ORDRE DES INGÉNIEURS DU QUÉBEC
MAY 2018 SESSION

Any documentation permitted
Calculators: Permitted models only
Duration of examination: 3 hours

14-IN-A4. PRODUCTION MANAGEMENT

A total of 50 points with 7 exercises.
Justify your answer if asked.
If you lack data, make clear, consistent and credible assumptions about the missing data and work with these assumptions.

Exercise 1 (7 points) :

A chemical company manufactures products A, B and C in 50 kg bags on the same production line. The setup time is estimated at 2 hours for a cost of $ 100 per hour (hourly cost of the production line). The cost of ownership (storage cost) is estimated at $ 6 per ton per year. The company works 200 days a year, 8 hours a day.

	Daily demand (tons)	Production rate (ton/day)	Maximum demand
A	20	60	30
B	30	100	40
C	10	50	15

Question 1 (5 points):

Applying the classic formula, give the economic order quantity (in bags) for each product, and the production time of each.

		Annuel			
	EOQ (BAGS)	Number of Setup	Setup time (h)	Production time (h)	total (h)
A					
B					
C					
Total					

Question 2 (2 points):

What is the average stock (in tons) in the company and what is the total utilization rate of the production line (production plus set-up)?

Produit	A	B	C
Stock moyen			

utilization rate:

Exercise 2 (7 points):

A company observes the following consumption for one of its products, in the last 12 months and wishes to use a simple method to establish its forecasts next year. For this, she wants to apply a posteriori two simple methods of forecasting on the history and see the best method. She believes that her product is not seasonal and that there is no trend. Observed demand:

1	2	3	4	5	6	7	8	9	10	11	12
100	100	97	99	99	97	101	102	106	108	107	109

Question 1 (3 points):

Apply a simple forecast using the 3-period moving average and calculate the average difference between forecasts and real demand over the last 10 periods.

Semaine	1	2	3	4	5	6	7	8	.	9	10	11	12
Réel	100	100	97	99	99	97	101	102		106	108	107	109
Prévu													
Écart													

Average difference between forecast and real demand:

Question 2 (3 points):

Apply a simple forecast using a 0.4 coefficient exponential smoothing and calculate the average difference between forecast and real demand over the last 10 periods:

Semaine	1	2	3	4	5	6	7	8	9	10	11	12
Réel	100	100	97	99	99	97	101	102	106	108	107	109
Prévu												
Écart												

Average difference between forecast and real demand:

Question 3 (1 point):

What do you propose ?

Exercise 3 (12 points):

Let consider the following set of tasks:

Task	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Successors	EF	CD	GJ	H	I	GJ	I	M	N	KL	N	-	-	-
Duration	4	3	5	6	3	7	7	1	7	8	2	8	4	1

Question 1 (6 points):

Draw the corresponding precedence graph with the tasks on the arcs. Give the start dates at the earliest, at the latest, the margins of each task, and the length of the critical path.

Task	Earliest starting	Latest starting	margin		Task	Earliest starting	Latest starting	margin
A					H			
B					I			
C					J			
D					K			
E					L			
F					M			
G					N			

Question 2 (3 points):

Give the graph with the tasks on the vertices

Question 3 (3 points):

It is possible to shorten certain tasks with an extra cost per each reduced day. The following table gives the additional costs per day and the minimum possible durations:

Task	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Successors	EF	CD	GJ	H	I	GJ	I	M	N	KL	N	-	-	-
Duration	4	3	5	6	3	7	7	1	7	8	2	8	4	1
Minimum	3	3	3	4	3	5	5	1	5	5	2	7	3	1
Cost for each day	5	-	1	2	-	5	7	-	7	7	2	3	2	-

What is the right strategy with 10K$?

Exercise 4 (6 points):

An independent worker receives daily work to perform. She has almost 9 hours of work today. She has received 10 requests for work, classified in the order of arrival, and for each she knows the estimated duration (in minutes) and the expected time of delivery (in minutes since 8 o'clock in the morning, for simplicity).

