

**ORDRE DES INGÉNIEURS DU QUÉBEC**  
**May 2017 SESSION**

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

**14-BA-A3 Construction Project Management**

**Question 1 (5 points)**

What does the breakdown of prices (ventilation des prix) mean? How is it prepared and what are the problems encountered in its preparation?

**Question 2 (5 points)**

Compare and discuss the "Cost of conformance" and the "Cost of non-conformance"

**Question 3 (5 points)**

Discuss internal and external adversity cases and give examples

#### Question 4 (17 points)

Using the data in Table 1, 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 1**

Activity	Duration	Relationship	
		With the Start	With the End
<b>M</b>	<b>20</b>	<i>No predecessor</i>	
<b>N</b>	<b>30</b>	<i>No predecessor</i>	
<b>O</b>	<b>10</b>	After the end of N	
<b>P</b>	<b>20</b>	After the end of M	5 days after the end of O
<b>Q</b>	<b>10</b>	After the end of V	
<b>R</b>	<b>10</b>	After the end of Q	
		5 days after the end of P	
<b>S</b>	<b>10</b>	<i>No predecessor</i>	
<b>T</b>	<b>10</b>	After the beginning of V	
		After the end of S	
<b>V</b>	<b>5</b>	2 days after the beginning of O	

### Question 5 (17 points)

Using the data in Table 2, 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).

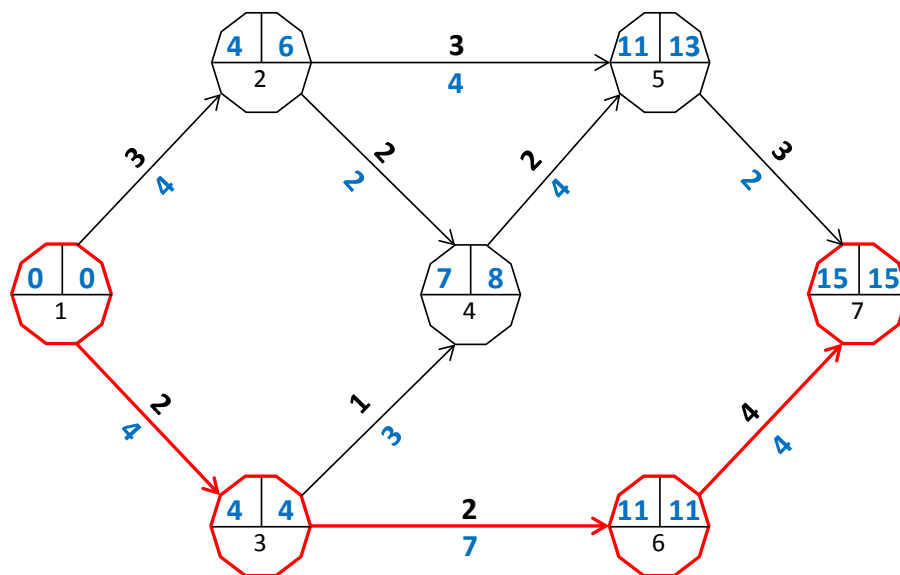
**Table 2**

Activity	Duration	Predecessor
A	10	aucun
B	7	F
C	5	A
D	5	C
E	8	F
F	12	A
G	3	B
H	3	D, F
K	7	B, H, E
L	14	D, F
M	5	G
N	5	B, E, H, L

### Question 6 (14 points)

Resolve the resource conflicts for the following project, knowing that you can use up to 7 resources at the same time. The activities must be carried out on an ongoing basis (no interruption of work is permitted).

The **calculation steps must be demonstrated**. This means that you have to redraw the network and make a new Gantt chart every time an activity is delayed because of a conflict.



Activity	Resources	Duration
1-2	2	4
1-3	3	4
2-5	3	5
2-4	2	2
3-4	1	2
3-6	2	7
4-5	2	5
5-7	3	2
6-7	4	4

Figure 1 – Resource conflicts

### Question 7 (10 points)

You are a contractor specialized in institutional construction projects. Your bond limit (limite de cautionnement) is \$ 150 million. Currently, you have a \$ 50 million contract. You have two estimators to your jobs. One of them prepares a bid to be presented in three weeks with an estimated value of \$ 40 million, while the other estimator prepares another bid for the next week with an estimated value of \$ 20 million. What is your opinion if you can or want to prepare bids for the following projects, and why.

1. Construction of a university building with an estimated value of \$ 30 million. Bids must be submitted within 2 weeks.
2. A 10 km road construction project with an estimated value of \$ 20 million. Bids must be submitted within 4 weeks.
3. Building a new wing for a hospital with an estimated value of \$ 60 million. Bids must be submitted within 4 weeks.
4. The construction of a petrochemical plant with an estimated value of \$ 35 million. Bids must be submitted within 5 weeks.
5. The construction of a museum with an estimated value of \$ 35 million, for which only four bidders are invited. Bids must be submitted within 3 weeks.

### Question 8 (10 points)

Your employer wants to calculate the **excavation activity duration** and determine the **number of trucks** required for an activity of mass excavation for a building foundation. He gives you the following information:

1. The land is rectangular with dimensions of 120 m (length) x 150 m (width).
2. The total excavation depth is 2.8 m.
3. The surveys indicate that there are two types of soil whose thicknesses and densities in their natural state are shown in the figure 2 below.
4. The percentage of swelling is 22% for the Sandy Clay and 24% for the clay.
5. The production of the excavator is  $110 \text{ m}^3 / \text{h}$  for the sandy clay and  $100 \text{ m}^3 / \text{h}$  for the clay.
6. The excavator works 10 h / day.
7. The soil was loaded on trucks of 20 tons. Each truck has one (1) cycle each 40 minutes (Load, travel to the dump site, unload, return to the loading unit).

