ORDRE DES INGÉNIEURS DU QUÉBEC

NOVEMBER 2021 SESSION

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

14-IN-A2 ANALYSIS AND DESIGN OF WORK

Question 1 (20 points)

The diagram in **Appendix A** shows the relationship between the operator and a Lathe (machine C). You are asked to determine:

a) What is the purpose of such a diagram.

b) The loading and unloading time of the machine.

c) The machine time.

d) If you want the operator to operate more than one machine, how many machines should be assigned to the operator to keep the cost (per machine) as a minimum?

The operator cost is $24.00 per hour, the machine cost is $16.00 per hour and the running time between machines is 0.06 minutes.

Question 2 **(**20 points)

Marisar. Inc. is specialised in the assembly of components used in the manufacture of calculators. It has a contract to assemble 1,000 units. As 2^{d} of May, 300 units had been assembled. The company wants to complete the contract in the next few weeks by ensuring full employment for its 25 workers, considering that the normal work week is 40 hours.

The company determined that the first assembly took 200 hours, the second unit took 160 hours. The company estimated when submitting that the average assembly time would be 32 hours per product. The hourly rate for employees is $10.

1. Determine the learning factor.
2. Determine how long it will take to assemble the 500th unit.
3. Determine the number of weeks required to complete the contract.
4. Determine if the contract to assemble this order will be profitable. Estimate the profit or loss.

Question 3 (10 points)

«*Drexron Furniture Co*» maintains a permanent inventory of chair backs for a line of kitchen chairs. The activities and times required to produce a batch of chairs are described below.
The operation starts with rough cutting (step 1), i.e. sawing the received material, for 20 minutes. Then, the operator must transfer the sawn part (step 2) to the next turning step (step 3). This 10-minute transfer precedes the hour during which he will turn the part using the lathe (step 3). The part's dimensions and other parameters are checked for just 5 minutes (step 4) and then the operator must wait for his colleague (step 5) who brings a motorized cart to take (step 6) the sawn and turned part to the gluing shop (step 7). The steel bars 's gluing (step 7) to the back of the chair is done in 30 minutes while the waiting (step 5) and the transfer (step 6) take 15 and 10 minutes, respectively. After this gluing (step 7) and before placing the finished product in the warehouse to await shipment to the customer (step 10), the chair must wait 2 hours (step 8) for the glue to dry and the transfer (step 9) to the warehouse takes about 10 minutes.

You are asked to:

Illustrate these activities with an ***operation process chart***.

Question 4 **(**10 points)

Gadget. Inc. manufactures a wide range of low-cost accessories and toys such as Christmas decorations, water pistols and Halloween flashlights. Michel Vaillant was hired as a foreman in the assembly department a few weeks ago. The assembly department, with its 10 employees, oversees assembling the various gadgets that are sold to small stores specializing in the sale of useless objects. Surprised by the very low productivity of his employees, he decided to hire you to conduct a study based on the ***work sampling technique***.

According to Mr. Vaillant, the employees are constantly disturbed and are rarely at their workstations. After a brief interview with the foreman, you estimate that the shift of the department's employees is approximately divided as follows:

Table 4.1 : M. Vaillant 's estimation

Activity / Elements	Duration (estimation)
Production	4,5 hours
Unavoidable delays	1 h
Avoidable delays + downtime	1 h 15 minutes
Personal breaks and lunch	1 h 15 minutes
Total (shift length):	8 hours

1. Determine the percentage (%) of each of the activities (elements) listed in the table above.
2. Estimate the minimum number of observations required for the sample time study if the required confidence level is 95% and the precision level is ± 6%.

Question 5 (20 points)

You are asked to answer the following independent questions:

A. Why do a study of work ... & ... what are its objectives?

B. The standard time of a task (as measured by time study) is usually greater than the observed time of that task. TRUE or FALSE? Justify your choice.

C. A senior executive at a university hires you to study concierges' tasks to reorganize their work. He tells you that he has read an outline of an article on measuring work during a boring meeting and deduces that you should use the technique of time study to do this work. In a few words, what do you say to him? And what do you suggest?

D. A timing study has given you the following results:

Elements	Observations (minutes)					
	Obs. #1	Obs. #2	Obs. #3	Obs. #4	Obs. #5	Performance rate
A	19	18	17	16	15	115
B	13	12	14	11	12	100
C	30	32	30	30	31	120
D	10	11	9	9	10	110

In addition, the company uses a 15% allowance factor in all cases.

What is the standard time for the complete task?

Question 6 (4 points)

What are the advantages and disadvantages of the following two compensation plans?

