University of Toronto
Faculty of Applied Science & Engineering
Lassonde Mineral Engineering Program

Mining Engineering - MIN450 - Spring 2001

Final Examination - Friday, April 27, 2001, 9;30 am
Examiner: L.D. Smith

A single aid sheet is allowed.
All questions are based on information presented in the lectures.
Please start a new page for each question.
Please write your answers in complete sentences.
Use bullet format for organization if you wish.

All answers should be brief and to the point.
Show all of your math. Marking includes the math

ANSWER ALL QUESTIONS **100 MARKS**

1. Economic Evaluation

You are part of a team that is reviewing a mining project at the feasibility study phase. Data has been provided to you for tonnages, grades, costs, etc, and you have used this information to generate an after tax cash flow, with no inflation, no debt, that has the following values:

Year -2	-$130 million (Construction)
Year -1	-$170 million (Construction)
Year 1	+$50 million
Year 2	+$60 million
Year 3	+$60 million
Year 4	+$60 million
Year 5	+$60 million
Year 6	+$60 million
Year 7	+$60 million
Year 8	+$60 million
Year 9	+$60 million
Year 10	+$40 million
Year 11	-$10 million (Closure)

a) What is the NPV at 10%? (assume end-of-year discounting) **5 marks**
b) What is the NPV at 15%? (assume end-of-year discounting) **5 marks**
c) What is the approximate IRR (use a graph)? Why is this number the IRR? **3 marks**
d) Your corporate hurdle rate for these economic criteria is 11.5%. Would this be considered to be a "GO" project? Why **3 marks**

Total = 16 marks

2. Resources & Reserves

During the 1940s, a copper-zinc deposit in northern Ontario was mined by the federal government for 5 years to provide material for the war effort. It was developed for strategic reasons but could just barely pay the operating costs in peace time and so was shut down. In the 60 years since the mine shut down, a smelter was built nearby but the mine that supports it is running out of ore. You work for a consulting company that has been hired by the smelter to review the abandoned copper-zinc mine as a potential source of new feed for the smelter.

The bottom of the shaft is at 330 m. The mineralized material above 330m was drilled extensively and there are detailed mine plans and production data available from official government records showing the mine layout, the amount of material that was mined, and where the material was mined. A small amount of drilling below the 330m level indicates that the mineralization continues at depth.

Your task is to develop a program outlining a technical and economic due diligence review that will provide the information required to allow the evaluation of this property as an investment for the smelter owners. There are two parts to the review:

a) Reserves: Using the list of modifying factors that are applied to resources when determining reserves, describe what you would need to determine the reserves in this particular situation and why. (7 modifying factors and 7 reasons =) **14 marks**

b) Describe the team you would assemble to undertake a review of the abandoned mine. What technical skills would you want and why? **6 marks**

Total = 20 marks

3. Country Risk

Estimate the level of country risk for Canada, USA, Chile, and China.

a) Create a table with five columns, the first column for country risk components plus one column for each country. List seven (7) significant components of country risk in the table and rank each country as High, Medium, Low for each component. **7 marks**

b) Give an overall ranking (High, Medium, Low) for each country and offer a **brief** comment on each overall ranking. (4 countries =) **4 marks**

Total = 11 marks

4. General

A brief answer is required for each. Full sentences in bullet format are acceptable.

a) Why would you go outside of your own company to raise funds for a mining project? (3 reasons =) **3 marks**

b) What is the impact of debt on a project's IRR? Why? **2 marks**

c) What is a completion test? When does it occur? Why is it important to the owner and the banks? (3 points =)**3 marks**

d) Use one word to describe the biggest difference between "After Tax Cash Flow" and accounting "After Tax Earnings". **2 marks**

e) Should taxes be included in a cash flow evaluation? Why? **2 marks**

f) Consultants can be used to fill a number of important roles in the life of a mineral project. Indicate where a consultant could be used and why. **3 marks**

Total = 15 marks

5. Evaluation & Cash Costs

A mining operation has the following operating and cost statistics:

