

**ORDRE DES INGÉNIEURS DU QUÉBEC
MAY 2018 SESSION**

All documentation is permitted
Calculators: allowed models only
Exam duration: 3 hours

14-BA-A3 Building Construction Management

Question 1 (8 points)

What is the utility of the Earned Value method? Use curves and formulas to explain this method.

Question 2 (20 points)

Using the data in Table 1, draw the AOA diagram (Activity On Arrow) and indicate the critical path.

Indicate, for each activity, the Early Start (ES), the Early Finish (EF), the Late Start (LS), the Late Finish (LF), the total Float (TF), and the Free Float (FF).

Table 1

ACTIVITY	DURATION	PREDECESSOR
K	5	None
L	8	K
M	3	K
N	6	K
O	11	L
P	5	M
Q	6	M, N
R	4	Q
S	11	O
T	4	L, P, R
U	4	L, P, R
W	5	U

Question 3 (20 points)

Using the data in Table 2, draw the Precedence Diagram Method (PDM) also called AON diagram (Activity-On-Node) and indicate the critical path.

Indicate, for each activity, the Early Start (ES), the Early Finish (EF), the Late Start (LS), the Late Finish (LF), the total Float (TF), and the Free Float (FF).

Table 2

Activity	Duration	Relations	
		Start	End
B	10		
C	8	After the end of B and F	
D	5		5 days after the end of B
E	10	5 days After the start of D	
F	10	After the end of D	
G	5	After the end of E	
H	10	10 days After the start of E	
K	5	After the end of H	

Question 4 (20 points)

Your company is committed to implement the following project according to the schedule shown in **figure 1**, in 20 days that represent the normal duration of the project.

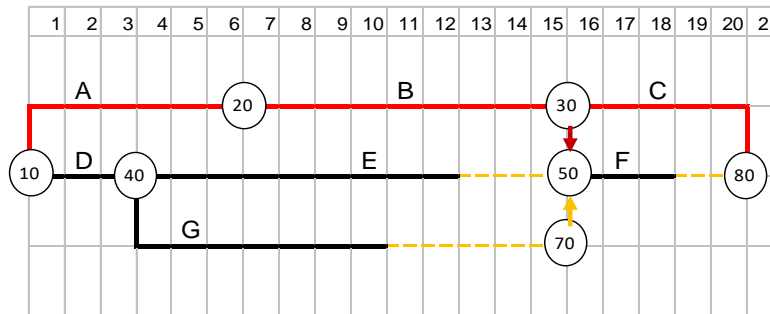


Figure 1. Project schedule

The project includes fixed overhead costs of \$ 3 000 to be spent at the beginning (1st day) of the project. It also includes variable overhead of \$ 1 000 / day. The project data are in Table 3:

Table 3

Activity	Predécessors	Normal		Compressed	
		Duration	Cost	Duration	Cost
A		6	9 000	3	12 000
B	A	9	7 000	6	8 800
C	B	5	6 000	3	7 000
D		3	4 000	2	5 000
E	D	9	5 000	8	6 200
F	B, E, G	3	3 000	3	3 000
G	D	7	2 000	6	2 400
Total			36 000		

We ask you to:

- Calculate the minimum duration of the project after compression and demonstrate all the calculation steps (11 points);
- Calculate the indirect and total costs for the project (4 points);
- Draw the CPM direct costs-duration curve for the project (1 point);
- Draw the CPM indirect costs-duration curve for the project (1 point);
- Taking into account the indirect and direct costs establish the total cost-duration curve (1 point);
- Calculate the optimum duration to complete this project and the relative cost (2 points)

Question 5 (12 points)

Your employer wants to determine the duration and total cost required for an activity of mass excavation. He gives you the following information:

1. The land is rectangular with dimensions of 80 m x 50 m at the natural ground level;
2. The total excavation depth is 2 m;
3. The surveys indicate that there is only one type of soil, namely a sandy clay soil with a natural density of 2t/m^3 . The slopes to consider during excavation are 2:1 (this means 2m horizontally for 1m vertical);
4. The percentage of swelling is 20%;
5. The excavation is done by an excavator whose production rate is $100\text{ m}^3/\text{hour}$;
6. The excavator works 10 hours/day;
7. The soil was loaded on 10 m^3 trucks;
8. The transport distance is 10 km. The speed of the loaded truck is 50 km/hour and the speed of return is 60 km/hour. The loading time depends on the excavator and unloading time is three (3) minutes (you have to calculate the number of trucks);
9. Hourly equipment costs include drivers are \$ 250/hour for the excavator and \$ 120/hour per truck.

