

# ORDRE DES INGÉNIEURS DU QUÉBEC

## NOVEMBER 2018 SESSION

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

### 14-IN-A3 FACILITIES PLANNING

#### QUESTION I (20 POINTS)

Pratt's Department Store is opening a new store in The Center's Mall. Customer movement method tracked in its existing stores shows the following patterns:

Table 1: Number of Customers.

<b>To From</b>	<b>Women's</b>	<b>Men's</b>	<b>Boys'</b>	<b>Girls'</b>	<b>Infants</b>	<b>Housewares</b>	<b>Accessories</b>
<b>Women's</b>		20	50	50	50	70	60
<b>Men's</b>			20	10	5	20	30
<b>Boys'</b>		20		20			
<b>Girls'</b>	30		50		30		
<b>infants</b>	30						
<b>Housewares</b>	40						
<b>Accessories</b>	30					20	

- Design a layout for Pratt's new store on a 3 X 3 grid that will minimize nonadjacent customer movement. **10 POINTS**
- If you eliminate the square of the grid where there are no departments, what is the shape of your building? **10 POINTS**

#### QUESTION II (20 POINTS)

Professional Image Briefcases is an exclusive producer of handcrafted, stylish cases. Priding itself on its earlier reputation, the company assembles each case with care and attention to detail. This laborious process requires the completion of six primary work elements, which are listed here.

<b>Work Element</b>	<b>Precedence</b>	<b>Time (min)</b>
A Tan leather	----	30
B Dye leather	A	15
C Shape case	B	10
D Mold hinges and fixtures	----	5
E Install hinges and fixtures	C, D	10
F Assemble case	E	10

- Construct a precedence diagram for the manufacture of briefcases.
- If the demand is 50 cases per 40-hour week, compute the cycle time for the process.
- Compute the lead time required for assembling one briefcase.
- How would you balance this assembly line?
- Compute the line's efficiency and balance delay.

**a (4 Pts); b (4 Pts); c(4 Pts); d(4 Pts); e(4Pts)**

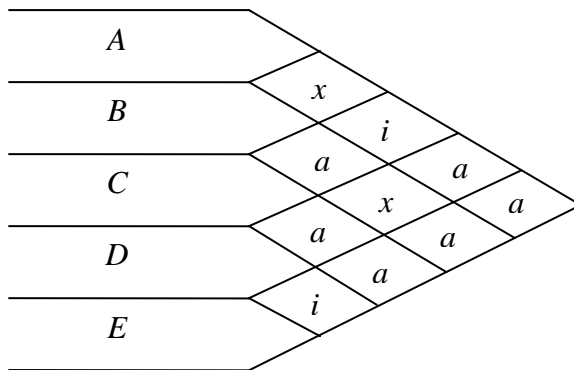
### QUESTION III (20 POINTS):

Departments *A*, *C*, *D*, and *E* should be 40 X 40 feet. Department *B* should be 40 X 80 feet. Arrange these five departments in a space 80 X 120-feet so that the layout meets the conditions specified in the matrix.

*a* = absolutely necessary

*i* = important

*x* = undesirable



### QUESTION IV (20 POINTS)

The *Michael* Corporation has plants in three cities. It distributes products from these plants to some customers and two distribution centers. The company is planning to open a third distribution center in either Oklahoma City or Amarillo. The costs of shipping products from the company's plants to its present and prospective distribution center locations are given in the following table along with the plant capacities and requirements for each distribution center.

- Determine the best distribution pattern if Amarillo is selected as the location for the new distribution center. **7 POINTS**
- Determine the best distribution pattern if Oklahoma City is selected. **7 POINTS**
- Compute the total distribution cost for part *a* and *b*, and determine which location results in the lowest total distribution cost. **6 POINTS**

Shipping Costs from Plants to Current and Potential Distribution Centers.

Distribution Centers	Plants			Demand at Distribution Centers
	San Jose	Salt Lake City	Little Rock	
St. Louis	\$17	\$13	\$5	900
Phoenix	6	9	11	700
Amarillo	9	8	7	600
Oklahoma City	10	7	7	600
Capacity at plant	800	900	800	

**QUESTION V (20 POINTS):**

The company *Vélopro* manufactures racing bikes. The management is considering four sites for a new plant: Quebec, Montreal, Chicoutimi and Trois-Rivieres. The following table presents the annual fixed cost and variable costs per bike:

Location	Annual fixed cost (\$)	Variable costs per bike (\$)
Québec	8 200 000	280
Montréal	2 500 000	160
Chicoutimi	3 600 000	105
Trois-Rivières	4 800 000	75

Although fixed costs and variable costs for other cities are lower than those of the implementation in Quebec, the company management *Vélopro* think the demand and selling prices of bicycles would be both higher if the production took place in Quebec City. The following table illustrates these projections:

Location	Sale price per bike (\$)	Annual forecasted demand (bike)
Québec	600	65 000
Montréal	450	50 000
Chicoutimi	450	48 000
Trois-Rivières	450	45 000

1. Determine the location that will generate the highest annual profit. **10 POINTS**
2. Is the choice of this place sensitive to the forecast accuracy? What should be the minimum sales for Quebec to be the best solution? **-10 POINTS**