

MET2  
MANUFACTURING ENGINEERING TRIPOS PART IIA

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Tuesday 3 May 2022 9.00 to 12.10

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**Paper 3**

**MODULE 3P4: OPERATIONS MANAGEMENT**  
(SECTION A)

**MODULE 3P5: INDUSTRIAL ENGINEERING**  
(SECTION B)

*Answer all questions from sections A and B.*

*Answers to section A and B must appear in two separate booklets.*

*All questions carry the same number of marks.*

*The **approximate** percentage of marks allocated to each part of a question is indicated in the right margin.*

*Write your candidate number **not** your name on the cover sheet.*

**STATIONERY REQUIREMENTS**

8 page answer booklet x 2

Rough work pad

**SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAM**

CUED approved calculator allowed

Engineering Data Book

3P5 Data Sheet

**10 minutes reading time is allowed for this paper at the start of the exam.**

**You may not start to read the questions printed on the subsequent pages of this question paper until instructed to do so.**

**You may not remove any stationery from the Examination Room.**

## SECTION A

1 (a) You are the operations manager at KickStart, a medium sized aerospace supplier based in the UK. KickStart's board of directors is considering to outsource several of its business functions.

(i) Outline key advantages and disadvantages of outsourcing. [20%]

(ii) Kickstart is specifically considering the outsourcing of its human resource (HR) function. What aspects of HR processes are most suitable for outsourcing and which ones are not? Justify your answer. [20%]

(b) KickStart has decided to implement a Supplier Relationship Management (SRM) programme after its new supply chain has been set up.

(i) Describe the benefits of positive relationship management in Supply Chains. [20%]

(ii) Describe the factors that may influence the appropriate type of relationship between a purchaser and a supplier. [20%]

(iii) Explain the term *supplier development* and describe supplier development approaches that could be used to improve a supplier's performance. [20%]

2 (a) Two independent manufacturing lines A and B, produce identical products and follow the same process sequence. The capacities of each process step and the Work-In-Progress (WIP) buffer are shown in Fig. 1. Briefly explain which process will, on average, have a higher total throughput.

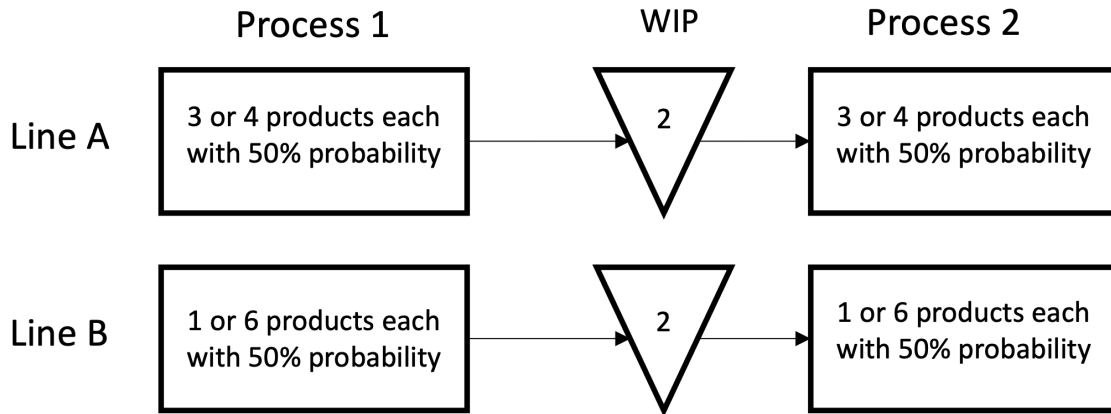


Fig. 1

[20%]

(b) A local service station is open 7 days per week, 365 days per year. It sells on average 25 cans of premium grade oil per day. Inventory holding costs are £0.75 per can per year. Its ordering costs for this oil are £9 per order and orders are received 1.5 weeks after the order is placed. The standard deviation of demand was determined from a data sample to be 2.5 cans per day. Determine the optimal inventory plan for a 95% service level requirement.

[35%]

(c) Figure 2 shows optimal Economic Order Quantity (EOQ) inventory policies for two different companies for the same time horizon.

(i) If both companies have the same annual demand, and the same fixed cost per order, briefly explain which of the companies would have a higher inventory holding cost.

[10%]

(ii) Assume now that both companies have the same annual demand and inventory holding cost. Briefly explain which of the companies would have a higher fixed cost per order.