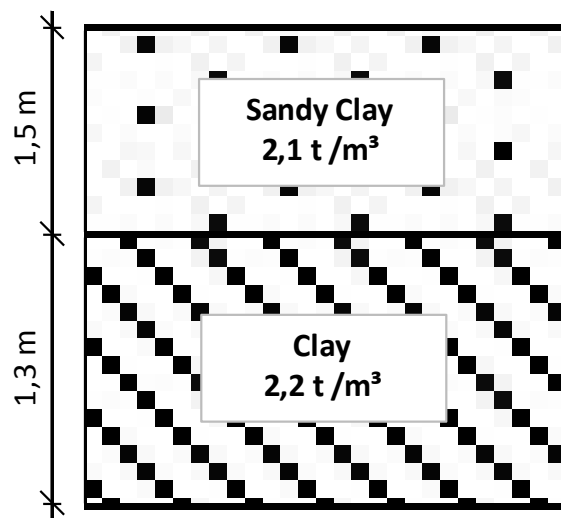


Figure 2- Geotechnical investigations - Vertical cross section

**Question 9 (17 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 3) should be 35 000.

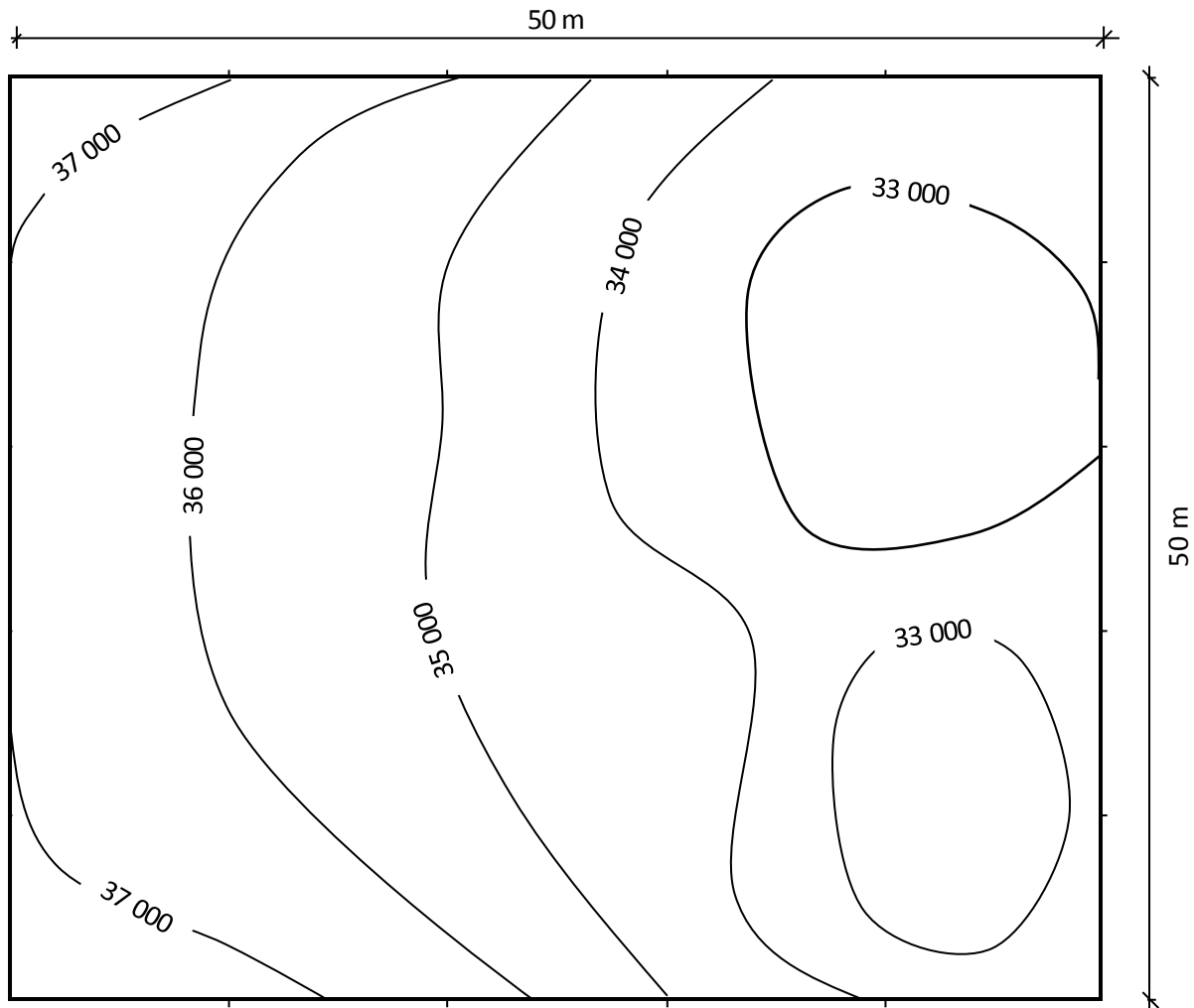


Figure 3 – The site map