- Paste fill
- Rock fill
- Flocculated fill

(1.5 marks each)

Question 2 (15 marks total)**One of Four Optional Questions**

A mine has a single fan with a static head H_s of 500 Pa (2 in H_2O) and a total head H_t of 750 Pa (3 in H_2O) at a quantity of $190 \text{ m}^3/\text{s}$ (400,000 cfm);

- 2.1 Determine the static and total heads at an air quantity of $375 \text{ m}^3/\text{s}$ (800,000 cfm).
- 2.2 Draw neat mine characteristic curves graph (X quantities (m^3/s or cfm)) versus (Y heads (in H_2O or Pa)). The X axis should span 0 to 400 m^3/s (0 to 800,000 cfm) and Y 0 to 3000 Pa (0-12 in).
- 2.3 From your graph at 285 m^3/s (600,000 cfm) what are the H_s and H_t values.

(5 marks each)

Question 3 (15 marks total)**One of Four Optional Questions**

For this question the liberal use of neat diagrams is encouraged.

- 3.1 Draw neat cross section and side view of the following wire hoist ropes. What are the special attributes of each lay, how is the rope constructed.
 - Regular Lay
 - Langs Lay

(1 mark each, total 2)

- 3.2 Typical hoist ropes include the following. Describe typical usage of each type;

Round Strand

Flattened Strand

Locked Coil

Half-locked Coil

(1 mark each, total 4)

3.3 With reference to shaft hoisting, what do you understand by the term "overwind" and describe two methods of preventing it. (1 mark each, total 2)

3.4 Describe the following shaft mucking methods used in sinking

Cryderman

Clamshell

Cactus Grabber

(1 mark each, total 3)

3.5 With reference to rock hoisting what do you understand by the terms "skip" and "loading pocket" (total mark 1)

Describe the following skip designs, how they are loaded and dumped and their typical loading pockets;

Fixed body bottom dump

Overturning (Kimberly)

Swing out body

What are the advantages and disadvantages of each type, including maintenance.

(1 mark each, total 3)

Question 4 (15 marks total)

One of Four Optional Questions

Compare and contrast the cut & fill and longhole mining methods with special emphasis on the following;

- Geology, orebody shape, size and orientation
- Host and ore rock properties
- Development size, amount, cost and time taken to start extraction
- Ground support
- Mining sequence and mill feed rate
- Number and skills of mining personnel

- Types and numbers of mechanized equipment
- Cost of mining
- Mine life
- Mining rate
- Dilution and recovery
- Methods and costs of any pillar recovery
- Post mining stabilization

Your answer may be in table format if you feel this makes your answers more understandable.

(1 mark each plus 2 for clarity)

Question 5 (15 marks total)

One of Four Optional Questions

Compare and contrast the shrinkage and sub-level caving mining methods with special emphasis on the following;

- Geology, orebody shape, size and orientation
- Host and ore rock properties
- Development size, amount, cost and time taken to start extraction
- Ground support
- Mining sequence and mill feed rate
- Number and skills of mining personnel
- Types and numbers of mechanized equipment
- Cost of mining
- Mine life
- Mining rate
- Dilution and recovery
- Methods and costs of any pillar recovery
- Post mining stabilization

Your answer may be in table format if you feel this makes your answers more understandable.

(1 mark each plus 2 for clarity)

Question 6 (15 marks total)

One of Four Optional Questions

- 6.1 What are the four most important "services" which must be supplied to an underground mine.
- 6.2 Describe the surface and underground infrastructure to supply these services.
- 6.3 What are the methods of transferring the service underground.
- 6.4 What range of amounts of each services are required and at what capital and unit cost.
- 6.5 What types of equipment are typically supplied by the four services, and what ranges of consumption rates per unit of equipment can be expected.

(3 marks each, total 15)

Question 7 (15 marks total)

One of Four Optional Questions

- 7.1 What methods are used in mine processing plants (mills) to make backfill suitable for support and filling voids left by mining.
- 7.2 What mining methods and/or host rock characteristics make the use of backfill essential.
- 7.3 How does the mine and mill cope with backfill sequencing, i.e. the mill produces a relatively constant supply of suitable material but the mine may demand fill on an intermittent basis.
- 7.4 Discuss backfill additives such as cement, fly ash, ground glass and etc. Your answer should include material on the availability and cost of additives in remote mine locations, and the increase in fill strength.
- 7.5 Paste fill technology is relatively difficult to apply in many mines. Describe how such fill is produced in a mill, transported underground and placed. What difficulties can be anticipated with paste fill production, transportation and placement.

(3 marks each, total 15)

End of Exam