Work	a	b	c	d	e	f	g	h	i
Duration	100	30	85	55	30	55	20	95	55
Expected finishing date (MN from 8)	475	270	520	635	195	505	190	615	430

What matters for the worker are the two following indicators: sum of the delays and the average completion date of the different works.

Apply 3 different scheduling priority rules:

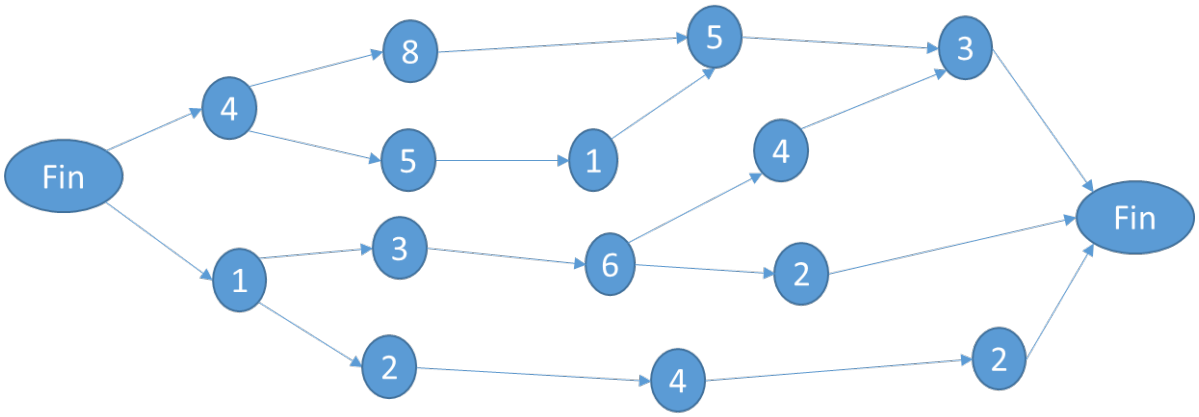
- First In First Out
- Shortest Processing Time
- Earliest Due Date

For each priority rule, give the scheduling order, the sum of the delays and the average completion date (in minutes since 8 am):

	Scheduling order	Sum of delays	Average completion date
FIFO			
SPT			
EDD			

Exercise 5 (6 points):

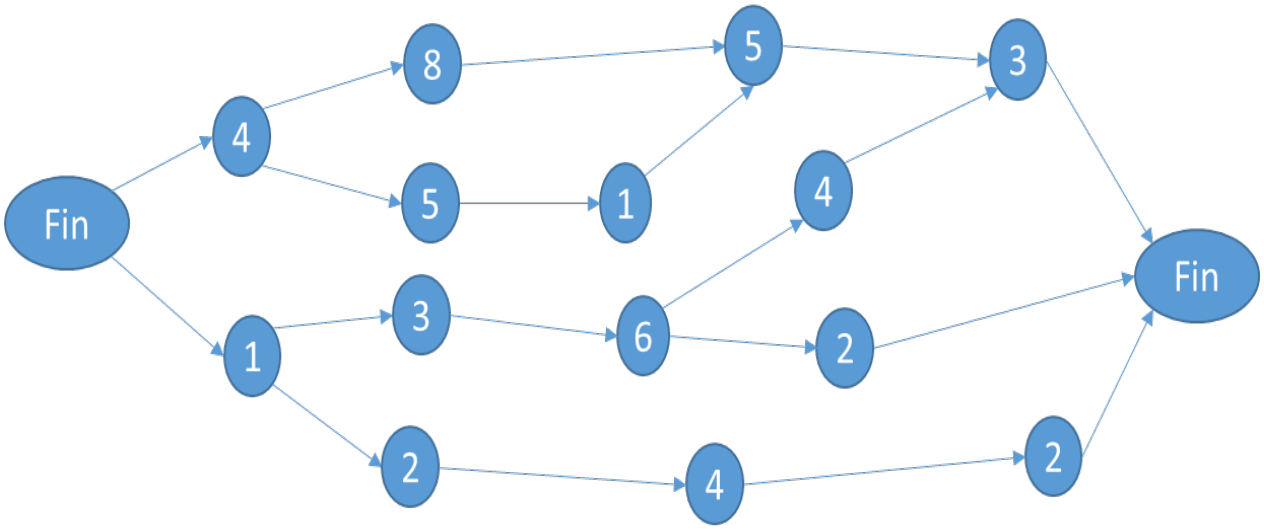
The following precedence graph represents a set of elementary tasks required to assemble a product. Each node is a task and the duration is indicated in the node.