[10%]

(iii) If both companies have the same annual demand on average, briefly explain which of these companies would hold less inventory for the same time horizon?

[10%]

(iv) What are limitations of using EOQ, and how can companies overcome such

limitations?

[15%]

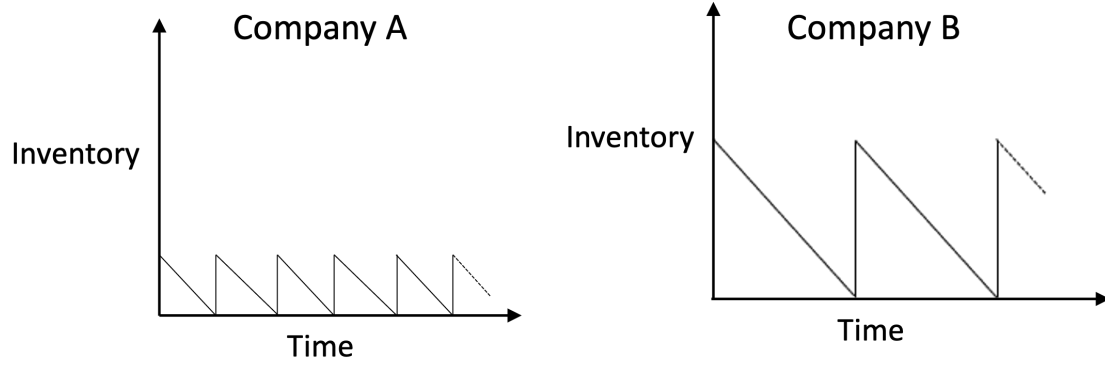


Fig. 2

**SECTION B**

3 (a) A manufacturing company is planning to acquire a building to set up its new factory. The factory will have six production departments: I (inspection), F (finishing), P (production), T (tooling), A (assembly), and S (shipping). Figure 3 shows the proposed layout of the factory, where the thick lines indicate existing building walls and doors. Products will be routed for processing through these departments in the quantities and sequences indicated in Table 1.

- (i) Calculate the *Layout Efficiency Rating* of the proposed layout. [40%]
- (ii) Propose an alternative layout for the factory that improves the Layout Efficiency Rating and explain how it does so. [20%]
- (iii) In addition to layout efficiency, discuss any other considerations that need to be taken into account when designing the layout of the factory. [20%]

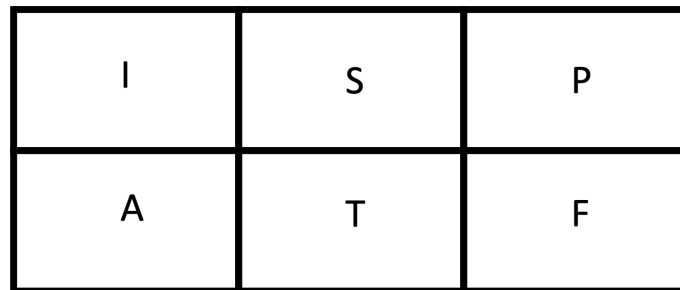


Fig. 3

(b) An engineer repeatedly measures the time taken for a worker to assemble a product with the results shown on Table 2:

Table 1

<b>Product</b>	<b>Quantity per day</b>	<b>Sequence</b>
1	40	I-F-A-S
2	50	P-T-A
3	20	P-F-A
4	60	T-A-S
5	70	I-F-I-T-A
6	30	P-I-A-S
7	10	I-P-T

Table 2

<b>Observation</b>	<b>Time</b>
1st	49.5 s
2nd	48.8 s
3rd	54.1 s
4th	53.7 s
5th	47.5 s

After noticing the variation in product assembly times, an additional period of observation is undertaken by the supervisor. Over the next 10 days, 400 additional random observations of the same worker were carried out. During this period, the worker worked for 70 hours and produced 3400 products.

Calculate 95% confidence intervals for the time to perform the assembly operation using:

- (i) the engineer's time study; [10%]
- (ii) the supervisor's sample. [10%]

4 You have been asked to organise the re-shoring of the production of light electrical assemblies from India to Manchester.

(a) What steps would you take to capture and analyse current production methods in preparation for the transfer? [30%]

(b) Explain how you will design the new manufacturing system in the light of the analysis of the existing facility. How would you make provision for variations in volume and variety? [50%]

(c) What other contextual factors would you consider for re-shoring? [20%]

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