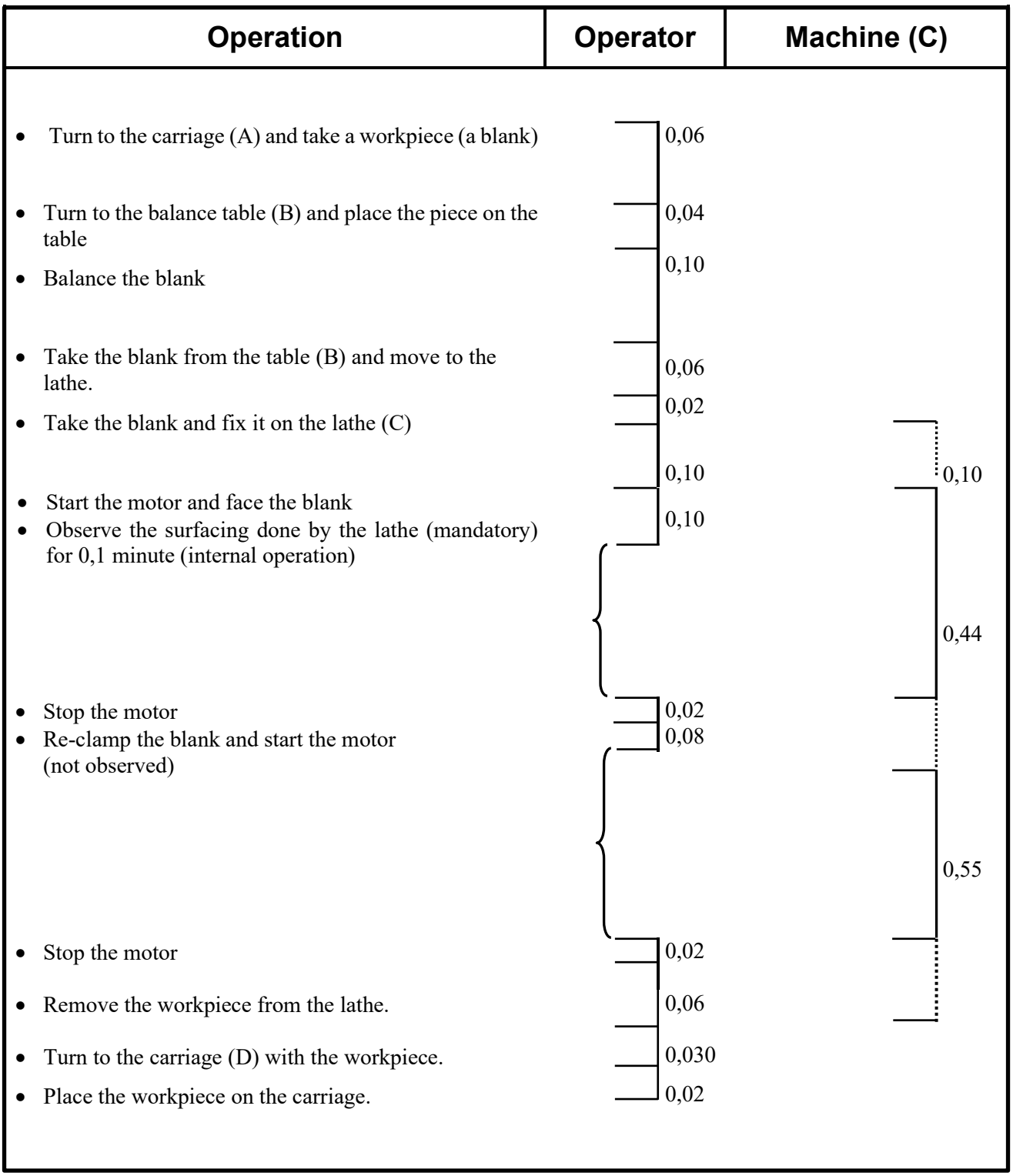
1- Incentive plans
2- Time-based compensation plans

Question 7 (16 points)

Use the MTM-1 tables and identify the ***symbol, TMU time*** and ***normal time in seconds*** for each of the following:

a)	Reach an isolated object, located 30 cm away in a place that may vary slightly from one cycle to another
b)	Grasp an object mixed with others (dimensions 12x12x12 mm)
c)	Carry an object weighing 0.5 kg with the right hand towards the left hand located at 16 cm from the right hand
d)	Turn an object weighing 6 kg by 90°
e)	Engage a symmetrical part (S), easy to handle in case of a soft adjustment
f)	Disengage a part, difficult to grip and requiring only a slight effort
g)	Move the leg 30 cm
h)	Release a part by opening the fingers

APPENDIX A



UTime is MINUTE