Question 1 (4 points):

Apply strictly the line balancing method using the greatest positional weight, with a cycle time of 10 units of time.

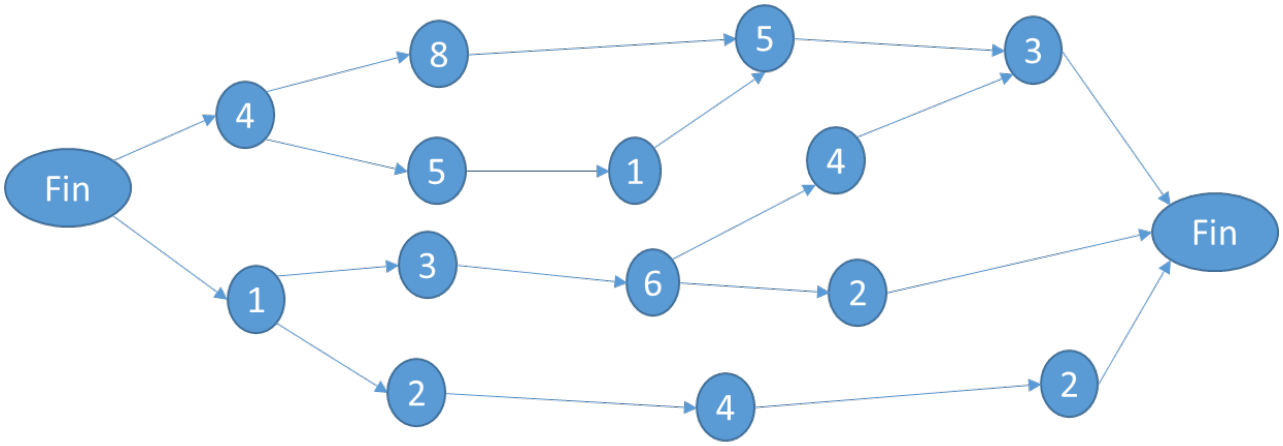
Put on the graph the positional weight of the different nodes and build the workstations (surround the workstations and number them).



Number of workstations :

Question 2 (2 points):

Is it possible to have a better solution with a tack time of 10 ?



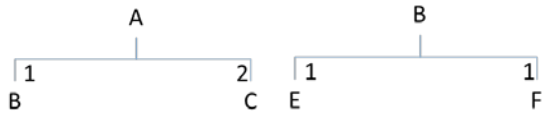
Number of workstations:

Exercise 6 (6 points):

	Oui	Non
Safety stocks should never be consumed		
Scheduling is a planning method with infinite capacity		
The net requirement calculation begins with the finished products and ends with the supply components		
Net requirements take into account on-hand stocks and gross requirements		
If we know that the consumption model follows a seasonal pattern, we must apply a filter such as exponential smoothing before applying seasonal relatives.		
Kanban is a push method		

Exercice 7 (6 points) :

A company manufactures a product A with a following simple nomenclature:



The demand for product A is known over a period of 10 weeks, the assembly time of A is 2 weeks and the supply is made by a fixed quantity of 100.

Question 1 (5 points):

Fill in the table with the requirements of the planned receipts, Projected on hand, net requirements, planned order releases and finally the gross requirements in B and C.

Semaine	1	2	3	4	5	6	7	8	9	10
Gross requirements for A			50		60		50		60	
Scheduled receipts		80								
Projected On Hand	20									
Gross requirements for A										
Planned order releases										
Gross requirements for B										
Gross requirements for C										

Note: the planned consumption is supposed to be done at the end of the week and the reception during the week (a reception week i can cover a need week i).

Question 2 (1 point):

What happens to products E and F if product B is managed in Kanban?