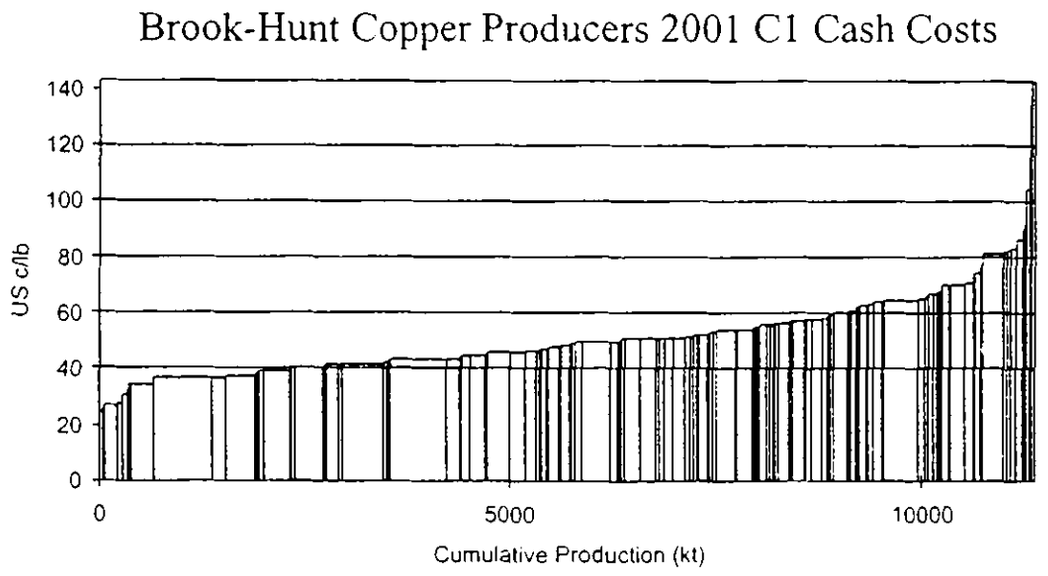
Production	30,000,000	tonnes of ore per year
	2,035,700	dry metric tonnes of concentrate per year
	28%	Cu per dry metric tonne (dmt) of concentrate
	96.5%	Cu in concentrate paid
Copper Price	$.95	per lb Cu
Depreciation	$.10	per lb Cu
Mining cost	$1.50	per tonne ore
Processing	$5.40	per tonne ore
General & Administration	$15,000,000	per year
Smelter TC	$95.00	per dmt concentrate
Smelter RC	$.095	per lb Cu paid
Freight Costs	$32.00	per dmt concentrate
Penalties, Losses, Insurance	$3.25	per dmt concentrate

a) What is the Net Smelter Return (NSR) of this operation in $/dmt of concentrate? **6 marks**

b) What is the C1 cash cost of this operation in $/lb Cu paid? **3 marks**

c) Mark this operation sit on the attached cost curve. **1 mark**

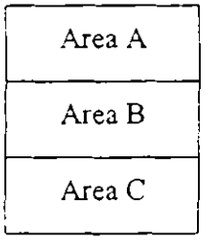
(Hint: Work in a table and start by expressing all values in $/year) **Total = 10 marks**



6. Project Life Cycle

There is a typical pattern of events that a mineral project experiences from the first discovery through to the final decommissioning. For this question you are asked to draw 3 diagrams to illustrate these events, to identify critical points in the life of the project, and to provide comments for each critical point as numbered notes on a separate page to accompany the diagrams. The horizontal axis for all three diagrams is TIME. Use the same scale for each diagram so they will be aligned vertically. Assuming a 10 year mining operation, the scale should cover more than 20 years.

To assist in drawing the graphs, divide an examination notebook page into 3 areas as shown. Use the same horizontal axis (time) for all 3 graphs and plot them vertically above each other.



a) In Area A plot the life cycle of a mineral project with DOLLARS (plus and minus, not necessarily to scale) as the vertical axis. Show when funds come into the project (investments), when funds are spent, and when funds are generated by the project. Indicate an approximate duration for each activity. Mark at least 6 significant events using numbers (A1, A2, etc) and, on a separate page, briefly explain the significance of each.

(6 activities plus 6 descriptions =) **12 marks**

b) In Area B plot a curve with DISCOUNT RATE as the vertical axis. Indicate approximately what discount rate you would expect to used if evaluating a base metal (as opposed to gold) project at different stages in its life cycle. Mark at least 3 points using numbers (B1, B2, etc) to indicate significant points on this graph and, on a separate page, briefly explain the risk associated with each.

(3 phases/rates plus 3 descriptions =) **6 marks**

c) In Area C indicate FIVE (5) EVALUATIONS METHODS that would be appropriate at different stages of the project life cycle. Draw a horizontal bar for each method to indicate the portion of the life cycle when that particular method would be applicable. Mark each method using numbers (C1, C2, etc) on this graph and, on a separate page, identify and briefly describe each method and why it is appropriate for that stage.

(5 methods plus 5 descriptions =) **10 marks**

Total = 28 marks