The total cost includes indirect costs of \$ 2,000/day and administrative costs of 15% on direct and indirect costs.

Question 6 (20 points)

Using the method of parallelepipeds (méthode des parallélépipèdes), calculate the required volumes of excavation and backfill. The final level of the site (shown in Figure 2) should be 13 000.

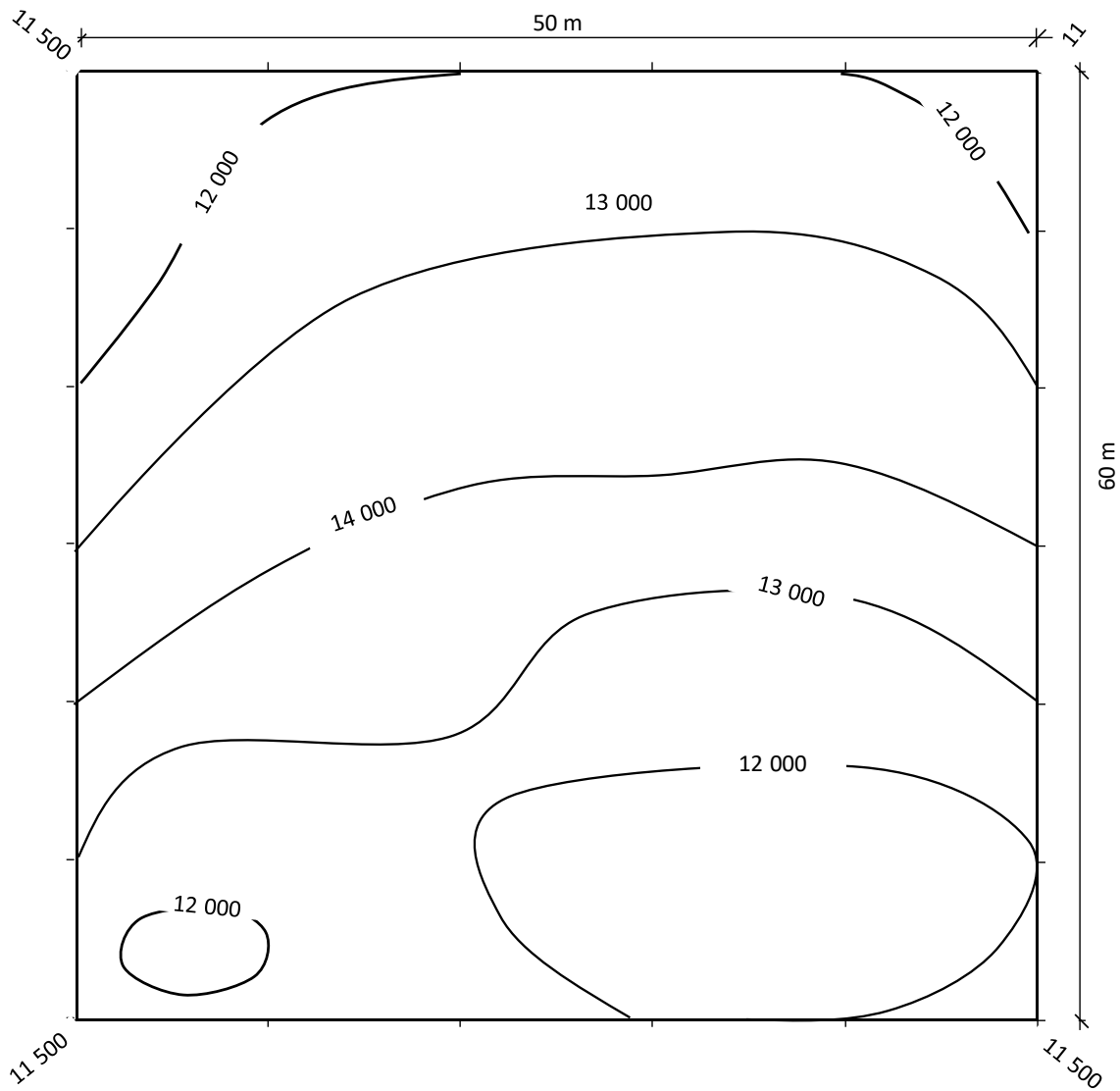


Figure 2 - Site plan