ORDRE DES INGÉNIEURS DU QUÉBEC

MAY 2019 SESSION

Open-book examination Calculators : only authorized models Duration : 3 hours

Exam 14-MI-A2 Underground Mining Methods and Design

Total = 100 points

Question 1 (35 points)

You have to mine an orebody that is 150 m long by 5 m wide and 800 m high with cut-and fill mining method using external ramps. The dip of the orebody is 80°. The orientation of the orebody is east-west The main production shaft is 100 m south of the eastern limit of the orebody and the ventilation shaft is 75 m south of the western limit of the orebody.

a) Present schematic plan view of the main excavations needed at the bottom of the orebody
b) Draw a side view of the mining method with the main levels needed
c) Illustrate how the ramps will be used to mine the different cuts
d) List the equipment that will be needed to mine the orebody
e) Indicate what type of fill you would suggest and the infrastructure needed for that type of fill
f) Assuming a rock density of 3 t/m^3, and 2 shift per day, what would be the daily production of ore (in tons/day)? Show your calculations.

Question 2 (35 points)

The geological characteristics of a gold orebody are given in the following table:

Cutting grade (g/t)	Proven ore reserves (Millions of tonnes)	Average grade (g/t)
0.5	25	3.5
1	20	3.7
1.5	18	3.9
2	16	4.0
2.5	13.5	4.1
3	12	4.3
3.5	11	5.0
4	10	5.3

4.5	9	5.7
5	8	5.9
5.5	6	6

The orebody will be mined with the long hole method and will need a 450 M$ investment. The annual production of ore will be 1.5 Mt. Total costs (not including the investment) are 60$ per tonne of ore. Selling price is 1555 $/oz (1 oz = 31.1 g), mill recovery is 95% and ore dilution in stopes is 20%.

a) Considering the investment (depreciated on the mine life with an interest rate of 10%), calculate the final cutting grade of the project.
b) For the cutting grade calculated in a), calculate the Net Present Value of the project considering the dilution in the stopes. Selling price will remain constant but costs will increase at a rate of 2 % per year.

Show all your calculations.

Question 3 (15 points)

Select the best mining method for the following orebodies (justify your selection) and describe briefly (max 15 lines) the mining sequence for the selected method

Orebody #1: Small width vein (3-5 m) with a dip of 20°. The vein is 800 m long and 200 m high. The mineralized rock is very competent (RMR = 85, Unconfined strength of 200 MPa) but the surrounding rock mass is more fractured (RMR = 70; Unconfined strength of 250 MPa). The orebody is located at a depth of 1000 m.

Orebody #2: Small width vein (2-8 m) with a dip of 75°. The vein has an irregular shape and is 150 m long and 500 m high. The ore and surrounding rocks are very resistant (RMR > 80; Unconfined strength > 175 MPa).

Orebody #3: Massive orebody (300 m x 200 m x 300 m). The surrounding rock mass strength is average (RMR = 65) but the orebody is very weak (RMR < 35). The orebody is at a depth of 400 m.

Question 4 (15 points)

Figure 1 shows individual (Vent. A and Vent. B) and combined (combinée) fan curves (H = Pressure; Q = airflow in cfm). Pressure measurements on the fans gave the operating points as shown on the curves. When the measurements were made, there was a natural ventilation pressure of 1 inch of H_2O (1 po eau) in the same direction as the fans. Determine:

a) if the fans are installed in series or in parallel;
b) the mine airflow Q;
c) the equivalent mine resistance R_{eq};

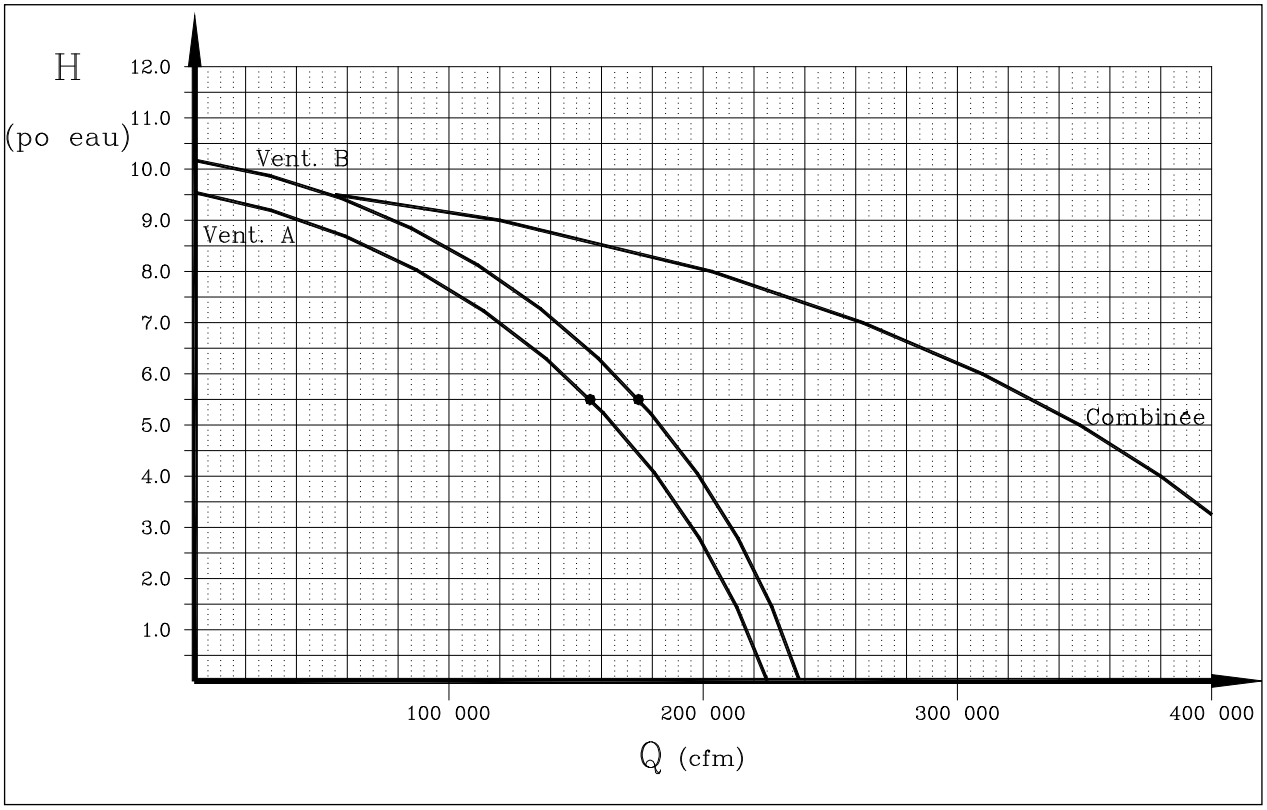

Figure 1